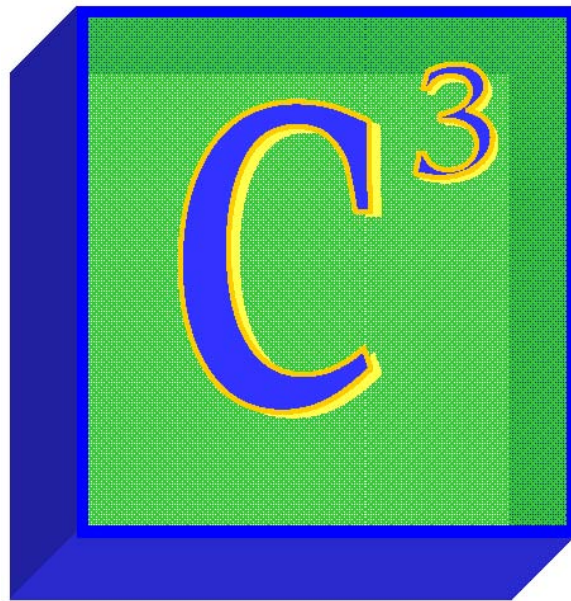


# **Teacher's Guide**

# **COMSEP Clinical Cases**

**A Clinical Reasoning Case Based Review**



**Clark • Templeton • Sanguino**

**Teacher's Guide**  
**COMSEP Clinical Cases**  
**A Clinical Reasoning Case Based Review**

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## **Introduction**

The Curriculum Taskforce has developed a user's guide to the COMSEP Clinical Cases found on the [COMSEP website](#). Some clerkship directors and educators use these problem sets to teach factual information and clinical reasoning. Others use these as teaching resources for residents and faculty who may be out of their comfort zone.

The user's guide is peer-reviewed and published as a password-protected document on the COMSEP website.

The guides are written to address the learning objectives of junior medical students. The format of each user's guide follows a template that includes definition of terms, review of important concepts, historical points, physical exam findings, clinical reasoning questions, and supplemental learning activities to not only provide answers but to supplement discussion for each case.

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## **BEHAVIOR**

### **Behavior, Case #1**

Written by Gray M. Buchanan, Ph.D.

The parents of a three-year-old boy are concerned that he is not yet toilet trained. How would you counsel them? What are the signs that indicate that a child may be ready for toilet training?

### **Definitions for Specific Terms:**

**Enuresis** – Repeated voiding of urine into bed or clothes (whether voluntary or intentional)

**Nocturnal** – Passage of urine only during nighttime sleep

**Diurnal** – Passage of urine during waking hours

**Encopresis** – Repeated passage of feces into inappropriate places (e.g., clothing/floor) whether involuntary or intentional w/constipation and overflow incontinence – evidence on physical exam  
Anticipatory guidance – the preparation of a child to assist with relieving fear and anxiousness of an event expected to be stressful.

### **Review of Important Concepts:**

#### **Historical Points**

1. Is the child showing any interest in the toilet?
2. Does the child have any known developmental delays?
3. You should ask specifically about gross motor, fine motor, speech, and social skills.
4. You may want to gauge the parental expectations for toilet training.

#### **Physical Exam Findings**

1. You should examine the genitalia for labial adhesions, meatal stenosis, or any other abnormalities.
2. Check for defects in the lower spine such as a sacral dimple, placement of the anus, anal tone, lower extremity tone, and reflexes.

#### **Clinical Reasoning**

1. Should one expect a three-year-old boy to be potty trained?
  - a. Toilet training varies widely by culture and caregiver and will typically begin when children are developmentally demonstrating some autonomy and mastery. Many caregivers begin with anticipatory guidance around toileting when children are approximately 1 to 1 ½ years of age. Typically developing children will generally demonstrate developmental skills needed for toileting between 18-30 months of age. Developmentally children follow a progression of nighttime bowel continence, followed by daytime bowel continence, then daytime urine continence, and finally nighttime urine continence.



- b. In regard to urinary continence approximately 30% of children sense bladder fullness by 2 years of age and almost all typically developing children by 4 years of age. On average, daytime continence is attained by the majority of children by 3 ½ years and by 5 years approximately 85% of children demonstrate nocturnal dryness. Typically developing children older than 5 years void approximately 5-8 times/day. If urinary continence issues persist past 5 years of age the condition may be labeled enuresis.
  - c. In regard to bowel function, the incidence of difficulties is approximately 3% in children 4 years of age, 1.5% in children 7-8 years of age, and 1.5% in 10-11 year olds. If bowel difficulties persist past 4 years of age the condition may be labeled encopresis.
2. How can you help the parents determine if their child is ready for potty training?
- Readiness Signs – a child should demonstrate physical, cognitive, and behavioral signs for initiation of toileting.
- a. Cognitively, the child should be developed enough to follow simple directives and be able to label toileting activities (e.g., pee pee).
  - b. Physically, the child should demonstrate dry periods lasting 2-3 hours suggesting bladder muscles developed enough to demonstrate continence. Bowel movements should also be well formed and the child should be able to ambulate, sit, and assist with the removal of clothing.
  - c. Behaviorally, the child should be demonstrating an interest in more independence, be open to attempting toileting, and be able to provide a sign of the need to toilet (e.g., verbal or nonverbal cue, facial expression, posture, etc.). Most children will also demonstrate a discomfort when wet/dirty.


### Other Helpful Information

Parents should be counseled on the readiness signs (briefly outlined above) and can be provided with guidelines for toileting (see ages and stages resources below). Additionally, counseling parents on potential behavioral reward systems for encouraging readiness and the need to provide verbal praise for attempts and signs of readiness can be helpful. Finally, in this scenario parents should be encouraged to attend to the readiness signs their child is providing and a plan for further monitoring toileting skills (toileting log/diary) may be implemented for review at future appointments.

### Suggestions for Learning Activities:

- Ask the student to provide a general timeline of developmental skills children typically demonstrate for toileting readiness
- Role play how to respond to parents when such toileting concerns present
- Review DSM criteria of enuresis and encopresis and the potential behavioral and pathophysiological causes for such conditions

### Other Resources:

- <http://www.healthychildren.org/English/ages-stages/Pages/default.aspx>
- Houts, A. C. (2003).  [Behavioral treatment for enuresis](#). In A. E. Kazdin & J. R. Weisz, (Eds), Evidence-based psychotherapies for children and adolescents (pp. 389-406) New York: Guilford.
- [http://drhouts.com/pdfs/12%20Houts%20\(2003\)%20Behavioral%20Tx%20Enuresis%20Kazdin%20&%20Weisz%201.pdf](http://drhouts.com/pdfs/12%20Houts%20(2003)%20Behavioral%20Tx%20Enuresis%20Kazdin%20&%20Weisz%201.pdf)
- The American Academy of Pediatrics Guide to Toilet Training (2003) by Mark Wolraich



## **Behavior, Case #2**

Written by Joanne Kennedy, M.D.

A 16 mo boy has had several episodes of breath holding leading to cyanosis and becoming limp for a few seconds. They occur when he is angry or upset. What is the most likely diagnosis? How would you counsel the parents? What work-up may be warranted?

### **Definitions for Specific Terms:**

**Syncope (commonly called fainting)**- A sudden and usually brief loss of consciousness and postural tone, caused by a transient decrease in cerebral blood flow. Etiologies include breathholding spells, vasovagal syncope, postural or orthostatic hypotension, arrhythmias, seizures, and hypoglycemia. Apnea: From the Greek "absence of breath," refers clinically to the partial or complete cessation of respiratory flow. An episode lasting more than 20 seconds usually is considered pathologic and may be accompanied by cyanosis, hypotonia, bradycardia, or pallor.

**Hypotonia**- Decreased muscle tone. It can be a condition on its own, called benign congenital hypotonia, or it can be indicative of another problem where there is progressive loss of muscle tone, such as muscular dystrophy or cerebral palsy. An infant with hypotonia exhibits a floppy quality or "rag doll" feeling when he or she is held.

**Seizure**- Seizures and epilepsy are not synonymous. A seizure is defined as uncontrolled electrical activity in the brain that may be manifested clinically by loss of consciousness, abnormal motor activity, behavioral and emotional abnormalities, sensory disturbances, or autonomic dysfunction. Epilepsy: Recurrent convulsive or non convulsive seizures.

**Cyanosis**- A bluish color of the skin and the mucous membranes due to insufficient oxygen in the blood. For example, the lips may show cyanosis. Cyanosis can be evident at birth, as in a "blue baby" who has a heart malformation that permits blood that is not fully oxygenated to enter the arterial circulation. Cyanosis can also appear at any time later in life. The word "cyanosis" comes from the Greek "cyanos" meaning dark blue. Approximately 5 g/dL of unoxygenated hemoglobin in the capillaries generates the dark blue color appreciated clinically as cyanosis. For this reason, patients who are anemic may be hypoxemic without showing any cyanosis. Cyanosis can be caused by: Lack of oxygen (such as in suffocation or cyanotic heart disease), Abnormal hemoglobin (such as methemoglobinemia), or Toxins (such as cyanide). Mild cyanosis may be hard to detect. Usually the oxygen saturation of the blood has to drop from the normal level of nearly 100% to below 90% before cyanosis occurs. In dark-skinned people, cyanosis may be easier to see in the mucus membranes (lips, gums, around the eyes) and nail beds, rather than in the skin. It may also appear on the feet, nose, and ears.

### **Review of Important Concepts:**

#### **Historical Points**

The history is critical for making the etiologic diagnosis, selecting confirmatory investigations, and guiding appropriate therapy.

- What was the child doing right before the event?

- Are there any prodromes or associated symptoms?
- What is the duration of unconsciousness?
- Does the child (or household contacts) take any medications?
- Is there family history (sudden cardiac death, deafness)?

### Physical Exam Findings

Although not always revealing, a thorough physical examination is required and should focus on the neurologic and cardiovascular system.

1. What is the pulse and BP?
2. Do they vary from supine to standing?
3. Are there any murmurs or clicks?
4. Are there any focal neurologic findings?
5. Is the fundoscopic exam normal?

### Clinical Reasoning

1. What might cause a child this age to have a syncopal episode?
  - a. Breath holding spell:
    - Cyanotic Type (“classic” breath-holding spell) is rare prior to 6 months of age, peaks at about age 2 years, and resolves spontaneously by 5 years of age. These spells are self-limited and have a uniformly favorable prognosis. After being startled or becoming upset, the child may make a short gasp and then exhale and stop breathing. The child becomes cyanotic and there is a brief period of unconsciousness, at which time normal breathing restarts. The spells often occur with tantrums but are not thought to be a willful act of defiance. Breath holding spells can run in families. If a child's parents had similar spells in childhood, the child may be more likely to have spells. Children with iron deficiency anemia may also have increased episodes of breath holding.
    - A second type of breath holding spell is known as a Pallid Type. These typically are initiated by a seemingly innocuous stimulus, such as frustration at play or scolding; a painful experience; a sudden startle; or a minor trauma, such as venipuncture. There is an initial quieting, with breath holding in the end-expiratory phase, followed by pallor, brief loss of consciousness, loss of muscle tone, and a fall to the ground. The spells are self-limited and have an excellent prognosis; affected children are asymptomatic between the spells and physically and intellectually normal.
  - b. Seizure:
 

Nonfebrile seizures occur in children of all ages. The prevalence of epilepsy in the pediatric population is 4 to 6 cases per 1000 children. In this case presentation, we should consider myoclonic, atonic and absence seizures. Myoclonic seizures are characterized by brief, sometimes repetitive symmetric muscle contractions with loss of normal body tone. Atonic seizures typically cause the child to fall because of the sudden loss of postural tone. Simple absence seizures are characterized by brief (5 to 20 sec) lapses in consciousness, speech, or motor activity, sometimes associated with flickering of the eyelids.
  - c. Neurocardiogenic Syncope:
 

Vasovagal or neurocardiogenic syncope are due to autonomic dysfunction and usually occur in adolescents after prolonged motionless standing in a crowded and warm environment.

d. Cardiac Syncope:

- Arrhythmogenic or structural heart conditions always must be considered in the differential diagnosis of syncope. For example, prolongation of the QT interval may predispose to ventricular arrhythmias, syncope, and generalized seizures. The QT interval is prolonged when the corrected QT interval or QTc is above the upper normal limit for age, usually more than 0.44 seconds. The condition may be due to acquired heart disease but more often is congenital and inherited. Other historical findings may be suggestive. For example, in the Jervell and Lange-Nielsen syndrome, there is associated sensorineural deafness.
- Hypoglycemia may cause syncope, usually in those who have diabetes. Associated symptoms include weakness, hunger, sweating, agitation, and confusion. The onset is always gradual.

2. What diagnostic studies if any should you obtain?

- a. A 12-lead ECG could be employed for evaluation of arrhythmias. A detailed interpretation must include the rhythm, conduction, premature beats, presence of a delta pre-excitation wave, chamber enlargement, and accurate measurement of the PR, QRS, and QT intervals (corrected QTc).
- b. A cardiology consultation could be considered if a pathologic heart murmur is heard, there is chest pain preceding syncope, arrhythmia, prolonged QT interval, Q waves on ECG, or a family history of cardiomyopathy or sudden death.
- c. An EEG is considered for patients in whom there is prolonged loss of consciousness, suspected seizure activity.
- d. A hemoglobin should be performed as there is a high incidence of iron-deficiency anemia in children with breath-holding spells. There is improvement after treatment with ferrous sulfate.

## Diagnosis and Treatment

1. The most likely diagnosis for this child, pallid spells, can be made based on the history without further testing. Although generally not necessary if the diagnosis of pallid spells by history needs confirmation, an ocular compression test may be performed under EEG and ECG surveillance.
2. What advice should you give the parents?  
Although the label “Breath Holding Spell” suggests a voluntary action, such spells are actually involuntarily and reflexive. The duration of the spells is typically from 2 to 20 seconds but can last as long as a minute or more. Approximately 20% to 30% of breath-holders have a family member who exhibited Breath Holding Spells during childhood. There are no well-documented differences between genders. Studies that have tried to detect significant behavioral or psychological differences between breath-holders and control groups have been unsuccessful. Reassure parents about the nonharmful outcome of these spells. You can give a layperson’s account of how interrupted breathing patterns can lead to loss of consciousness. Although it may be difficult, parents need to be calm and not over react to the event. They should not give in when the child becomes upset for fear that the child will have a spell as this may reinforce temper tantrums.

## Suggestions for Learning Activities:

- View videos of breath holding spells available on You Tube.
- Role-play giving advice to parents on how to react to breath holding spell.

**Other Resources:**

- **The Child Who Passes Out** Hassib Narchi Pediatr. Rev. 2000;21;384-388
- **Long Term Prognosis for Children With Breath Holding Spells** Olsen AL, Mathiasen R, Rasmussen NH, Knudsen FU Dan Med Bull. 2010 Nov;57(11):A4217.
- **Caring for Your Baby and Young Child: Birth to Age 5** AAP publications
- AAP NEWS Vol. 26 No. 5 May 1, 2005 pp. 1

## **Behavior, Case #5**

Written by Gray M. Buchanan, Ph.D.

A seven year-old boy is still wetting the bed at night. How would you evaluate the patient and counsel him and his family? What treatment modalities are available for enuresis and when should they be implemented?

### **Definitions for Specific Terms:**

**Enuresis** – Repeated voiding of urine into bed or clothes (whether voluntary or intentional)

**Nocturnal** – Passage of urine only during nighttime sleep

**Diurnal** – Passage of urine during waking hours

### **Review of Important Concepts:**

#### **Historical Points**

- Does the child have any known developmental delays?
- You should ask specifically about gross motor, fine motor, speech, and social skills. Is there a family history of enuresis?
- Does the child take any medication (e.g. a diuretic). Does the child have a medical problem (e.g., diabetes, seizure disorder, spina bifida)?
- Enuresis is not by definition a functional disorder and; therefore, ruling out any organic dysfunction is essential.

#### **Physical Exam Findings**

1. Elevated blood pressure might reflect renal dysfunction; bladder percussion may find distention from outlet obstruction or neurogenic disease.
2. Examination of the back can identify vertebral anomalies; neurologic examination of lower extremities may identify spinal cord disease (e.g., altered gait, diminished muscle reflexes, up-going toes).
3. You should examine the genitalia for labial adhesions, meatal stenosis, or any other abnormalities.
4. Check for defects in the lower spine such as a sacral dimple, placement of the anus, anal tone, lower extremity tone, and reflexes.
5. Tonsillar hypertrophy is associated with disordered sleep and enuresis.

#### **Clinical Reasoning**

1. Should one expect a seven-year-old boy to be dry at night?
  - a. DSM-IV criteria define enuresis as “repeated voiding of urine into bed or clothes.” The behavior must be present either twice per week for at least 3 consecutive months or interfere with social, academic, or other areas of functioning. Chronological and developmental age must be 5 years. Developmentally children follow a progression of nighttime bowel continence, followed by

daytime bowel continence, then daytime urine continence, and finally nighttime urine continence.

- b. On average nocturnal dryness is demonstrated by 85% of children by 5 years of age. Typically developing children older than 5 years void approximately 5-8 times/day. At age 5 approximately 7% of males and 3% of females have enuresis. By age 10 the rates are approximately 3% and 2%, respectively.
2. Should you treat this boy and what treatments are available?
- a. Because spontaneous remission progresses each year of age, some individuals question whether or not enuresis should be treated. However, if the patient presents with repeated voiding treatment options should be discussed. Failure to treat may result in poor sanitation, poor self esteem, embarrassment/teasing from peers, and/or family conflict.
  - b. Urine alarm treatment – One of the most effective treatments uses an alarm that is sounded when the child wets. These alarms are commercially available and generally take a training period of 8-12 weeks. They have been shown to demonstrate success rates up to 90% and appear as effective, or more effective, than medication in most studies.
  - c. Medication – Several medications are currently available to assist with enuresis. Imipramine (Tofranil), Desmopressin Acetate (DDVAP), and Oxybutynin Chloride (Ditropan) have all demonstrated some effectiveness. All are associated with potentially severe side effects from fluid and electrolyte disturbances to cardiac arrhythmias. While each medication has demonstrated some effectiveness, when the medication is terminated most children demonstrate relapse, with non-relapse percentages being approximately equivalent to the spontaneous remission rates.
  - d. Multiple Intervention Packages – Numerous treatment packages have been examined which involve a variety of components (see resources below). These include various combinations of medications, urine alarms, hourly awakenings, positive practice, overlearning procedures, retention control training, and behavioral therapies.


### Other Helpful Information

Commonly parents report that children presenting with enuresis are exceedingly deep sleepers. However, while some studies demonstrate that children with enuresis may be more difficult to arouse, most sleep studies do not suggest a relationship between enuresis and depth and/or stage of sleep. No specific emotional conditions are associated with enuresis. However, commonly noted concerns include family conflict, immaturity, and anxiousness.

### Suggestions for Learning Activities:

- Ask the student to provide a general timeline of developmental skills children typically demonstrate for toileting readiness
- Role play how to respond to parents when such concerns present
- Review DSM criteria of enuresis and the potential behavioral and pathophysiological causes for such conditions

**Other Resources:**

- <http://www.healthychildren.org/English/ages-stages/Pages/default.aspx>
- Houts, A. C. (2003).  [Behavioral treatment for enuresis](#). In A. E. Kazdin & J. R. Weisz, (Eds), Evidence-based psychotherapies for children and adolescents (pp. 389-406) New York: Guilford.
- [http://drhouts.com/pdfs/12%20Houts%20\(2003\)%20Behavioral%20Tx%20Enuresis%20Kazdin%20&%20Weisz%201.pdf](http://drhouts.com/pdfs/12%20Houts%20(2003)%20Behavioral%20Tx%20Enuresis%20Kazdin%20&%20Weisz%201.pdf)
- The American Academy of Pediatrics Guide to Toilet Training (2003) by Mark Wolraich



**Behavior, Case #6**

Written by Gray M. Buchanan, Ph.D.

The parents of a two-year old are concerned because he “refuses to eat.” What additional information do you need? How would you evaluate him and counsel his family?

**Definitions for Specific Terms:**

**Failure to thrive (FTT)**- A child whose growth is below the 5<sup>th</sup> percentile for age or whose weight crosses at least two major percentile lines on a standard growth chart (e.g. 75<sup>th</sup> to below 25<sup>th</sup> percentile).

**Food refusal**- Feeding problem in which children refuse to eat some or all foods presented and exhibit problems with growth.

**Review of Important Concepts:****Historical Points**

- Does the child have any known developmental delays? You should ask specifically about gross motor, fine motor, speech, and social skills.
- Was the child premature or small for gestational age?
- Does the child take any medications which affect appetite/weight or is any medical condition present (e.g., diabetes, GERD, cystic fibrosis, HIV, etc.)?
- Is the child presented with appropriate foods for his/her age?
- Does the child refuse all foods or just certain foods? What are they?

**Physical Exam Findings**

1. Examine for dysmorphic features which may suggest syndromes associated with short stature and/or feeding difficulties.
2. Specific organ diseases should be assessed (e.g., chronic serous otitis media, abdominal masses, congenital heart disease).
3. Examine for low muscle tone and peripheral reflexes.
4. Cranial nerve dysfunction related to swallowing.
5. Hypertonicity and hyperreflexia not related to cerebral palsy.
6. Evaluate for physical abuse (e.g., burns, fractures, retinal hemorrhages, skin lesions).
7. Appearance of skin (detectable pallor, bruising, petechiae), hair (texture, pluckability related to malnutrition), mucosal surfaces, and oral/dental evaluation.

**Clinical Reasoning**

1. When should the parents be concerned regarding the child’s refusal to eat?  
Mild forms of weight loss secondary to underfeeding are not uncommon in the first 3 years of life. It is acceptable for children from 0 – 24 months to cross growth percentiles. However, if the child presents with an extended pattern of food refusals, significant weight loss and/or FTT a comprehensive medical and psychosocial evaluation would be appropriate. Assessment will typically involve classifying the difficulty which will assist in treating the child, if necessary.

Classifications may include medical etiologies (e.g., GERD, prematurity), difficulties related to oral-motor delay (e.g., cerebral palsy), and/or behavioral etiologies [e.g., conditioned anxiety, feeder-child interactions, stimulus control associations (i.e., environmental characteristics or situations that serve to trigger maladaptive feeding behaviors)].

2. Should you treat this child and what treatments are available for feeding difficulties?

Food refusals are fairly common at this age and one determining factor in seeking additional treatment will be weight loss. A thorough clinical interview with the caregiver(s) regarding the child's feeding history, mealtime routines, and techniques that have been tried with the child will be a step toward gathering data to determine if intervention is needed. A nutritional diary of the child's food intake may also be informative in determining the presenting difficulties. If weight loss is present a variety of treatments may be available depending on the classification of the difficulty.

- a. Behavioral components of treatment – numerous behavioral techniques are typically employed and may include stimulus control procedures (e.g., modification of environmental factors or situations that serve to trigger maladaptive eating), appetite manipulation, contingent social attention (i.e., positive social attention for desired eating), desensitization of feeding related fears, modeling, and tangible consequences.
- b. Nutritional rehabilitation – typically involves a nutritionist who will establish appropriate intake, restoration, and maintenance of nutritional needs. This might include working to stabilize a feeding schedule, diminish between meals foods and liquids and increase monitoring of nutritional intake by caregivers.
- c. Medical intervention – outpatient and inpatient treatment approaches exist which can assist with managing food refusals which also involve weight loss. Often history and physical examination may lead to further laboratory evaluation to identify organic causes. This might include evaluation for blood cell count, urinalysis, chemical panel (electrolytes, calcium, glucose), sweat test, serologic screening for celiac disease, evaluation for gastroesophageal reflux, and/or study of gastrointestinal malabsorption.
- d. Multiple Intervention Packages – Most approaches to food refusals and FTT include a multidisciplinary team. Treatment may be outpatient and/or inpatient depending on the severity of difficulties, caregiver management abilities and other factors. Management most typically involves professionals including physicians, psychologists, nutritionists/dieticians, speech/language therapists, and occupational therapists.

### Other Helpful Information

Observation of the parent-child interaction and observations of feeder-child interactions during mealtimes can be extremely informative in deciding on interventions. Changes in feeding should be considered in relation to the child's social emotional development also. During the toddler years children are often beginning to assert their autonomy and noncompliance (e.g., food refusal, dressing themselves, etc.); therefore, helping caregivers to understand such normal developmental milestones and patiently monitor such changes is necessary. It may be the case that this child is simply a "picky eater" and parents may just need some nutritional counseling and feedback about what is typical for age.

### Suggestions for Learning Activities:

- Ask the student to provide a general timeline of feeding behaviors and milestones in oral motor development
- Role play how to respond to parents when such concerns present

- Review potential behavioral and pathophysiological causes for such conditions as FTT

**Other Resources:**

- <http://www.healthychildren.org/english/ages-stages/baby/feeding-nutrition/Pages/default.aspx>
- [http://kidshealth.org/parent/growth/growth/failure\\_thrive.html](http://kidshealth.org/parent/growth/growth/failure_thrive.html)

## **Behavior, Case #8**

Written by Joanne Kennedy, M.D.

The parents of a 7 year-old boy receive a call from the child's teacher because he is having difficulty following directions and behaving in class. She feels he has a short attention span and is distractible. How should you proceed? What are possible etiologies of why a child is demonstrating these behaviors?

### **Definitions for Specific Terms:**

**Attention-Deficit/Hyperactivity Disorder (ADHD)**- a neurobiological disorder that is characterized by developmentally inappropriate impulsivity, inattention, and to some degree, hyperactivity.

**Disruptive behavior disorders**- includes two similar disorders: oppositional defiant disorder (ODD) and conduct disorder (CD). Common symptoms occurring in children with these disorders include: defiance of authority figures, angry outbursts, and other antisocial behaviors such as lying and stealing. It is felt that the difference between oppositional defiant disorder and conduct disorder is in the severity of symptoms and that they may lie on a continuum often with a developmental progression from ODD to CD with increasing age.

**Simple tics**- Sudden, purposeless, repetitive, involuntary movements or vocalizations. They may commonly include such behaviors as eye-blinking, mouth-opening, sniffing or throat clearing. Tics are commonly seen in childhood occurring in up to 20 percent of all children. Tics can be temporary, lasting less than 12 months, or chronic.

**Tourette syndrome**- A complex, genetically inherited disorder whose primary manifestation includes tics (both motor and vocal) lasting for more than one year. Tourette syndrome is usually mild and is often accompanied by other conditions including ADHD, obsessive-compulsive behavior, learning disabilities and mood disorders.

### **Review of Important Concepts:**

#### **Historical Points**

- Does the child have any significant past medical history including prematurity, low birth weight, in utero exposure to alcohol or tobacco, brain injury or risk of lead poisoning?
- Is there a family history of ADHD?
- Have the symptoms persisted for at least six months?
- Were any of these problems noted before age 7?
- Do these symptoms happen in more than one setting?
- Does the child have problems in social settings or making friends?
- Social history is important including details such as new baby at home, parental discord, etc.

#### **Physical Exam**

1. Is the child's growth and development normal for age?
2. Are there any stigmata of an underlying syndrome (fragile-X syndrome, fetal alcohol syndrome)?
3. Have vision and hearing screens been performed and are they normal?

4. Is his neurological exam normal?

### Clinical Reasoning

1. How should you proceed?

The child should have a full check up to review the history and perform a physical exam with screening tests such as vision and hearing. If risk is suggested, one should consider lab testing for lead, thyroid function, etc.

2. If you suspect ADHD, the diagnosis of ADHD requires that a child meet DSM-IV criteria.

Document the following:

- a. Documentation of at least six of nine behaviors in the hyperactive/impulsive domain and/or in the inattentive domain
- b. The presence of these behaviors in two or more settings (e.g., home and school) for at least 6 months
- c. The presence (by history) prior to 7 years of age, and
- d. Significant impairment in learning and/or social interactions

Note:

- Behavior questionnaires for parents, which are specific for the diagnosis of ADHD, help clinicians make the diagnosis in office practice. These behavior scales ask questions about each of the 18 behaviors in the DSM-IV criteria for ADHD. Several published forms are available.
- The assessment of ADHD requires evidence directly obtained from the classroom teacher (or other school professional) regarding the core symptoms of ADHD, the duration of symptoms, the degree of functional impairment, and coexisting conditions. A physician should review any reports from a school-based multidisciplinary evaluation where they exist, which will include assessments from the teacher or other school-based professional. The AAP recommends the use of (ADHD-specific) rating scales as a clinical option when evaluating children for ADHD.

3. What are possible etiologies for these behaviors?

- a. Research has demonstrated that ADHD has a very strong neurobiological basis. Although precise causes have not yet been identified, there is little question that heredity makes the largest contribution to the expression of the disorder in the population.
- b. In instances where heredity does not seem to be a factor, difficulties during pregnancy, prenatal exposure to alcohol and tobacco, premature delivery, significantly low birth weight, excessively high body lead levels, and postnatal injury to the prefrontal regions of the brain have all been found to contribute to the risk for ADHD to varying degrees.
- c. Other illnesses may manifest as inattention. Examples would include thyroid disease, drug use, anemia which should be considered based on history and physical exam. The school should also be asked to consider screening for learning disabilities as part of their comprehensive evaluation.

4. Can there be common co-existing diagnoses?

- a. Around two-thirds of children with ADHD have at least one other coexisting disorder. Disruptive behavior disorders, mood disorders, anxiety disorders, tics, Tourette syndrome, and

learning disabilities are among the most common conditions that co-occur in children with ADHD.

- b. The lives of most adults with ADHD are complicated by overlapping symptoms of such conditions as anxiety, depression, or substance use.
- c. In the case of tics, the intermittent nature of the condition may make it difficult to pinpoint in the early stages of the disorder; however, over time, a pattern of motor tics and other behaviors will emerge. During the assessment process, it is important to determine the intensity and frequency of the symptoms. In addition, it is essential to ascertain the degree to which the tics and other behaviors impair functioning and affect self-esteem from the viewpoint of parents, peers, school personnel, and the child with the condition. Patterns associated with the tics (for example, are they brought on or made worse by stress or tiredness) may also be key in recommending appropriate modifications or strategies to deal with them. Significant impairments may be seen with both chronic tic disorder and Tourette syndrome.

### **Suggestions for Learning Activities:**

- Review evaluation tools for ADHD that are commonly used to have teachers and parents report behavior (for example, the Conner's form). Students could practice completing these forms and/or scoring the forms.
- Participate in a school observation and/or attend the Behavior and Developmental clinic and observe a physician evaluation of ADHD.
- Visit the CHADD website and read blogs written by parents of children with ADHD.

### **Other Resources:**

- **Diagnosis and Treatment of ADHD in School-age Children in Primary Care Settings: A Synopsis of the AAP Practice Guidelines** Pediatrics in Review, Feb 1995; 16: 76 - 77.
- **www.CHADD .org**
- **National Resource Center on ADHD at [www.help4adhd.org](http://www.help4adhd.org)**

**Behavior, Case #10**

Written by Philip Malouf, M.D.

The parents of a two-year-old ask how to control their son's temper tantrums. Describe how you would address this situation and what advice you would give.

**Definitions for Specific Terms:**

**Temper tantrum**- an intense display of anger, stubbornness, screaming, crying, defiance, and occasionally violence that is associated with a child in emotional distress.

**Review of Important Concepts:****Historical Points**

- How often are the temper tantrums and what circumstances provoke them?
- How does the child behave during and in the interval between temper tantrums?
- How do the parents respond to the tantrums?
- Are parental expectations consistent with the child's developmental age?
- Have there been any changes at home or school (e.g. birth of new sibling, changed schools)?
- Is the child having any other behavioral or developmental problems?
- Are there any signs or symptoms of obstructive sleep apnea?
- Does the child have any chronic or recurrent medical problems that necessitate frequent doctor's visits and/or needle sticks?

**Physical Exam Findings**

1. A thorough developmental assessment should be performed to determine if there are findings consistent with a pervasive developmental disorder (e.g. speech delay or other behavioral concerns).
2. The practitioner should perform a detailed physical exam to assess for findings consistent with allergic rhinitis, atopic dermatitis, or any other illness that makes the child physically uncomfortable.

**Clinical Reasoning**

1. How do parents' reactions encourage or discourage temper tantrums?
  - a. Temper tantrums are a common, normal developmental behavior in children from one to five years of age. They occur, in part, due to the child's natural progression toward self-reliance and independence. Before entering school, a child's view of the world is egocentric, with little recognition of the position of other individuals and morality. This often leads to problems when they encounter limitations in the form of parental and societal rules and restrictions imposed in the interest of the child's safety. The problem is compounded by the fact that children at this age do not have a complete verbal or emotional vocabulary. Often, the act of throwing a temper tantrum is a manifestation of an emotion that is not anger—such as fear, confusion, or sadness—that they are unable to express in any other way. Unlike adults who have the ability to verbalize frustrations or simply walk away, young children have neither the sophisticated ability to articulate their emotions nor the freedom to walk away.



- b. Problematic tantrums are those that occur more than three times per day, last longer than 15 minutes each, or lead to property destruction or physical harm. They are often associated with disordered eating, sleeping, and/or peer relationships.
  - c. Parental expectations that are inappropriate for the child's age and developmental maturity may create unnecessary tensions between parents and children and lead to tantrum behavior. Too many rules or restrictions leave a child feeling more frustrated and predisposed to tantrums whereas children who are given frequent opportunities to make choices tend to feel less conflict. During a tantrum, a child should be allowed to vent their frustration in an acceptable manner. When a child is silenced and not allowed to make their feelings known they become prone to more frequent and aggressive tantrums. Social disruptions including domestic violence, divorce, and frequent moves--as well as more common stressors like violence on television and scary movies—contribute to the development of tantrums.
  - d. Finally, children depend on parents for consistency and calm. As a tantrum is often an expression of emotions that are not anger, it can be confusing and counterproductive to respond with anger. Shouting and spanking indicate to a child that the parent is also out of control. If the parent remains calm, it often helps discourage tantrums from occurring or persisting.
2. What appropriate management strategies may help control this behavior?
- Timely anticipatory guidance is often key in minimizing and controlling temper tantrums. Parents can use the following strategies to help reduce the frequency or severity of tantrums:
- a. Childproof the home to minimize unnecessary conflicts.
  - b. Distract the child. Children are like dynamite with a fuse and stick portion; it makes the most sense to intervene before the spark reaches the stick. Children often show signs of overwhelming emotion or frustration building up prior to the “explosion.” Parents should be counseled to look for those signs and intervene prior to the tantrum. The intervention most often utilized is distraction--take the child from the inflammatory situation and re-direct them to a new activity.
  - c. Teach the child how to vent their anger in an acceptable manner (e.g. encourage them to articulate their feelings, squeezing a designated pillow).
  - d. Tell the child that you understand why they are frustrated.
  - e. Copious praise for positive behaviors (no matter how small).
  - f. Provide consistent daily routines and allow reasonable choices when possible to increase a small child's sense of control.
  - g. Ignore attention-seeking tantrums and during tantrums remove children from “the audience.” If a child is completely ignored the parents should be wary of a brief initial increase in unwanted behavior (“response burst”) that may occur.
  - h. Time-outs are appropriate for older or more developmentally mature children who display adverse behaviors (violence) during a tantrum despite warnings to stop those behaviors.
  - i. Holding children may give them a sense of security and help calm them.
3. What are side effects of spanking?
- Although most Americans attest to being spanked as children, the American Academy of Pediatrics currently recommends against spanking as a form of discipline, citing the following reasons:
- a. During temper tantrums, children are often seeking stability or control. Spanking gives the perception of a parent who has lost control of the situation.
  - b. Spanking models that violence is an okay response when we should, in fact, be instilling the idea that violence is never acceptable.
  - c. Spanking teaches aggression and anger rather than responsibility and rational behavior.

- d. Parents are inconsistent with spanking; proper discipline requires consistency. Furthermore, there is never a clear line between what offences warrant spanking and which do not. This is unclear to children who should have clearly delineated responsibilities and consequences.
- e. Spanking can lead to physical struggles which may cause harm to the child.
- f. Compared with children who are not spanked, children who are spanked are more likely to become adults who are depressed, use alcohol, have more anger, hit their own children or spouses, or engage in violent criminal activities.

**Diagnosis:**

1. Normal temper tantrums
2. Problematic temper tantrums

**Suggestions for Learning Activities:**

- Ask the student the questions listed under “clinical reasoning” to assess their thinking about the case.
- Role-play with the student a health maintenance visit in which they are counseling a parent on the prevention and management of temper tantrums.
- Ask the student how they would counsel a parent on how to administer a time-out.
- Ask the student to describe features and potential causes of problematic tantrums.

**Other Resources:**

- Chapter 37 Temper Tantrums by Geeta Grover. Berkowitz, Pediatrics: A Primary Care Approach, 3<sup>rd</sup> Ed. ©2008 American Academy of Pediatrics.
- [www.healthychildren.org](http://www.healthychildren.org)

## CHILD ABUSE

### Child Abuse, Case #2

Written by Coral Steffey, M.D.

A two-year-old presents to the Emergency Department after breaking her arm during a fall. The child was seen six months ago with a broken leg. What are your concerns? How would you evaluate this child?

### Review of Important Concepts:

#### Teaching points for the student

1. Identify that repeated fractures in a young child are abnormal.
2. Develop a differential diagnosis for multiple fractures in a toddler.
3. Understand the diagnostic workup for a child with a history of multiple fractures.
4. Identify types of fractures that are common to specific age groups, and types of fractures more concerning for inflicted injury.
5. Understand the role of child development in the evaluation of fractures.

#### Historical Points

- What are the child's developmental abilities?  
Are the activities leading to the injury described by the parents consistent with the child's age? As a normal two year old, it is possible that this child may injure herself, and even sustain a fracture during active play. As with any pediatric injury, it is essential to obtain a thorough history of the injury and developmental history in order to determine whether the injury is consistent with the child's developmental abilities.
- Are there illnesses that run in the family that might predispose the child to fractures?  
Osteogenesis imperfecta is a rare genetic disorder that effects collagen, and results in increased bone fragility. Many children with OI have a positive family history, however most cases are due to new mutations.
- Does the child have any medical problems that might predispose to fractures?  
Multiple fractures may be a sign of underlying medical illness, but are more commonly indicative of abusive injury.
- What is the child's diet?  
Dietary and family histories are also important. Though rickets is an unusual diagnosis in the United States, children with intestinal malabsorption, end-stage kidney disease, and those taking seizure medications are at increased risk. Also exclusively breastfed infants and children on a strict vegan diet may not receive adequate Vitamin D and calcium to prevent rickets.

#### Physical Exam Findings

Perform a complete physical exam assessing for patterned marks, bruises, or swelling indicative of bony injury in another location.

## Clinical Reasoning:

1. What studies might you consider to further evaluate this child?  
A skeletal survey is the first study typically ordered to evaluate children with concerns for physical abuse, particularly in the setting of fractures. A minimum of 19 individual radiographs are obtained, including dedicated films of the hands, feet, all long bones, chest, pelvis, and skull. The skeletal survey not only evaluates for unsuspected fractures, including healing fractures, but can also be helpful in ruling out medical conditions as the etiology of a fracture.
2. How might these study results affect your level of concern for abuse?
  - a. The findings of a skeletal survey, in conjunction with the clinical history and the child's developmental abilities, can either increase or decrease suspicion for inflicted injuries.
  - b. In contrast, cupping or widening of the metaphases, osteopenia, or bowing of the leg bones may be revealed by a skeletal survey, suggesting rickets as the etiology of multiple fractures. In osteogenesis imperfecta, radiographs may reveal thin bone cortex, wormian bones, or bone deformities.
3. Are there findings that are pathognomonic for abuse?  
There are no fractures that are pathognomonic for abuse, though some fractures are more concerning for inflicted trauma.
  - a. Rib fractures are always concerning for child abuse, particularly posterior rib fractures that result from squeezing pressure on an infant's chest.
  - b. Oblique, or "spiral" fractures are concerning when they occur in the femur or humerus, particularly in a non-ambulatory child. However, children ages 1-2 are prone to falls, often with a torsional component. In fact, spiral fractures of the lower tibia, known as "toddler fractures," are a relatively common injury in this age group and do not signify abuse.
  - c. Fractures of any type in non-ambulatory children are of particular concern for possible child abuse.
  - d. Metaphyseal fractures, also known as "corner" and "bucket-handle" fractures, are found at the ends of the long bones and are concerning for abusive injury. Specifically, these result from flailing of the limbs, and often become evident after a shaking injury.

## Suggestions for Learning Activities:

- Review radiologic studies including normal pediatric films, as well as examples of spiral fractures, metaphyseal fractures, rib fractures, and toddler fractures.
- Discuss developmental milestones that would affect the plausibility of accidental injury.

## Other Resources:

- Davis, HW, Carrasco, MM. Chapter 6. Child Abuse and Neglect. Zitelli & Davis Atlas of Pediatric Physical Diagnosis, 4<sup>th</sup> ed. Pp 171-178.

**Child Abuse, Case #3**

Written by Coral Steffey, M.D.

A seven-year-old female patient presents with vaginal discharge. In addition to poor hygiene, what else is in the differential diagnosis?

**Review of Important Concepts:****Teaching Points**

- Identify that vaginal discharge in pre-pubertal girl may be the result of sexual abuse, but can also be caused by a variety of medical conditions.
- Develop a differential diagnosis for vaginal discharge in a child.
- Identify key components of the history required to evaluate a child with vaginal discharge.
- Understand the appropriate physical exam technique for evaluating a child with vaginal discharge.

**Historical Points**

- When did the discharge begin?
- Does it have a particular color, consistency, or odor?
- Does the child complain of itching or pain?
- Has the caregiver had any prior concern for sexual abuse?
- Have there been any new caregivers?
- Is the child responsible for her own toileting hygiene?
- Does she have any history of urinary tract infections or vaginal discharge?
- Does the child have other medical problems, such as diabetes?
- Has the child recently taken antibiotics?

**Physical Exam Findings**

Perform a complete physical exam, including a genital exam and anal exam.

1. Explain the exam to the child in developmentally appropriate terms. Restraint during a genital examination is not appropriate; typically, with enough time and encouragement the child can cooperate and if not then consultation with a pediatric gynecologist or child abuse pediatrician will be necessary.
2. In cases where an exam is essential, e.g., where there is active bleeding, an examination under anesthesia may be necessary if the child is overly anxious and unable to cooperate.
3. Instruments and probes, including a speculum, should NOT be inserted into the vagina of a prepubertal child.

4. During the exam, evaluate the source of the discharge and assess for injuries and foreign bodies. If a foreign body is suspected but poorly visualized, a syringe filled with sterile water or saline may be used to irrigate the vagina and “float out” the object.

### **Clinical Reasoning**

1. What resources may be available to help perform the physical exam?
  - a. Providers specially trained in child abuse pediatrics are valuable resources when evaluating a prepubertal girl with vaginal discharge, especially if sexual abuse is suspected. If a child has genital injuries or a foreign body that requires sedation for a complete evaluation, a gynecology consult may be helpful.
  - b. Also, many hospitals have child life specialists who can help the child understand what will happen during the exam, or may help to reassure or distract an anxious child during the genital exam.
2. What laboratory tests would be useful for evaluating a girl with vaginal discharge?
  - a. Urinalysis for ketones and glucose, as well as serum glucose can be useful for evaluating a child with symptoms of diabetes.
  - b. Microscopy with KOH may be useful for evaluating candidal infection.
  - c. Although DNA amplification probes can be used to diagnose Chlamydia and Gonorrhea in young children, the CDC recommends vaginal Gonococcal culture as the gold standard for diagnosis of a Gonococcal infection.
3. What pathogen would you expect to culture from a vaginal discharge caused by retained toilet tissue?

Skin flora, particularly staph aureus are the most common bacteria associated with vaginal foreign body.

### **Possible Diagnoses**

1. Poor hygiene or poor toileting technique is often a consideration in young children presenting with vaginal discharge, especially for preschool-aged girls who have recently mastered toilet training. A careful history can help to distinguish this from other medical conditions. For instance, if the caregiver reports wetness, odor, and minimal staining to the child’s underwear, one consideration is reflux of urine into the vagina. This typically occurs in overweight girls who sit on the toilet with their knees close together. During toileting, urine becomes trapped between the labia majora, and refluxes into the vaginal vault. Over time, urine leaks out into the underwear and can be confused with vaginal discharge or enuresis.
2. The vaginal environment of pre-pubescent girls is less conducive to fungal growth than the adult vagina. However girls may develop candidal infections in the setting of untreated diabetes mellitus, or after disruption of normal flora due to antibiotic therapy. The discharge is typically described as white, with a paste-like consistency, and there may also be associated pruritis.
3. Vaginal pinworm infestation is another pruritic condition that may be mistaken for vaginal discharge. The patient (or other contacts) may have a history of perianal irritation or itching.

4. Foreign body is a more common cause of vaginal discharge in prepubertal girls. Caregivers are typically unaware of a foreign body, so history may be unrevealing. Small pieces of toilet tissue can be inadvertently retained in the vagina. Occasionally a child will insert a small object, such as a piece of a toy, into the vagina. Mucus and proliferation of bacteria around the foreign body eventually result in discharge, which may be green, yellow, brown, or white in color, and may emanate a foul odor.
5. When a prepubertal girl has vaginal discharge, the caregiver may have considerable anxiety about possible sexual abuse. Gonorrhea, Chlamydia, and trichomonas can each cause vaginal discharge in a prepubertal child, and should be a diagnostic consideration. When there is concern for sexual abuse it is important to avoid discussing this concern in front of the child. Any information volunteered by the child should be documented carefully, using the child's own words, but the child should not be questioned by medical providers.

**Suggestions for Learning Activities:**

- Review appropriate examination positions for prepubertal genital exams, including frog-leg and knee chest positions.
- Review normal anatomic genital findings for prepubertal girls.

**Other Resources:**

- Workowski, K., Berman, S. Sexually Transmitted Diseases Treatment Guidelines, 2010. Morbidity and Mortality Weekly Report (MMWR). **December 17, 2010 / 59(RR12);1-110.**
- Finkel, M, Giardino, A. (2009). Medical Evaluation of Child Sexual Abuse: A Practical Guide (2nd ed). Elk Grove Park, IL: American Academy of Pediatrics



## **Child Abuse, Case #6**

Written by Susanne Tropez-Sims, M.D.

A nine-month-old boy has a history of poor weight gain for several months. His weight has fallen from the 50% to the 10% over the past four months. During a hospitalization for poor weight gain he had a normal physical examination, normal laboratory values, and demonstrated excellent weight gain on an age-appropriate diet. Now one month following discharge from the hospital he has lost weight. What would you do for this child? Discuss the medical, legal and social implications of your actions.

### **Definitions for Specific Terms:**

**Failure to thrive (FTT)** - Growth consistently below the 3-5<sup>th</sup> percentile or identify growth changes that cross two growth percentiles over a short period of time. Traditionally identified as organic or non-organic, organic is an underlying medical condition that may affect growth parameters. Non-organic is caused from psychosocial issues in children less than 5 years of age. But children can have both organic and non-organic etiology to their poor weight gain, sometimes referred to as “mixed FTT”.

### **Review of Important Concepts:**

1. Determine etiology: not enough calories; unable to absorb calories; or unable to consume sufficient calories.
2. Identify causes to non organic failure to thrive.
3. Know the difference between FTT and constitutional growth delay.
4. Growth adjustments for premature infants.
5. Skills needed in obtaining a detailed diet and social history.
6. Specific physical findings that will assist in diagnosis of FTT.
7. Identify relationship between weights, heights, and weight for height in evaluating children.
8. Consider endocrine causes of FTT as hypothyroid, pituitary dysfunction etc..
9. What constitutes chronic malnutrition?

### **Historical Points**

- What psychosocial history questions should be asked of caregiver to assess patient and family dynamics?
- What is the detailed dietary history questions needed to be asked?
- This includes, what is fed; the amount of formula; how formula is mixed?
- How often fed?
- Any unusual dietary beliefs?
- Is infant on Women Infant Children (WIC) Food Program?
- Any causes of inadequate calories?
- Any anatomical abnormalities?
- Cardiopulmonary dysfunction?
- Any gastroenterology or neurological problems?

## Physical Exams Findings

1. Perform a detailed and complete physical exam. Look specifically for: narrow face, thin extremities, prominent ribs, protuberant abdomen, wasted buttocks, hygiene neglect, flattened occiput with hair loss, and delay in social or speech development.
2. A detailed history is needed to assess a child failing to gain weight.
3. Observe social interactions. Look for avoidance of eye contact, expressionless face, note cuddling response, and handling of child with force or anger.
4. Obtain accurate growth parameter measurements and interpret findings.
5. Document linear growth, growth for age and height using CDC/NCHS or WHO charts.  
What constitutes genetic short stature?

## Clinical Reasoning

1. How do you know if this is a normal growth pattern for this child?
2. When do you consider Child abuse and neglect?
3. When do you refer to Child Protective Services (CPS)/police?  
Children have three mechanisms to define failure to grow:
  - a. Failure of child to be offered sufficient calories.
  - b. Failure of child to consume sufficient calories.
  - c. Failure of child to retain sufficient calories. To assess constitutional delay, X-rays are required. Bone age is less than chronologic age. If there is no clinical reason for child's poor weight gain CPS should be involved in managing this patient.
4. What labs, if any, do you need to make a diagnosis?
  - a. No labs until diet management is tried for one week and failed unless physical exam and history dictates otherwise. Clearly, a "shot-gun" approach where "all known labs" are ordered is discouraged since unless indicated by history or physical, such an approach is unlikely to yield a result that will assist in working through the differential diagnosis.
  - b. Chronic Malnutrition – Labs Needed:
    - CBC with diff
    - Lead level
    - U/A
    - Bone age to determine familial short stature
    - Endocrine or nutritional
    - Thyroid function (TSH, IGF-1 and IGF BG-3)
    - Test for GE Reflux and malabsorption
    - Organic and amino acids or a sweat test (if needed)
6. What psychosocial diagnosis needs to be entertained?
7. What organic disease should be considered?
8. How do you know if growth might be normal for this child?
9. When do you decide it is Child Abuse and Neglect?

**Diagnoses**

1. Genetic Short Stature/ Constitutional Short Stature
2. Nutritional Deprivation
3. Medical History
4. Psychosocial Stresses
5. Organic Diseases
6. Malnutrition
7. Child Abuse or Neglect

**Other Resources**

- Nelson's Textbook of Pediatrics, Editors: Behrman, Klugman, Jenson, 17<sup>th</sup> Ed.
- Kirkland and Motil, [uptodate.com/contents/etiology-and-evaluations-of-failure-to-thrive-undernutrition](http://uptodate.com/contents/etiology-and-evaluations-of-failure-to-thrive-undernutrition) Jan 2011

## **Child Abuse, Case #7**

Written by Susanne Tropez-Sims, M.D.

An eighteen-month-old infant presents with scald burns to the buttocks and legs. The parents report the child “turned on the hot water tap while playing in the bathtub”. How would you differentiate an accidental burn from an inflicted burn?

### **Definitions for Specific Terms:**

**Forced immersion burns**- These burns have a characteristic pattern that typically consist of sharply demarcated edge pattern lesions often in a stocking and glove like distribution, rare or no splash marks and owing to protective reflexes that cause the skin to be tightly opposed in the flexed regions such as the femoral/genital area to be free of injury.

**Splash burns**- This burn pattern consist of irregular burn markings and different degrees of burned areas due to splashing or flailing to get away from burning substance.

**Spill pattern burns**- These burns typically occur when a toddler reaches for a hot liquid above their head and it falls on top of them. We’d expect the hottest liquid to be at the point of impact, often the face or shoulder, then it cools as it flows down the child’s skin thus have an arrow like burn pattern.

### **Review of Important Concepts:**

#### **Historical Points**

- Obtain complete history of incidence. Including:
  - When did injuries occur including date time and where?
  - When was it noticed?
  - Who witnesses it?
  - How child was initially cared for after the incident?
  - What was child like after incident?
  - What did the care provided do after the injury?
  - What was the length of time from injury to seeking help? (remember, a burn might progress to blistering over time so once progression is noted, one would expect a prudent layperson to bring the child for care)
- Developmental history
- Social environment
- Assess plausibility of information surrounding incident.

#### **Physical Exam Findings**

What would you look for specifically on physical exam to assist in determining accident vs. non-accidental injuries?

- a. Note the injury pattern
- b. Evidence of multiple old and new injuries
- c. Injuries in different stages; poor hygiene
- d. Pathognomonic injuries

- e. Look for fractures.

### **Clinical Reasoning**

1. What would raise concern that this may be an inflicted injury?
  - a. Caregiver provides inconsistent history and changing it over time.
  - b. Data is not consistent with trauma seen on child's physical examination.
  - c. Caregiver unsure how injury occurred or claims it is self-inflicted.
  - d. Delay in seeking care.
  - e. Serious injuries blamed on older or younger siblings/playmates.
  - f. Caregiver frequently changes healthcare facilities.
2. When would you consider reporting to Child Protection Services (CPS)?

CPS should be notified immediately after obtaining history and initial work-up. A burn team should be available to assess situation and help with determination of suspected abuse.
3. What X-rays, if any, should be obtained?

A complete, set of body X-rays, defined as a skeletal survey, looking for fractures of skull, ribs, long bones, pelvis, hands and feet. CT and MRI if physical exam deems necessary.

### **Diagnosis:**

Child abuse secondary to forced immersion burn.

### **Other Resources:**

- Reece, R and C Christian Child Abuse Medical Diagnosis and Management 3<sup>rd</sup> ed. 2008.
- Giardino A, Giardino E. Child Abuse and Neglect: Physical Abuse  
[emedicine.medscape.com/article/915664-print](http://emedicine.medscape.com/article/915664-print) Dec 2008.
- Maguire S, et.al. A systemic review of the features that indicate intentional scalds in children.  
*Burns* 2008 Dec;34(8):1072-81. Epub 2008. PMID: 18538478.
- Herndon D. Total Burn Care 4<sup>th</sup> ed. Chapter 60. Elsevier, 2011 in press.

## CHRONIC ILLNESS AND DISABILITY

### Chronic Illness and Disability, Case #7

Written by Judy Rowen, M.D.

During routine screening at 14 weeks gestation, the mother of one of your patients is found to be HIV antibody positive. What interventions can be done to minimize perinatal transmission? After delivery, how would you confirm or exclude HIV infection in the infant?

#### **Definitions for Specific Terms:**

**14 weeks gestation-** How much will the baby have developed so far/how big is it? What evaluations can be done at this stage of pregnancy?

This is the second trimester, which begins after the completion of 12 weeks. The pregnant woman likely can feel fetal movement at this stage. The fetus is about 3.5 inches long and is beginning to grow lanugo. The liver begins secreting bile, the spleen produces red cells and meconium and urine are excreted. The eyes, ears, external genitalia and CNS are continuing to develop. Doppler heart monitors will detect the fetal heartbeat by 10 weeks of gestation. Ultrasound is reliable at 14 weeks. It is probably too early for amniocentesis if indicated; 18 weeks is the ideal timing for that procedure although it may be done earlier. Chorionic villus sampling can be done at this stage if a chromosomal disorder is suspected.

**Perinatal-** Assess that the students know the difference between prenatal, perinatal and antenatal. Most vertical transmission of HIV is truly perinatal rather than prenatal, although 10% of cases are acquired in utero.

**HIV antibody-** Understanding of the methods of testing for HIV antibody positivity is critical to the management of this case. Who is screened for HIV? What tests are actually done?

Screening of pregnant women is recommended for all women at the first prenatal visit. A second HIV antibody screening is recommended for selected populations during the third trimester. Many states have “opt out” laws that require HIV testing of all pregnant women unless the woman specifically asks not to be tested. When blood is drawn for HIV testing, it is first tested by ELISA which is a highly sensitive test (very few false negatives) but not as specific as needed. However, an ELISA is quick and relatively inexpensive. Samples that test positive by ELISA are then subjected to a Western Blot, a very specific test that looks for antibodies against particular HIV epitopes. Most laboratories do not report HIV test results until the Western Blot confirmation is done, but other laboratories may report a positive ELISA in certain circumstances, especially when a woman is in labor. It is important to know whether the diagnosis has been confirmed by Western blot before talking to the mother. When patients are found to be HIV seropositive, (with confirmation) the next level of testing is often a quantitative PCR to determine the viral load.

Review of important concepts:

#### **Historical Points**

- If you were meeting with this mother to establish care for her expected child, what historical information might you want to ask about?
- You may want to explore her risk factors for HIV acquisition, such as drug use, which may impact her child in utero if ongoing.

- You may want to explore the social situation – Does mom have support? Her partner(s) will need to be tested as well.
- The mother needs ongoing care – Does she have health insurance and a care provider?

### Clinical Reasoning

1. At birth, what will the results be on this infant's HIV ELISA?  
An HIV ELISA or Western Blot will be positive on any infant born to an infected mother because of placentally transmitted antibody. Therefore, finding a positive antibody test on an infant does not mean the infant is itself infected.
2. How can a baby be tested to see if they are infected?
  - a. Viral detection testing such as a qualitative PCR is done to evaluate infants born to HIV infected women. There should not be any detectable virus; any level of positivity is likely to reflect vertical infection.
  - b. Testing is usually done at birth – This will be negative unless the child acquired infection in utero. It is usually repeated at subsequent visits; generally, a negative PCR at 4 months of age is considered good evidence that the child is uninfected. Rare infants have been described who remained PCR negative until somewhat later.
  - c. The antibody tests will remain positive for a year, sometime as long as 18 months – This is because the tests are highly sensitive so it takes several half-lives for it to “wear off.”
3. How do infants who get infected acquire the infection?
  - a. Most infants are infected during parturition, through exposure to infected maternal secretions and blood.
  - b. Approximately 10% of infected infants appear to acquire the infection in utero through hematogenous spread.
  - c. A small percentage are infected postnatally, usually through breastmilk.
  - d. In some cultures, pre-chewing an infant's food may be common, exposing the infant to an additional source of possible infection.
  - e. Sadly, some children are also infected via sexual abuse.
4. How can transmission risk be decreased?
  - a. The key thing is to decrease the possibility of exposure to the virus. In the US, breastfeeding is generally discouraged – in other parts of the world the risk of HIV transmission must be balanced with the risk of diarrheal illness due to contaminated water sources for reconstituting formula.
  - b. HIV infected pregnant women should all receive antiretroviral treatment, regardless of their viral load or CD4 count. Although transmission is more likely with a high viral load, babies have been infected after delivery to untreated women with very low levels of viremia. Treatment should be tailored to best address the woman's health, and should always be multidrug (highly active antiretroviral therapy or HAART) but ideally should include zidovudine. Typically, if a woman is not already on medications, therapy is started in the second trimester and continues throughout pregnancy.
  - c. IV zidovudine is given during labor and delivery, and then the infant remains on therapy for the first 6 weeks of life. Zidovudine alone is used for prophylaxis of many HIV exposed infants, but the decision is based on maternal and infant characteristics and should be determined in concert with a pediatric HIV specialist.



- d. Controversy still exists about the role of Cesarean section in these cases, but generally if a woman is adequately treated with good viral suppression and delivery proceeds quickly, vaginal delivery is safe. Women who are untreated or who have prolonged rupture of membranes are offered Cesarean section. Without any treatment, the rate of transmission is approximately 25% whereas most US centers now see transmission rates below 2%.

**Diagnosis:**

Congenital HIV exposure, at risk for vertical transmission

**Suggestions for Learning Activities:**

- Assign the student some tasks ahead – for instance, the questions in the “definitions” section above. You may also have them review the resources below before discussing this case.
- Ask the student(s) the questions listed under “clinical reasoning” to probe their knowledge about the case
- Role play – have the students explain to you as the “expectant mother” what the plans for following the baby will be and what the mom can do to prevent transmission.
- A basic science objective could be linked to this case: “Describe the difference between a qualitative PCR (HIV DNA PCR) and quantitative PCR (HIV RNA PCR) in the diagnosis and management of HIV infection in children”

**Other Resources:**

- “HIV Testing and Prophylaxis to Prevent Mother-to-Child Transmission in the United States” Pediatrics 2008;122:1127-34
- A short review of this topic:  
<http://www.cdc.gov/hiv/topics/perinatal/resources/factsheets/perinatal.htm>
- The full prophylaxis guidelines, 156 pages: <http://aidsinfo.nih.gov/contentfiles/PerinatalGL.pdf>
- Revised Recommendations for HIV Testing of Adults, Adolescents, and Pregnant Women in Health-Care Settings
- <http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5514a1.htm>

## COMMON ACUTE PEDIATRIC ILLNESSES

### Common Pediatric Acute Illnesses: Cough, Case 1

Written by Judy Rowen, M.D.

A twelve-year-old child presents with a three-day history of cough, chest pain and fever of 101 F. Exam reveals diffuse bilateral crackles. A CXR shows diffuse interstitial markings. Discuss your differential diagnosis. How would you evaluate and manage this patient?

#### Definitions for Specific Terms:

**Fever-** Fever is a temperature  $\geq 100.4$ . At this age an oral thermometer is accurate. Ear thermometry, when properly administered and calibrated, is also accurate. In infants, rectal thermometry is preferred.

**Interstitial markings-** (Assess that the students know the difference between interstitial patterns on a chest radiograph vs. consolidations).

#### Review of Important Concepts:

#### Historical Points

- What is the time course of disease, i.e. is this acute or more indolent?  
As the patient presented after 3 days, it suggests a more indolent course.
- What associated symptoms might be relevant, both from the case as given and for additional questions?  
The associated chest pain may suggest pleuritic involvement. You would want to know if there are additional systemic symptoms – any headache, sore throat, nausea/vomiting, abdominal pain. Other URI symptoms such as congestion or rhinorrhea may suggest a viral pneumonia.
- What items in the past medical history, social history or family history might be relevant? From the past history, it is important to know if the child has an underlying pulmonary disorder (e.g. CF) or immunodeficiency, because if the answer is yes the differential diagnosis becomes very broad. Past history of pneumonia is also important – it may be a sign of an underlying but as yet undiagnosed immunodeficiency or anatomic abnormality. From the social history, recent travel may be important; fungal pneumonia such as coccidioidomycosis, histoplasmosis or cryptococcosis may present this way – luckily they are generally self-limited in young, healthy patients.

#### Physical Exam Findings

What is the difference between crackles and rhonchi? How do you “weed out” transmitted upper airway noises when listening to children?

- According to Bates' Guide to Physical Examination and History Taking (author Lynn S. Bickley, Lippincott, 10<sup>th</sup> ed. 2008), rhonchi are lower-pitched, continuous and have a “snoring” quality; they are caused by secretions in large airways. Crackles are more intermittent and are due to opening of smaller airways filled with secretions. Several websites provide sounds for comparison, here are a few to try:

[http://www.stethographics.com/main/physiology\\_ls\\_introduction.html](http://www.stethographics.com/main/physiology_ls_introduction.html)

<http://www.youtube.com/watch?v=5JA6D1Mguh0&feature=related>

## Clinical Reasoning

1. Is this a “typical” pneumonia vs. “atypical”
  - a. “Typical” pneumonia is the term used for classical pneumococcal pneumonia or other similar consolidating pneumonias. The onset is acute rather than indolent, the findings on chest radiographs are lobar consolidation/infiltrates rather than interstitial, and there are few prodromal symptoms such as sore throat and headache, although “typical” pneumonia may follow a viral respiratory illness.
  - b. “Atypical” pneumonia is more indolent, associated with lower peak temperatures, more prodromal symptomatology especially headache and sore throat. The common pathogens are *Mycoplasma* or *Chlamydia pneumoniae* (not to be confused with *Chlamydia trachomatis*). Many viruses may lead to an interstitial pattern on chest radiograph as well.
2. How does the age of the patient impact your list of likely pathogens?
  - a. This child is a school-age patient. Atypical pneumonia due to *Mycoplasma* or *Chlamydia pneumoniae* is more common in this age group.
  - b. They may also develop “typical” pneumonia, although this age group is the least often affected.
  - c. Viral pneumonia may also occur, although the most common viral pathogen in school age children is influenza, which usually leads to the patient appearing more ill than the child in this case.
  - d. Neonates are more likely to be affected with organisms acquired during parturition, such as group B *Streptococcus* or *Chlamydia trachomatis*.
  - e. Infants outside the neonatal period may have viral pneumonia or serious bacterial infection with *Staphylococcus aureus*, *Streptococcus pneumoniae* (especially if incompletely immunized) or occasionally non-typeable *Haemophilus influenzae*.
3. How is pneumonia diagnosed?
  - a. The vast majority of cases are diagnosed clinically. Not even a chest radiograph is required if the findings are clear – the constellation of fever, tachypnea, cough and crackles are pathognomonic.
  - b. Although blood tests are available to check for antibodies against common agents of atypical pneumonia, they rarely impact care and aren’t necessary before empiric therapy is offered.
  - c. In cases of “typical” pneumonia, a sputum Gram stain and culture is probably always warranted in a patient old enough to produce a sample – it is a non-invasive test that is reasonably inexpensive and may yield information about drug susceptibilities.
  - d. If influenza is suspected, rapid testing may be indicated if antiviral therapy is to be offered – however, if an influenza epidemic is ongoing, then it is also a clinical diagnosis and testing is unnecessary before treatment is rendered.
4. Treatment of pneumonia – would you choose oral vs. parenteral therapy, which patients should be hospitalized?
  - a. Most patients with atypical pneumonia may be treated as outpatients, with oral therapy – hence the nickname “walking pneumonia” for mycoplasmal disease.
    - A macrolide would be the drug of choice for this patient.
    - Older patients could be treated with a quinolone such as levofloxacin which would cover other agents of community acquired pneumonia, however, they are not labeled for use in growing children because of concerns about effects on cartilage.

- Doxycycline could also be used – this patient is old enough – but the side effect profile and number of drug-drug interactions make the macrolides a more attractive choice.
- b. Nothing in the case stem suggests hospitalization would be indicated, but you would hospitalize a patient with atypical pneumonia under some circumstances, such as: respiratory distress/need for supplemental oxygen, inability to tolerate PO intake and/or dehydration, immunocompromised host, failure of outpatient therapy (if said therapy was appropriate), etc.

## Diagnosis

Atypical pneumonia, most likely due to *Mycoplasma pneumoniae* or *Chlamydia pneumoniae*.

## Suggestions for Learning Activities

- Ask the student(s) the questions listed under “clinical reasoning” to probe their thinking about the case
- Review chest radiographs of different types of pneumonia (Google image search or your local radiologist may be good sources)
- Practice writing a prescription for this patient – you would need to provide a weight.
- Role play – have the students explain to you as the “parent” what the problem is with this patient and what they plan to do about it. Be sure they include explanations about the expected course and when to bring the child back if there is no improvement.

## **Common Acute Pediatric Illnesses: Cough, Case #2**

Written by Judy Rowen, M.D.

A two-month-old afebrile infant with a history of conjunctivitis at 10 days of age presents with a staccato cough and tachypnea. Physical exam reveals bilateral crackles and mild retractions. A CXR shows patchy densities and hyperinflation. A CBC has an increased numbers of eosinophils. Discuss your differential diagnosis. How would you manage this patient?

### **Definitions for Specific Terms:**

**Staccato cough** – This is a cough which occurs in runs of short, dry coughs. The term comes from music – for an example of staccato music on harmonica, watch the 20 seconds of this video from 2:21-02:43: <http://www.youtube.com/watch?v=aZf5uRrpWB0>

**Tachypnea** – A rapid rate of breathing above the normal range. The student needs to know what the respiratory rate should be at different ages. Infants will breathe 30-60 times/minute.

**Increased number of eosinophils** – The absolute eosinophil count should be below 350 in most patients. Calculate this by multiplying the total white count by the percentage of eosinophils on the differential, for example a patient with a total white count of 10,000 with 5% eosinophils has an absolute eosinophil count of 500.

### **Review of Important Concepts:**

#### **Historical Points**

- Assess the severity of illness and its impact on the child. Any cyanosis? Any apnea? Is the child able to take in the normal amount of breastmilk or formula? How is the urinary output?
- Assess associated symptoms – any rhinorrhea? Rash? Vomiting (post-tussive or unassociated with coughing) or diarrhea? Presence of any of these associated symptoms may suggest a viral process. Pertussis has associated rhinorrhea (the catarrhal phase), so this is not absolute.
- Find out more about the conjunctivitis – was it treated? If so, how? Was it horribly goopy and nasty or more mucoid “mattering” of the eye? (Gonococcal ophthalmia generally presents in the first few days of life, but it is alarming. Viral and chlamydial conjunctivitis are more likely to lead to mucoid discharge, and a parent could conceivably care for it at home without seeking medical attention.)
- Verify that the child has been afebrile throughout the illness, as this impacts the differential (see below.)
- Ask questions to determine if there is anything unique about the baby that may force you to broaden your differential, for example, was the baby born full-term or prematurely? Has the baby been seriously ill with other infections? If so, consider the possibility of an immunodeficiency.
- Has anyone in close contact with the baby been ill in any way? Specifically cough, sore throat, runny nose? Did the mother have any infections during pregnancy? Has she ever had Chlamydia or other sexually transmitted infections?

## Physical Exam Findings

What signs may indicate respiratory distress in a baby of this age?

- Nasal flaring
- Head bobbing
- Grunting
- Retractions.

Note: Ensure that the student knows how to look for retractions and can recognize abnormal respiratory patterns.

## Clinical Reasoning

This case presents a classic pattern that an experienced pediatrician will immediately recognize. The student may not have built this pattern yet, so questions 1-3 below could be used to derive a list of possibilities, and the most likely answer will be the one that appears on all three lists.

1. What infections may cause conjunctivitis in a 10 day old? Is there any possibility the two processes are related?  
Viruses and Chlamydia trachomatis are most likely at this age. Some children will have dacryocystitis and will have eye drainage, but generally they will also have a small swelling over the blocked tear duct at the medial canthus as well. Some viruses may cause both conjunctivitis and pneumonia, but usually concurrently, not 6 weeks later. This is the classic progression of perinatal Chlamydia infection.
2. What causes of increased eosinophils may be seen in a 2 month old?  
Some babies will have an increase in eosinophils when they stop losing weight and hit positive protein balance – this would have happened earlier in the baby's life and is more common in premature infants. Asthma may affect an infant as young as this and may have an associated increase in eosinophils. Other allergic processes may be associated with eosinophilia. Premature neonates have been best studied, and we know that eosinophilia is fairly common with most infectious processes seen in that population.
3. What causes of pneumonia may be seen in a 2 month old? Which are most likely in a baby who is afebrile?  
Many pathogens cause pneumonia in a neonate – viruses such as RSV, influenza, parainfluenza and adenovirus are probably most common, but Chlamydia, Staphylococcus aureus, Streptococcus pneumoniae and Hemophilus influenzae should also be considered. Chlamydia is the most likely to be seen in an afebrile child, but some viral infections may not have much associated fever. Some would add Ureaplasma to the list, as well as CMV.
4. If the baby acquired the infection during birth, why is it just now presenting at age 2 months?  
Chlamydia is an intracellular pathogen that probably first infected the conjunctival epithelium after spread from infected maternal secretions, and from there colonized the nasopharyngeal mucosa and eventually spread down the airway to the lungs. Replication and spread takes time. 50% of infants born to mothers with untreated Chlamydia become colonized.

5. Would things be different if the baby had been treated for the conjunctivitis at age 10 days?  
Treatment for presumed chlamydial conjunctivitis must be with oral medications, not just topical, or the nasopharyngeal spread goes unchecked. With topical treatment, the eyes may improve but the child is still at risk for the pneumonitis; 5-13% of infants who acquire the pathogen will develop pneumonia if untreated.
6. How would you manage this patient?
  - a. Would you hospitalize or treat as an outpatient?  
If the child was ever cyanotic or apneic, inpatient monitoring is required. If the baby is otherwise stable, drinking and urinating normally, the decision on location of management varies by “soft” criteria – how far away does the family live? Do they have reliable transportation to return if the baby doesn’t continue to do well? Can they fill a prescription right away?
  - b. What laboratory testing would you order?  
Many practitioners treat this condition empirically, without specific laboratory testing. If you have a lab with skill in isolating Chlamydia, a nasopharyngeal swab for culture could be sent. The nucleic acid amplification techniques used for genital samples are not meant for respiratory samples.
  - c. What medication would you prescribe?  
A macrolide is the preferred treatment. At this age, azithromycin would probably be chosen although some feel the data concerning use of new macrolides for this condition are sparse and thus use erythromycin. The antibiotic would be given orally as it is quite bioavailable.

### Diagnosis:

Pneumonia due to Chlamydia trachomatis. A very astute student may propose Ureaplasma urealyticum or CMV as a possible pathogen.

### Suggestions for Learning Activities:

- Ask the student the questions in the clinical reasoning section above.
- Provide the case to the student ahead of time, and tell them to be prepared to come “pitch” their leading diagnosis to you in 25 seconds or less. This will require them to pare the presentation down to the absolutely essential elements.
- Review chest radiographs on-line or with your friendly, neighborhood pediatric radiologist to see “hyperinflation with patchy infiltrates”.

### Other Resources

- Discussion of eosinophilia in neonates: S. Juul et al., Evaluation of Eosinophilia in Hospitalized Preterm Infants, Journal of Perinatology (2005) **25**, 182–188.
- Red Book American Academy of Pediatrics Report of the Committee on Infectious Diseases

## **Common Pediatric Acute Illnesses: Cough Case #5**

Written by Kyra Len, MD

A four-year-old presents with a cough for 3-4 days following a URI. He has had a fever to 104° F for twenty-four hours. Exam reveals crackles on the right. What other physical finding should you try to elicit? What would you expect the CXR to show? What are the potential etiologies? How would you manage this patient?

### **Definition for Specific Terms:**

**Crackles-** According to Bates' guide to Physical Examination and History, crackles are intermittent, nonmusical and brief-like dots in time (. . . .). Fine crackles are very brief high pitched soft sounds and coarse crackles are not as brief and lower in pitch and a little louder than fine crackles. Crackles may be due to pneumonia, bronchiectasis or congestive heart failure.

### **Review of Important Concepts:**

#### **Historical Points**

- Time course of illness: The patient develops fever and cough following a URI suggesting he may be developing an acute process after a viral upper respiratory infection.
- Associated symptoms: This patient has a high fever up to 104 with abrupt onset following a URI. This suggests the possibility of a bacterial infection. Patients with lower lobe pneumonia may sometimes present with abdominal pain and at times are initially evaluated for appendicitis. Patients with inflammation near the pleura may have chest pain.
- Past Medical History: Review the patient's medical history including prenatal and birth history. Does this patient have a history of previous pulmonary infections or asthma that may complicate this current infection?

#### **Physical Exam Findings**

1. What is the significance of looking at the general appearance of this patient?  
If the patient appears ill or toxic, they may be more likely to have a bacterial pneumonia or a complication of bacterial pneumonia such as empyema.
2. What is the significance of focal crackles on exam?
  - a. Focal crackles on exam suggest a localized pulmonary infection such as pneumonia.
  - b. Unilateral findings suggest that the patient has a pathologic process in only one lung such as atelectasis from a foreign body or mucous plug, or possibly pulmonary sequestration or a congenital cystic adenomatoid malformation (CCAM). However, since this patient also has a fever to 104, pneumonia is more likely.
3. What other physical findings may be seen in a patient with pneumonia?
  - a. Pediatric patients with pneumonia may present with tachypnea and/or signs of respiratory distress including grunting, flaring, retractions and accessory muscle use. Tachypnea is defined as (according to the WHO):

Age	Respiratory Rate
Newborn	>60
2-12 months	>50
1-5 years	>40
>5 years	>20



- b. In addition, patients with a lobar pneumonia or consolidation may have physical findings secondary to their consolidation (see findings listed below under clinical reasoning section: dullness to percussion, increased tactile fremitus, bronchophony, egophony, and whispered pectoriloquy).

### Clinical Reasoning:

1. What is in your differential diagnosis for this patient?
  - a. Pneumonia, atelectasis from foreign body or mucous plug, pulmonary sequestration, CCAM would be consistent with unilateral findings.
  - b. Since the findings in this case are unilateral, bronchiolitis, chlamydia, mycoplasma, asthma, early congestive heart failure, etc would be less likely.
2. What other physical findings should you try to elicit?
  - a. On percussion you may note dullness to percussion over airless area (area of pneumonia where the alveoli are filled with fluid or inflammatory cells as in pneumonia).
  - b. The patient may also have increased tactile fremitus over the involved area.
  - c. Bronchophony: Where spoken words are louder and clearer over the affected area
  - d. Egophony: When the patient says “ee” it is heard as “ay”
  - e. Whispered Pectoriloquy: When the whispered words sound louder or clearer vs. a normal lung where the whispered words are faint and indistinct or may not be heard at all.
3. What would you expect the CXR to show?
 

Depending on the etiology you may have different CXR findings. Pneumococcal pneumonia is more likely to have a focal infiltrate with lobar consolidation. Pneumococcal pneumonia is more consistent with this patient’s physical exam findings. Mycoplasma and Chlamydia pneumonia and viral pneumonia are more likely to have diffuse interstitial infiltrates, thus findings on physical exam that are not focal.
4. What are the potential etiologies?
 

Common etiologies of pneumonia depend on the age of the patient.

3 weeks to 3 months	Chlamydia trachomatis RSV Parainfluenza Streptococcus pneumoniae Bordetella pertussis
3 months to 4 years	Viral (RSV, parainfluenza, human metapneumovirus, influenza and rhinovirus) Streptococcus pneumoniae Mycoplasma pneumoniae
5 years through adolescence	Mycoplasma pneumoniae Chlamydia pneumoniae Streptococcus pneumoniae Mycobacterium tuberculosis

5. How would you manage this patient?
  - a. Given this patient's clinical findings and history suggestive of bacterial pneumonia he should be treated with high dose Amoxicillin/Ampicillin that will treat *Streptococcus pneumoniae*.
  - b. Depending on his clinical presentation he may be treated as an outpatient. Indications for hospitalization are:
    - Respiratory distress (retractions, flaring, grunting)
    - Hypoxemia
    - Young infants with suspected bacterial pneumonia
    - Complications such as empyema, large pleural effusion
    - Septic appearance, hypotensive, toxic appearing

### Diagnosis:

Bacterial Pneumonia, most likely Pneumococcal

### Suggestions for Learning Activities:

- Ask the student questions under the “clinical reasoning” section to probe their thinking about the case.
- Review chest radiographs with an article that has examples of classic CXR findings with associated etiologies including RSV, Mycoplasma and Pneumococcus. Durbin, W and C. Stille. Pneumonia. Peds in Review. 2008;29: 147-160.
- Review the physical findings of a patient with consolidation. If there is a patient admitted with a consolidated pneumonia you could do a bedside teaching exercise of having the students practice eliciting bronchophony, egophony, etc.
- Answer: Findings of pneumonia: focal crackles on auscultation, dullness to percussion, increased tactile fremitus, Bronchophony (where spoken words are louder, clearer over the affected area), Egophony (when the patient says “ee” it is heard as “ay”), Whispered Pectoriloquy (when the whispered words sound louder or clearer vs. a normal lung the whispered words are faint and indistinct or may not be heard at all.)
- If you don't have a patient to practice on here are some online examples of adventitious sounds and egophony and whispered pectoriloquy:
- [http://faculty.etsu.edu/arnall/www/public\\_html/heartlung/breathsounds/contents.html](http://faculty.etsu.edu/arnall/www/public_html/heartlung/breathsounds/contents.html)
- Online case of a 9 yo male with vomiting and abdominal distension. The patient was found to have a right lower lobe pneumonia and pleural effusion.
- <http://www.hawaii.edu/medicine/pediatrics/pemxray/v2c04.html>
- Students may practice reading pediatrics chest radiograph films with findings of infiltrates. <http://www.hawaii.edu/medicine/pediatrics/pemxray/v3c20.html>
- Cases: D, H, I, K, L, M, N and P have infiltrates.
- More pediatric chest radiographs of children with pneumonia. <http://www.hawaii.edu/medicine/pediatrics/pemxray/v4c05.html>
- Cases: D, E, F, H, J and N have infiltrates.

**Other Resources:**

- Durbin, W and C. Stille. Pneumonia. Peds in Review. 2008;29: 147-160.
- Otsuka, K (2003). Pulmonary Infections. In L. Yamamoto, A. Inaba, and J. Okamoto, Eds, Case Based Pediatrics for Medical Students and Residents (176-180). Honolulu, USA:Author House.

## **Common Pediatric Acute Illnesses: Cough, Case #6**

Written by Kyra Len, M.D.

A two-year-old child presents with the abrupt onset of cough, wheeze and tachypnea. He is afebrile. Physical exam reveals diminished air exchange and wheezing on the right. What is the most likely cause of this patient's finding? How would you proceed to evaluate and treat this patient? What anticipatory guidance should this encounter generate?

### **Definition for Specific Terms:**

**Tachypnea**- As in most things in pediatrics, tachypnea is determined by age dependant normal values. Tachypnea is defined as (according to the WHO):

Age	Respiratory Rate
Newborn	>60
2-12 months	>50
1-5 years	>40
>5 years	>20

**Wheeze**- Remember not all wheezing is due to asthma! Wheezes are relatively high pitched sounds that can occur when there are narrowed airways such as asthma, bronchiolitis or even the presence of a foreign body.

### **Review of Important Concepts:**

#### **Historical Points**

- Time course of illness: One of the key points of this clinical scenario is that it presents with an abrupt onset of wheeze. What was the patient doing when they started coughing and wheezing? Were they being supervised at that time?
- Associated symptoms: This patient does not have fever suggesting the cause of his illness is not infectious. Also he doesn't have associated upper respiratory symptoms such as runny nose or congestion to suggest an infectious etiology.
- Past Medical History: Review the patient's medical history including prenatal and birth history. Has this patient ever wheezed before or do they have a history of asthma?

#### **Physical Exam Findings**

1. What is the significance of the asymmetric findings on exam ("diminished air exchange and wheezing on the right")?  
Unilateral decreased breath sounds and unilateral wheezing and cough are classic physical findings of foreign body aspiration, but may not always be present. Sometimes lung auscultation may be normal in a patient with foreign body aspiration depending on the material and location of the foreign body.
2. What is the significance of wheezing heard on exam?  
In patients with extrathoracic airway obstruction you may hear stridor on exam. If the obstruction is in the intrathoracic airway you may be more likely to hear wheezing.
3. Will a child with a foreign body aspiration present with fever?  
While most patients who present with a foreign body aspiration are afebrile, they may present with fever if the aspiration occurred weeks or months earlier and the child now has a resulting obstructive

pneumonia or lung abscess. Also if the object aspirated was contaminated or chemically irritating, this may also manifest as fever.

### Clinical Reasoning

1. Differential Diagnosis for this patient:
  - a. Asthma
  - b. Pneumonia
  - c. Bronchiolitis
  - d. Bronchiectasis
2. What is the next step for evaluating a suspected foreign body aspiration?
  - a. If patient is stable, the next step to evaluate a foreign body is chest radiography. However, remember that most objects are organic and are radiolucent.
  - b. Indirect signs of a presence of foreign body may be present on a Chest radiograph such as air trapping (either asymmetric or bilateral) or atelectasis. Inspiratory and expiratory films will help to emphasize the air trapping and identify the foreign body. In young children who cannot cooperate with inspiratory and expiratory films, lateral decubitus films may be helpful.
3. What is the treatment of suspected foreign body aspiration?
  - a. For complete airway obstruction: back slaps and chest thrusts in head down position for infants, abdominal thrusts for older children.
  - b. For partial airway obstruction, allow the patient to cough and be taken to the nearest medical facility.
  - c. Do not perform a blind sweep in the child's mouth as it may push the object further into the airway.
  - d. Rigid bronchoscopy allows for direct visualization of the airway and removal of the foreign body.
4. What would you give as anticipatory guidance for parents?
  - a. Choking and foreign body aspiration is a common cause of unintentional death in young children. Toddlers are the most vulnerable age group.
  - b. Commonly aspirated foods include: organic matter like food such as peanuts, grapes, raw carrots, popcorn, seeds, hot dogs and vegetable matter or bones. Also inorganic items that may be aspirated include: toy parts, crayons, latex balloons, marbles, pen tops, tacks, pins, nails, screws, and bullets.
  - c. AAP resource for Choking prevention: <http://www.healthychildren.org/English/health-issues/injuries-emergencies/Pages/Choking-Prevention.aspx>

### Diagnosis:

Foreign Body Aspiration

### Suggestions for Learning Activities:

- Ask the student questions under the “clinical reasoning” section to probe their thinking about the case.
- Game: Find the foreign body!

- First start with obvious radiopaque foreign body:
- <http://emedicine.medscape.com/article/1001253-workup> (earring backing in right mainstem bronchus)
- Then start with some pictures of air trapping and ask them which side has the foreign body. <http://radiographics.rsna.org/content/28/3/e29/F38.expansion> (piece of apple in right mainstem bronchus, AP and lateral decubitus film with air trapping on right)
- Have the student explain the physiology of why expiratory films help identify air trapping and the location of a foreign body.
  - Answer: The Ball-Valve Effect: When the patient inspires the intrathoracic airways are expanded allowing for aeration around an obstructing foreign body. However, when the patient expires there is narrowing of these airways and the foreign body will be trapped in the airway and the air will be trapped behind it resulting in localized air trapping.
- Role Play: physician and parent about anticipatory guidance regarding choking and foreign body aspiration.
- Student may also review an online case of foreign body aspiration: A case of a 17 month old with a tracheal foreign body and bilateral air trapping. Explains case with radiographs including bilateral lateral decubitus films. <http://www.hawaii.edu/medicine/pediatrics/pemxray/v1c08.html>
- Another case of foreign body aspiration: A case of 2 yo male who presents with recurrent pneumonia. Explains case with radiographs. <http://www.hawaii.edu/medicine/pediatrics/pemxray/v2c07.html>

### Other Resources:

- Louie, M and S. Bradin. Foreign body ingestion and aspiration. Peds in Review. 2009;30: 295-301.
- Rovin, J and B. Rodgers. Pediatric foreign body aspiration. Peds in Review. 2000;21(3):86-90.
- Fong, E. (2004). Foreign Body Aspiration. In L. Yamamoto, A. Inaba, and J. Okamoto, Eds, Case Based Pediatrics for Medical Students and Residents (292-293). Honolulu, USA: Author House.

## **Common Acute Pediatric Illness: Cough, Case #7**

Written by Melissa Kleschen, M.D. and Marta King, M.D.

A one-month-old infant with a one-week history of cough and congestion now presents with paroxysms of cough associated with blue spells. He is afebrile with a normal examination between paroxysms of coughing. A CXR is normal. Discuss your differential diagnosis. How would you evaluate and manage this patient?

### **Definitions for Specific Terms:**

**Paroxysmal cough**- A long series of coughs that can be accompanied by gagging, choking, emesis, or cyanosis. It is usually followed by a large inhalation. (See website under “other resources” for an example.)

**Cyanosis**- A blue-purple discoloration of the skin due to an increased amount of deoxygenated hemoglobin.

**Apparent Life Threatening Event (ALTE)**- Acute, unexpected change in infant’s breathing that was frightening to the infant’s caretaker and included some of the following features:

Apnea (usually central): cessation of inspiratory gas flow for 20 sec, or for a shorter period of time if accompanied by bradycardia (< 100), cyanosis or pallor, color change, muscle tone change (usually limpness), choking or gagging.

### **Review of Important Concepts:**

After discussing this question the student should be able to:

- List the possible causes of cough and cyanosis in an infant and understand how history and physical exam findings can be used to narrow the differential diagnosis
- Recognize signs and symptoms of respiratory distress in an infant
- Understand the natural course, treatment, and prevention measures of pertussis

### **Historical Points**

- Cough description (barking, dry, productive, short bursts, etc) and when it occurs. Some parents might even bring in a cell phone recording!
- Clarification regarding “blue spells” to determine if it is consistent with cyanosis. Is it perioral (only around the mouth, does not include the lips or tongue), central cyanosis (includes the trunk, mucous membranes), or acrocyanosis (hands/feet)? Do they occur only during coughing? Has the patient ever become limp or stiff during the episodes? Have the parents ever needed to intervene in any way?
- Past medical history including mother’s prenatal labs, pregnancy, and delivery history. Review the first month, asking about infections, feeding, growth, and development. Have there been any parental concerns?
- Sick contacts: always helpful with infectious diseases! Ask specifically about any exposures to adults with persistent cough or to anyone who has not received the DTaP vaccines
- Season: many of the viral infections have season variations in temperate climates

- Review of systems:
  - Fevers at home→history of fever at home (even if afebrile at this time) would require further evaluation for serious bacterial infection
  - Eye discharge→think about viral infections and Chlamydia trachomatis
  - Sweating, diaphoresis, fatigue with eating→think about heart failure
  - Gastroesophageal reflux symptoms: frequent spitting up or vomiting, back arching or crying following feedings→think about reflux and secondary aspiration
  - Association between coughing spells and eating: Coughing spells occurring while eating →think about primary aspiration. Coughing spells occurring shortly after eating →think about reflux with secondary aspiration

### Physical Exam Findings

1. General: Is the infant in acute respiratory distress? Does he look toxic? Is he well-nourished? Any dysmorphic features?
2. HEENT: Eye discharge? Nasal discharge or congestion? Are the palate, jaw, and oropharynx normal?
3. CV: Tachycardia? Is there a murmur? Are femoral and brachial pulses equal?
4. RESP: Tachypnea? Retractions? Wheeze, crackles, coarse breath sounds? Equal air entry?
5. ABD: Hepatomegaly?

### Clinical Reasoning

1. Initial broad differential diagnosis for cough and cyanosis in an infant
  - a. Infectious: viral URI, viral bronchiolitis, pertussis, bacterial pneumonia (GBS, E.coli, staph/strep, Chlamydia trachomatis)
  - b. Cardiac: heart failure with pulmonary edema
  - c. GI: primary aspiration due to swallowing disorder or to a structural abnormality such as a tracheoesophageal fistula (TEF) or due to gastroesophageal reflux and secondary aspiration
2. Narrowing the Differential Diagnosis
  - a. Look at the information provided in the question: an infant with URI symptoms followed by paroxysms of cough associated with blue spells who is afebrile and who has a normal exam between coughing episodes is very suggestive of pertussis.
  - b. An infant with typical bacterial pneumonia, aspiration pneumonitis or pneumonia, bronchiolitis, or heart failure would not be expected to have a normal exam between coughing episodes. An infant with primary or secondary aspiration could potentially present in this way. The infant would be coughing and closing his vocal cords (leading to cyanosis) in an effort to clear his airway and prevent any formula from getting into his lung. Getting further historic information about any relation between feeding and coughing episodes would be very helpful.



3. Additional laboratory testing (should be done based on clinical suspicion!)
  - a. Pertussis PCR from nasal secretions
  - b. Chlamydia trachomatis respiratory DFA with reflex culture (Remember that it's an intracellular bug, so must get cells)
  - c. Viral respiratory DFA or PCR: RSV, metapneumovirus, parainfluenza, influenza, rhinovirus
  - d. CBC with differential:
    - ↑ wbc count is suggestive of infection
  - e. Pertussis can have a significant (15,000-50,000  $10^3/\text{mL}$ ) leukocytosis with lymphocyte predominance. Classically have an absolute lymphocytosis – take the total white count and multiply by the percentage of lymphocytes; absolute lymphocytosis is a value  $>10,000$ . So, for example, a baby with pertussis may have a total white count of 23,000 with 87% lymphocytes – the absolute lymphocyte count is 20,010. This is in contrast to the relative lymphocytosis seen in viral infections – a baby with RSV may have a total white count of 9,000 with 72% lymphocytes, for an absolute lymphocyte count of 6480, quite different.
  - f. Chlamydia trachomatis: can have a nl WBC with eosinophilia
4. Radiology
  - a. CXR (already done in this scenario). A consolidation or diffuse hazy opacities could suggest infection or aspiration. Evaluate heart size and signs of pulmonary edema for cardiac causes. The chest radiograph is usually normal in pertussis but may show mucous plugging and rarely infiltrates.
  - b. A swallow study could help determine if there is aspiration (if family gave a concerning history)
  - c. An Upper GI series could help evaluate reflux and anatomy

### Patient Management

1. Discuss reasons for patient admission infant with cyanotic spells alone deserves an admission due to need for close monitoring and possible intervention: supplemental oxygen or intubation. Other possible reasons for admission include:
2. Fever/hypothermia: would require a sepsis workup and IV antibiotics
3. Poor feeding, dehydration, or weight loss: would require supplemental IVF and potentially supplemental nutrition

### Diagnosis:

Pertussis

### Suggestions for Learning Activities:

- Ask the student(s) the questions listed under “clinical reasoning” to probe their thinking about the case. One way of starting out is to ask the students to think about all the various causes of cough and cyanosis in an infant and writing them out on the board. Then use the history, physical exam, +/- labs to narrow the differential and come up with the most likely and then the final diagnosis
- Have the student discuss the signs and symptoms of respiratory distress in an infant.
- Tachypnea: If you see it without other respiratory symptoms, think non-pulmonary conditions. Keep in mind normal varies by age (like everything in the world of pediatrics ☺)!

Age	Tachypnea (from WHO)
Newborn	>60
2-12mo	>50
1-5yrs	>40
>5 yrs	>20

- Accessory muscle use:
  - Nasal flaring
  - Head bobbing: neck strap muscles
  - Retractions
  - Grunting: forced expiration against a partially closed glottis
- Paradoxical breathing: asynchrony of chest and abdominal wall motion. Inspiration: chest wall draws in instead of out. OMINOUS
- Go over the natural course of pertussis infection:
  - Spread: Contact with infected individual (classically a young adult w/ prolonged coughing illness)→aerosolized droplets attach to and damages ciliated respiratory epithelium→ incubation period 7-10d
  - Catarrhal stage (1-2 w): URI sx. Most infectious. Severity of cough gradually increases
  - Paroxysmal stage (4-6 w): coughing spells→ inspired air goes through partially closed airway →loud whoop. Infants <6mo tend to become apneic and cyanotic instead of the classic “whoop”
  - Convalescent Stage: weeks to months of chronic cough gradually ↓ in frequency. Pertussis is sometimes called the “100 day cough” – important to counsel families about this so they are not worried or surprised.
- Go over treatment and infection control measures for pertussis
  - Antibiotics eliminate B pertussis from the pharynx → ↓ spread, but do not alter the severity or duration of illness unless initiated during the catarrhal phase
  - Patients remain contagious for 5 days after initiation of tx (respiratory isolation if hospitalized infants)
  - Remember to treat and/or prophylax all close contacts! Macrolides are used for treatment of disease and post-exposure prophylaxis. Erythromycin is recommended if the contact is >1 month of age. For infants <1 month, azithromycin is preferred, as there is a risk of pyloric stenosis with erythromycin in this age group.

### Additional Learning Activities:

- Ask the students how they would explain the workup and management plan they came up with to the family. Discuss how to talk with the family regarding testing for Chlamydia trachomatis (if they felt it was indicated).
- Discuss pertussis immunization and boosters
- Assign students to critically appraise the literature regarding
  - cost effectiveness of administering pertussis boosters to women of childbearing age
  - average hospitalization duration and cost for an infant with persussis
  - complications of infant pertussis infection

**Other Resources:**

- Web site with recording of classic pertussis (whooping cough) cough. Keep in mind that infants <6mo typically do not have the classic “whoop”! <http://www.whoopingcough.net/symptoms.htm>
- Review of pertussis in early infancy: McIntyre, P. and N. Wood (2009). "Pertussis in early infancy: disease burden and preventive strategies." Curr Opin Infect Dis 22(3): 215-23.

## **Common Acute Pediatric Illnesses: Cough Case #8**

Written by Gayani Silva, M.D.

A seven-year-old presents with two weeks of coughing and nasal congestion following a URI. The cough is worse at night and frequently awakens him. His mother says he has also developed bad breath. What is your differential diagnosis and how would you manage this patient? When would further workup/imaging be warranted?

### **Definitions for Specific Terms:**

**URI (upper respiratory infection)**- An URI or a common cold is usually caused by a variety of viruses and typically has a self limited course. Most URI's last 7-10 days and will have symptoms such as clear rhinorrhea, nasal congestion, sore throat, cough and fever. Rhinovirus and Coronaviruses are the two most common viruses that cause URI's. However, other viruses such as parainfluenza, RSV, adenovirus etc. can also give upper respiratory symptoms though these viruses commonly have other characteristic symptoms (ex: barking cough with parainfluenza, wheezing, infection in winter months with RSV etc) that cue you to the etiology.

**Bad breath (Halitosis)**- The most common cause of halitosis is oral disease such as poor oral hygiene, poor plaque control, periodontal disease, excessive coating and bacterial overgrowth of the posterior third of the tongue. In addition, it can be caused by disease of the upper respiratory tract such as sinusitis, tonsillitis, etc. Very rarely it can be a symptom of systemic disease.

### **Review of Important Concepts:**

#### **Historical Points**

- Time course of the disease, sequence of symptoms?
  - The congestion and cough has lasted two weeks. You want to find out what were the symptoms at the beginning of the illness – example: clear rhinorrhea changing to discolored nasal discharge, any fever or rashes at the beginning of the illness? These would clearly point to a viral etiology at the start of the illness
  - However, additional historical information such as the progression/change in the character of the cough, wheezing, painless peri-orbital swelling, headache, facial pain and fever again later on in the course of the illness should be elicited
- Other associated symptoms that should be elicited with a differential diagnosis in mind?
  - Congestion and worsening cough without any other symptoms following a URI would suggest sinusitis. Sinusitis should also be considered in a child with a URI and clinical worsening with constitutional symptoms in the latter part of a viral illness.
  - However, if the worsening cough is associated with high fever, difficulty breathing, worsening cough etc, then pneumonia / asthma should also be considered. It is important to remember that facial pain, headache, and fever, are not common symptoms of sinusitis in children.

## Physical Exam Findings

1. Perform a good HEENT exam
2. Perform a complete lung exam.
  - Assess air-entry, differentiate transmitted upper airway sounds, crackles, rhonchi and wheezing. Review Bates' Guide to Physical Examination and History Taking (author Lynn S. Bickley, Lippincott, 10<sup>th</sup> ed. 2008) on lung exam.  
[http://www.stethographics.com/main/physiology\\_ls\\_introduction.html](http://www.stethographics.com/main/physiology_ls_introduction.html)  
[http://www.youtube.com/watch?v=-A3\\_nYPAoEM](http://www.youtube.com/watch?v=-A3_nYPAoEM)

## Clinical Reasoning:

1. In making a diagnosis of sinusitis, should imaging studies be ordered on every patient?
  - a. Sinusitis is essentially a clinical diagnosis and should be treated based on history. The use of imaging studies in an otherwise healthy child with suspected sinusitis is controversial. They should be ordered in patients with poor response to therapy or with suspected complications. Sinus radiographs have been found to be unreliable unless read by an experienced pediatric radiologist (especially in children under 1 year), and should only be obtained in patients who have failed antibiotic therapy.
  - b. A CT scan, which again is not required in the management of uncomplicated sinusitis, should be obtained in patients with poor response to therapy, severe disease or if complications are suspected.
2. Are nasopharyngeal cultures indicated prior to treatment of sinusitis?  
 Nasal, oropharyngeal, and nasopharyngeal cultures correlate poorly with cultures of sinus aspirates and is not indicated in the diagnostic workup of acute or chronic sinusitis. Sinus aspirates are considered the gold standard in the diagnosis of sinusitis. However, as this is an invasive procedure, it is usually performed in patients with orbital or intracranial complications.
3. What antibiotics should be considered in the initial treatment of this patient?
  - a. Antibiotics used to treat acute bacterial sinusitis should cover *S. pneumoniae*, *H. influenzae*, and *M. catarrhalis*. Amoxicillin or Amoxicillin-Clavulanate is usually used as first line therapy.
  - b. For those with sinusitis of moderate severity, those treated with antibiotics previously and those that attend day care and have been treated with multiple antibiotics, high dose Amoxicillin-clavulanate, (80 -90 mg/kg/day), Cefdinir, Cefuroximes or Cefpodoxime can be used.
  - c. Clindamycin also can be used.
  - d. The duration of therapy also is somewhat controversial, but typically ranges from 14-21 days.

## Diagnosis:

Sinusitis

## Suggestions for Learning Activities:

- Have the student read the AAP practice guideline on sinusitis, listed below. Then ask them the questions outlined in the clinical reasoning section above.

- Have the student research the complications of sinusitis – how do they present? How often do they occur? Which types of patients are most commonly affected?
- Review radiographs of sinusitis – how much radiation is involved in obtaining a Waters view? A complete sinus series? A head CT for sinuses?

**Other Resources:**

- AMERICAN ACADEMY OF PEDIATRICS. Subcommittee on Management of Sinusitis and Committee on Quality Improvement. Clinical Practice Guideline: Management of Sinusitis. Pediatrics 2001;107:619
- <http://aappolicy.aappublications.org/cgi/reprint/pediatrics;108/3/798.pdf>

## **Common Pediatric Acute Illnesses, Cough Case #9**

Written by Gayani Silva, M.D.

An eleven-year-old presents with frequent episodes of a coughing illness often triggered by colds. What is the most likely diagnosis? How would you manage this patient?

### **Review of Important Concepts:**

#### **Historical Points**

- In an eleven year old, frequent episodes of “colds with episodes of coughing” could be due to asthma, allergic rhinitis or both. In addition, some of these episodes could be from sinusitis secondary to allergic rhinitis. In children, it is important to identify the etiology of the cough, especially when it has lasted over 4 weeks (chronic cough). Clear rhinorrhea, sneezing, watery eyes, itching, seasonal pattern etc. would suggest allergic rhinitis. Family history of asthma, wheezing, shortness of breath with or without exertion, history of atopy and night time coughing, would suggest a diagnosis of asthma. It is important to remember that a history of frequent episodes of bronchitis, that has been treated on multiple occasions with antibiotics, may mean that the child has asthma. It is also important to note that allergic rhinitis and asthma can co-exist. Purulent nasal discharge with the coughing spells, facial tenderness, headache, peri-orbital swelling would suggest sinusitis most likely secondary to allergic rhinitis. It is also important that the student takes a good environmental history to identify any triggers such as smoke exposure, dust mites and presence of pets.
- What are the symptoms of the “cold”?
- Are they associated with fever, congestion etc., or are they generally just congestion with clear rhinorrhea?
- Is there a seasonal pattern to this?
- Anything that relieves the symptoms?
- Is there a family history of allergies or asthma?
- Any triggers such as smoke exposure, pets etc.?

#### **Physical Exam Findings**

1. Are there signs of allergies, asthma present on the exam?
  - a. Wheezing, decreased air entry, skin findings of atopy and prolonged expiratory phase would indicate underlying asthma, though in some patients with cough-variant asthma, wheezing may not be evident at each visit. However, even in such patients, a history of the cough being induced by the classic asthma triggers such as URI's (as in this patient) or seasonal allergies is usually present.
  - b. In patients with allergic rhinitis, physical exam will reveal pale, blue, swollen nasal mucosa, watery discharge from eye/ nose and allergic shiners. Purulent discharge, halitosis, facial tenderness, peri-orbital swelling, elevated temperature will lead you to a diagnosis of bacterial super infection – most likely sinusitis. If recurrent sinusitis is the cause of the recurrent cough, then it is important to look for a history of underlying cause such as allergic rhinitis.

## Clinical Reasoning

1. In a patient with frequent episodes of coughing associated with colds, what would be the next step in management?
  - a. With a clear history and physical exam to support a diagnosis of asthma, a trial of beta agonists (with or without inhaled corticosteroids) can be prescribed for a limited time. Improvement would suggest a diagnosis of asthma, but it is important to establish a definitive diagnosis based on spirometry.
  - b. It is also reasonable to obtain a chest x-ray in a child with a recurrent cough (may show evidence of hyperinflation and peribronchial thickening in the case of asthma). However, most physicians would do empiric therapy first in an outpatient setting in the face of a clear history and physical exam findings.
  - c. Empiric therapy should be time limited, the patient should be re-evaluated in 2-4 weeks for improvement and eventually a definitive diagnosis should be established.
  - d. Once the diagnosis of asthma is established, the patient needs to have an asthma action plan and education on use of various medications, use of inhalers with spacer, avoidance of triggers etc.
2. Is there a place for cough suppressants and other over the counter medications in the management of a chronic recurrent cough?  
 An etiology for the cough should be defined and treatment decided accordingly. Cough suppressants and OTC medications should not be used, especially in young children as there have been reports of significant morbidity and mortality associated with them.

## Diagnosis:

Asthma

## Suggestions for Learning Activities:

- Review the article provided under resources and video on how to instruct a patient in the use of an inhaler with a spacer.
- [http://www.utmb.edu/pedi\\_ed/Online/online.htm](http://www.utmb.edu/pedi_ed/Online/online.htm) :
- Asthma: spacer & inhaler, developed by Lynda Williams RRT, AE-C, UTMB, Galveston.

## Other Resources:

- Chang AB, Glomb WB,. Guidelines for Evaluating Chronic Cough in Pediatrics:
- ACCP Evidence-Based Clinical Practice Guidelines. Chest 2006; 129:260S.
- [http://chestjournal.chestpubs.org/content/129/1\\_suppl/260S.full.pdf+html](http://chestjournal.chestpubs.org/content/129/1_suppl/260S.full.pdf+html)
- National Heart, Lung, Blood Institute guidelines for the diagnosis and treatment of asthma
- <http://www.nhlbi.nih.gov/guidelines/asthma/asthgdln.htm>



## **Common Acute Pediatric Illnesses: Fever, Case #1**

Written by April Buchanan, M.D.

A two-week-old presents with a fever of 101° F. She has been feeding a little less than normal and there has been no vomiting or diarrhea. Her physical exam is normal. What makes this patient concerning and why? How would you evaluate and manage this patient?

### **Definition for specific terms:**

**Fever**- Fever is a temperature >100.4; a rectal temperature is preferred in infants since it best represents a core temperature

### **Review of Important Concepts:**

1. Neonates with fever: What are the age cut-offs we use for fully evaluating serious bacterial infections? What are the clinical signs that may be associated with a serious bacterial infection?
2. Can a low temperature be cause for concern?  
All infants under 8 weeks (56 days) are fully evaluated for serious bacterial infections with temps >100.4°F or 38°C. Infants may exhibit poor feeding, decreased urination, fussiness, lethargy, diarrhea, or may only have fever and otherwise appear fairly well. Even with focal signs, infants with fever undergo a full evaluation. Some infants with serious bacterial infection present with hypothermia, usually defined as a rectal temperature below 97°F or 36.5°C.
3. Serious bacterial infections: Assess that the student knows the major types of serious bacterial infections for which infants undergo evaluation including sepsis, urinary tract infection, meningitis, and pneumonia. The student may also mention herpes simplex virus as causing a serious illness or bacterial gastroenteritis.

### **Clinical Reasoning**

1. How would you evaluate this infant for a serious bacterial infection?
  - a. It is necessary to obtain a CBC with differential, blood culture, urinalysis and culture (by catheterization or suprapubic tap), and cerebrospinal fluid studies including gram stain and culture, cell count, and differential, glucose, protein, and consideration of HSV PCR, enterovirus PCR, and fluid to hold.
  - b. A CXR is also recommended by the Philadelphia criteria (see below) and should definitely be done in the setting of respiratory illness such as cough, tachypnea, abnormal findings on auscultation, or hypoxia.
  - c. A stool culture is indicated for those infants with diarrhea.
2. What are the most common pathogens in a patient this age?
  - a. GBS
  - b. E. coli
  - c. Listeria
3. Does this patient need to be hospitalized?

This patient needs to be hospitalized, as do all infants with fever under the age of 28 days. Infants 29 – 56 days can be evaluated using Philadelphia criteria or other references to determine the need for hospitalization.

4. Would you treat this patient with antibiotics and if so, for how long?
  - a. This patient should be started on Ampicillin and Gentamicin or Ampicillin and Cefotaxime to cover the pathogens listed above.
  - b. If HSV is suspected, acyclovir should be started.
  - c. Antibiotics should be continued until the urine, blood, and CSF cultures are negative at 48 hours.
  - d. Acyclovir should be continued until the HSV PCR is confirmed to be negative.
  - e. If a culture is positive, the infant will need to be treated for a longer period of time and the antibiotic used is based on sensitivities from the culture.

#### **Suggestions for Learning Activities:**

- Review specific laboratory findings and have the student determine if an infant aged 6 weeks with fever of 101 is low risk utilizing the Philadelphia criteria (or the criteria used at your hospital i.e. Boston or Rochester)
- Practice writing admission orders for the 2 wk infant in this scenario using a weight of 4 kg.
- Role play – have the students explain to you as the “parent” what the concerns are for this patient and the necessary evaluation. Specifically, ask questions about why a lumbar puncture is necessary and how it is done.

#### **Other Resources:**

- Shah, SS, Alpern ER Fever, In: Zaoutis LB, Chiang V (eds) Comprehensive Pediatric Hospital Medicine, Philadelphia: Elsevier Publishing 2007
- See Comparison of Protocols to Identify Febrile Infants with Low Risk of Serious Bacterial Infection

**Common Pediatric Acute Illnesses: Fever, Case #2**

Written by April Buchanan, M.D.

A seven-month-old girl presents to your office with a one day history of fever to 103° F, mild irritability, and poor feeding. The physical exam is normal without any localizing findings. What are your concerns? How would you evaluate and manage this patient?

**Review of Important Concepts:**

1. Infants with fever:  
What are the clinical signs that may be associated with a serious bacterial infection?
  - a. fever
  - b. poor feeding
  - c. decreased urination
  - d. fussiness without consolability
  - e. lethargy
  - f. may only have fever and otherwise appear fairly well
2. Serious bacterial infections:
  - a. pneumonia
  - b. sepsis
  - c. meningitis
  - d. urinary tract infection

**Clinical Reasoning**

1. What is on your differential for this patient:
  - a. The patient could have a serious bacterial infection such as pneumonia, sepsis, meningitis, or a urinary tract infection.
  - b. The patient could also have a viral illness (i.e. influenza, adenovirus, enterovirus, etc.)
  - c. The student may also mention otitis media, tonsillitis, osteomyelitis, septic arthritis, etc.
  - d. You may ask them what they would expect to find on physical exam with these infections.
2. What questions would be important to ask the caregiver of this infant?
  - a. The student should ask about the response to antipyretics and the appearance and energy level of the child when the fever is down.
  - b. The amount of po intake should be quantified in addition to the number of wet diapers.
  - c. It would also be important to ask about sick family members or daycare exposure.
3. How would you evaluate this infant?
  - a. It is important to carefully examine the infant for any physical findings that may be associated with a viral illness or provide a source for the fever.
  - b. Since this infant has a normal exam without localizing findings, a urinalysis and culture (by catheterization or suprapubic tap) should be performed given the degree of fever.
  - c. A CBC with differential and blood culture should also be considered, especially in an ill appearing infant without obvious symptoms.

- d. A CXR should be considered in the setting of respiratory illness such as cough, tachypnea, abnormal findings on auscultation, or hypoxia.
  - e. If there are meningeal signs, extreme fussiness or irritability, or lethargy, cerebrospinal fluid studies including gram stain and culture, cell count and differential, glucose, and protein should be performed. If these signs are present, you may actually want to perform a head CT prior to LP to rule-out increased intracranial pressure.
4. How can you distinguish a viral from a bacterial process?  
Distinguishing a viral from a bacterial process can be challenging. Consider viral process if sick contacts and lab work is reassuring or with the presence of upper respiratory symptoms or rash.
  5. Does this patient need to be hospitalized?
    - a. This patient needs to be examined carefully and followed up with specific instructions to the family on when to call.
    - b. If there is evidence of sepsis, UTI, or pneumonia, depending on the severity of the child, inpatient or outpatient treatment can be considered.
  6. Would you treat this patient with antibiotics and if so, for how long?
    - a. If the CBC, UA, CXR, and CSF (if performed) are not concerning for a SBI, antibiotics are not indicated. This patient could certainly have a viral process.
    - b. If the infant is moderately ill-appearing and the UA or CBC are concerning, ceftriaxone can be given with 24 hour follow-up.
  7. What instructions would you give this family of "when to call"?  
Most "viral" fevers peak at 3 days, and resolve by 5 days. Viruses will usually declare themselves with symptoms within this time frame, although patients occasionally resolve the fever without development of systemic symptoms. Close phone follow up is necessary as well as follow-up on any cultures. Parents should call with persistent fever, decreased urination, decreased oral intake, lethargy, or other concerns of changing mental status.

### **Suggestions for Learning Activities:**

- Ask the student to explain the various methods of obtaining urine from children. Discuss the colony counts suggested to determine if the patient indeed has a UTI.
- (suprapubic tap  $\geq 1,000$  cfus of a single species, cath  $\geq 10,000$  cfus, clean catch  $\geq 100,000$  cfus)
- Have the student review the dosage forms and intervals for acetaminophen and ibuprofen. Specifically, make sure the differences in infant and children's concentrations are discussed.

### **Other Resources:**

- Trainor JL; Stamos JK. "Fever without a localizing source." [Pediatric Annals](#) 2011 Jan; Vol. 40 (1), pp. 21-5.

## **Common Acute Pediatric Illness: Fever, Case #5**

Written by Becky Latch, M.D.

A seven-year-old girl presents to your office with a history of two days of cough, coryza, conjunctivitis and a fever to 103° F. Today she developed a red maculopapular rash that started on her face and neck and it is spreading caudally. What are your concerns? How would you evaluate and manage this patient?

### **Definitions for Specific Terms:**

**Coryza**- inflammation of the mucous membranes in the nose and associated rhinorrhea

**Conjunctivitis**- inflammation of the outermost layer of the eye and the inner surface of the eyelid

**Maculopapular rash**- a rash with both macular (flat discolored areas of skin) and papular (small, raised bumps) components. Typically a large area that is discolored (erythematous or red) and has small bumps that are occasionally confluent.

**Caudal**- inferior or below another structure. A rash that spreads caudally starts at the head and spreads downward.

### **Review of Important Concepts:**

#### **Historical Points**

- Why is the description of the rash important?
  - Many infectious diseases can be identified by the appearance and/or timing of the rash. The description of a maculopapular rash that spreads caudally is typical of measles.
- What preventative care should this child have received?
- Verifying a child's immunization status is an important component of each physician encounter. As this child has a history consistent with measles, it is specifically important in this case.
- In addition, a detailed travel history and exposure history should be obtained. Measles is a reportable disease and health department officials will ensure that all unimmunized or immunosuppressed contacts are appropriately treated and/or isolated.
- What are associated symptoms that this patient may have?
  - Patients frequently complain of photophobia and myalgias. In addition, encephalitis occurs in 1 to 2 per 1000 measles cases.

#### **Physical Exam Findings**

1. Koplik spots: 1-3 mm gray-white spots with a red halo surrounding appearing on the buccal mucosa opposite of the lower molars. Koplik spots are pathognomonic for measles but do not occur in every patient.
2. Conjunctivitis: Patients with measles will have erythematous and inflamed conjunctiva. Examination of the eye may also reveal a characteristic transverse line of inflammation along and inferior to the eyelid margin called Stimson line.

3. Rash: The measles rash is an erythematous maculopapular rash that starts at the hairline or forehead and moves downward over most of the body within 24 hours. The rash frequently coalesces and becomes confluent on the face and trunk. Once the rash appears, other symptoms typically begin to improve.
4. Patients may also present with cervical lymphadenopathy, splenomegaly, and abdominal pain secondary to mesenteric lymphadenitis.

### **Clinical Reasoning**

1. Differential diagnosis for this patient includes measles, roseola, rubella, parvovirus or Fifth Disease, and other viral exanthems.
2. This patient description is consistent with measles.
  - a. The “3 C’s” of cough, coryza and conjunctivitis should immediately prompt one to consider measles in the diagnosis.
  - b. In addition, the rash that spreads from the forehead down is very consistent with measles.
3. Measles is an RNA paramyxovirus. The virus is present in respiratory secretions and is transmitted by large droplets from the respiratory tract.
4. It is important to consider any contacts the patient has had with unimmunized or immune compromised patients. Infected patients are contagious from one to two days before onset of symptoms to four days after the appearance of the rash.
5. Common sequela of measles include otitis media, pneumonia and encephalitis. In developing countries, other complications include malnutrition and blindness.

### **Diagnosis:**

Measles (also called Rubeola) can be confirmed with measles serology, viral culture, or PCR. Leukopenia is a characteristic laboratory finding and may assist with diagnosis.

### **Suggestions for Learning Activities:**

- Review recommended immunizations for a 7yo child.
- Discuss the importance of the measles vaccine in limiting the number of patients with measles encephalitis and its complications.
- Discuss treatment of measles in underdeveloped countries and need for Vitamin A supplementation.

### **Other Resources:**

- AAP Red Book: 2009 Report of the Committee on Infectious Diseases.
- Centers for Disease Control: Photos of patients with measles.  
<http://www.cdc.gov/measles/about/photos.html>

- Measles Initiative: Information on how measles affects vision.
- <http://www.measlesinitiative.org/mi-files/Reports/Measles%20&%20Immunization/Measles/ChildMeaslesEyeENG300.pdf>

## **Common Acute Pediatric Illness: Sore Throat, Case # 1**

Written by Maria Marquez, M.D.

A six-year-old boy presents with a fever, headache, sore throat, and raised, rough, red rash on his trunk and abdomen. There are no symptoms of a URI. What is the most likely diagnosis? How would you evaluate and manage your patient?

### **Definitions for Specific Terms:**

**Fever**- Rectal temperature more than 100.4 F or more than 38 degree C. Oral temperature above 100 degree F (37.2 C). Axillary, forehead and ear temperature measurements are easier to obtain, but they are less accurate and may be confirmed rectally or orally as needed. There are pros and cons of treating fever. Fever may play a role in fighting infection, but it can also make a child uncomfortable. The height of a child's fever is not always the best indicator of whether the child needs to be treated and/or evaluated. Instead it is important to individualize your patient presentation and note how child behaves and appears.

**Pharyngitis**- Inflammation of the throat and/or pharynx. It mostly causes pain.

### **Review of Important Concepts:**

After discussing this question the student should be able to:

1. Distinguish history and physical exam findings that help differentiate between viral and group A streptococcal (GAS) pharyngitis
2. Describe diagnostic testing available for GAS pharyngitis
3. Identify antibiotic treatment regimens for GAS pharyngitis
4. Discuss suppurative and non-suppurative complications of GAS pharyngitis

### **Historical Points**

- Illness time course: Symptoms caused by viral pharyngitis (except CMV and EBV) as well as GAS pharyngitis resolve within 2-5 days. A more prolonged time course is suggestive of infectious mononucleosis or a secondary pharyngitis caused by sinusitis and post-nasal drainage.
- Sick contacts: always helpful with infectious diseases!
- Immunization status: Diphtheria could be an extremely rare cause of pharyngitis. H.flu could cause epiglottitis. Measles could cause pharyngitis and a rash.
- Review of systems:
  - nausea, emesis, abdominal pain→ think about GAS
  - severe fatigue→think about infectious mononucleosis
  - associated cough, shortness of breath→think about mycoplasma
- Therapies attempted at home: Antipyretics attempted at home would affect the child's temperature and degree of discomfort in the office



- Possible further Details: HPI Two days ago he started to complain to his mom that his throat was sore and that he had some difficulty swallowing because of pain. The fever began yesterday and was initially responsive to acetaminophen, however the temperature up to 102 degrees taken orally, returns four hours after the medication was taken. He has been drinking appropriate amount of fluids, but he is not eating as usual. The last dose of acetaminophen was four hours before coming to the clinic. This morning the patient complained of headache and mild abdominal pain while having breakfast, no nausea, vomiting or diarrhea. Mom says the whole family has had a cold recently, but the patient has no associated cough, runny nose, earache, sneezing or red eyes.
- PMH: He's been healthy; immunizations are up to date, no surgeries or hospitalizations.
- Family history: No history of immunodeficiencies
- Social history: there is a cat and a dog at home. No smokers. In 1st grade

### Physical Exam Findings

1. Vital signs: T 103.2 (Taken Orally) HR 110 RR 26 BP 95/65. Weight and height are at the 50th percentile. Ill appearing but nontoxic.
2. Nasal exam, no nasal discharge or congestion. External ear canal normal, TM mobile bilateral, eyes no red or discharge.
  - Post-nasal drainage→think about upper respiratory infection or sinusitis with post-nasal drainage and secondary pharyngitis
3. Hydration status: mild to moderate dehydration with dry oral mucosa.
  - Oral vesicular lesions or ulcers→think about enterovirus or HSV
4. Other mucosal →mild erythema with papillitis of the tongue (strawberry tongue).
  - Strawberry tongue→think about GAS
5. Thick pharyngeal membrane in unimmunized child→ think about diphtheria
6. Tonsils are enlarged with erythema and white exudates, petechiae are present on the soft palate.
  - Uvula deviation or asymmetric tonsils→think about peritonsillar abscess
7. There was a 1.5 cm submandibular node mobile, tender, and soft on the right.
  - Cervical posterior lymphadenopathy (in contrast to anterior) →think about infectious mononucleosis
8. On the skin the patient has a generalized rash, fine papular rash (1mm) on extensor areas of the arms, chest, abdomen, and back; sparing neck and face. On palpation, the rash has a sand paper feel and it blanches.
  - Fine “sandpaper” rash →think about GAS Scarlet fever: diffuse erythematous eruption that occurs with pharyngitis and it is as a result of delayed-type skin reactivity to the pyrogenic exotoxin produced by the organism.
9. Heart and lungs sounded fine and abdomen was soft.
  - Enlarged spleen→think about infectious mononucleosis

## Clinical Reasoning

Initial broad differential diagnosis of infectious pharyngitis

1. Viral (most common)
  - a. Think about both primary infection of the pharynx as well as secondary pharyngitis caused by post-nasal drainage, cough, and mouth breathing
  - b. EBV, CMV, adenovirus, HSV, influenza, enterovirus, primary HIV infection, RSV, rhinovirus, parainfluenza, metapneumovirus, measles
2. Bacterial
  - a. Group A Streptococcus (GAS) 20- 30% GAS is the most common cause of bacterial pharyngitis in children and adolescents. In temperate climates, the incidence is highest in the winter and early spring. It is estimated that the economic burden of streptococcal pharyngitis among children in the United States is at 224 million to 529 million per year, including the associated costs attributable to parents' lost time from works. Streptococcal pharyngeal infection not only causes acute illness but also can cause post-infectious disease such as rheumatic fever.
  - b. Mycoplasma pneumoniae: 5-16%
  - c. Neisseria gonorrhea: rare, but consider in adolescents who engage in oral sex
  - d. Other rare bacterial causes: other streptococci, Arcanobacterium hemolyticum, Corynebacterium diphtheriae

## Narrowing the Differential Diagnosis

- The information provided in the question: school aged child with fever, pharyngitis, headache, and a rash are pointing towards group A strep pharyngitis with scarlet fever.
- The possible further details provided in the scenario (palatal petechiae, enlarged submandibular lymph node, and abdominal pain) all also point towards strep pharyngitis.
- Lack of associated upper respiratory symptoms makes viral pharyngitis less likely.
- The presence of a fine papular rash that spares the neck and face with pharyngitis suggests scarlet fever.
- Infectious mononucleosis is possible, but less likely given no associated posterior cervical lymphadenopathy or splenomegaly.
- Additional Testing: There is a rapid test identifying GAS antigen in 5 minutes. This test is very specific (greater than 95%) so if positive the patient receives antibiotic. The sensitivity of the test is 80% thus if negative it is recommended that a culture be sent to confirm the results or determine if strep is present. The culture is the gold standard for the diagnosis of strep.

## Patient Management:

1. Streptococcal pharyngitis is self-limited disease most of the times. Without treatment, strep pharyngitis is associated with persistent positive cultures for up to 6 weeks in 50% of the patients. If patients are treated with antibiotics, this results in a negative throat cultures within 24 hours in more than 80% of the patients.
2. If Strep is isolated the patient should receive penicillin as there is still low resistance to this narrow spectrum antibiotic. Recovery is generally within 12-24 hours after initiating therapy. The primary benefit of the treatment is the prevention of rheumatic fever, which is almost completely successful

if antibiotic is initiated within 9 days of illness. Also, antimicrobial therapy reduces the incidence of developing a suppurative complication like a peritonsillar abscess. If allergy to penicillin is documented, erythromycin is the drug of choice. GAS should be treated for 10 days.

3. Symptomatic pharyngitis management includes: oral antipyretic/analgesic agent, gargling with warm salt water, anesthetic sprays, and lozenges may provide local relieve.

### **Diagnosis:**

Group A Streptococcal Pharyngitis with Scarlet Fever

### **Suggestions for Learning Activities:**

- Ask the student(s) the questions listed under “clinical reasoning” to probe their thinking about the case. One way of starting out is to ask the students to think about all the various causes of pharyngitis and writing them out on the board. Then use the history, physical exam, +/- labs to narrow the differential and come up with the most likely and then the final diagnosis.
- Some additional clinical questions:
  - What if this was an unimmunized child with a negative rapid strep test?
  - If your patient with pharyngitis had a negative rapid strep test and was sent home without antimicrobials, what would you tell the patient and parents to expect?
  - If your patient had pharyngitis described above and you don’t treat with antimicrobials, what are the possible complications expected?
  - Is it possible that your patient will return with blood in the urine, and high blood pressure? Why?
  - Is it possible that your patient will return with a migratory polyarthritits, new heart murmur, jerky movements, subcutaneous nodules and/or a different generalized rash like pink rings on the trunk and limbs? Why?
  - What are other manifestations of scarlatina rash?
- Other potential activities:
  - Team base learning
  - Concept mapping activities
  - Find historical associations with GAS infections and complication? Little women, W Amadeus Mozart?

### **Other Resources:**

- Kliegman, et al. Nelson Textbooks of Pediatrics. pp1752
- Wessel, M Streptococcal Pharyngitis NEJM 2011;2;364:7 pp648
- Bisno AL Practice guidelines for the diagnosis and management of group A streptococcal pharyngitis. Clin Inft Dis 2002; 35:pp113
- Gerber MA Diagnosis and treatment of pharyngitis in children. Pedtr Clin North Am 2005;52:pp729
- Pickering, LK Group A streptococcal infections. Red Book AAP 2009 pp616
- McIsaac WJ Empirical validation of guidelines for the management of pharyngitis in children and adults JAMA 2004; 291:pp1587

- Pfof E Burden and economic cost of Group A streptococcal pharyngitis. Pediatrics 2008; 121:pp229-34
- Ebel MH The rational of clinical examination: Does this patient have Strep Throat? [JAMA](#). 2000 Dec 13;284(22):pp2912-8

## **Common Acute Pediatric Illness: Sore Throat, Case 2**

Written by Danae Goerl, M.D. and Marta King, M.D.

A nine-year-old presents with a sore throat and fever of 101° F. He has a cough and runny nose. There are small minimally tender anterior cervical lymph nodes and a red pharynx without exudate. What is your differential diagnosis? How would you evaluate and manage this patient?

### **Definitions for Specific Terms:**

**Pharyngitis**- Inflammation of the pharynx usually associated with a painful sensation. If the inflammation includes tonsils, it is called pharyngotonsillitis

**Exudate**- Fluid made of cells and proteins in an area of inflammation

**Anterior cervical lymph nodes**- The chain of lymph nodes that lies above and beneath the [sternocleidomastoid](#) muscles

### **Review of Important Concepts:**

After discussing this question the student will be able to:

- identify the common causes of pharyngitis and understand how history and physical exam findings can be used to narrow the differential diagnosis
- distinguish history and physical exam findings that help differentiate between viral and group A streptococcal (GAS) pharyngitis
- compare the different mechanisms by which respiratory viruses cause pharyngitis: primary infection vs secondary pharyngitis
- describe symptomatic treatment of viral pharyngitis

### **Historical Points**

- Illness time course: symptoms caused by viral pharyngitis (except CMV and EBV) as well as GAS pharyngitis resolve within 2-5 days. A more prolonged time course is suggestive of infectious mononucleosis or secondary pharyngitis caused by sinusitis and post-nasal drainage.
- Sick contacts: always helpful with infectious diseases!
- Immunization status: Measles and diphtheria would be extremely rare causes of pharyngitis. Hemophilus influenzae type B could cause epiglottitis
- Review of systems:
  - severe fatigue→think about infectious mononucleosis
  - nausea, emesis, abdominal pain→ think about GAS
  - associated cough, shortness of breath→think about Mycoplasma

### **Physical Exam Findings**

1. Vital signs and general appearance: patient who is ill appearing, drooling, or stridulous →think about upper airway obstruction, epiglottitis, tracheitis, peritonsillar abscess.

2. Nasal congestion, post-nasal drainage→think about upper respiratory infection or sinusitis with post-nasal drainage and secondary pharyngitis.
3. Oral vesicular lesions or ulcers→think about enterovirus or HSV.
4. Thick pharyngeal membrane in unimmunized child→ think about diphtheria.
5. Uvula deviation or asymmetric tonsils→think about peritonsillar abscess.
6. Posterior lymphadenopathy (in contrast to anterior) →think about infectious mononucleosis.
7. Fine “sandpaper” rash →think about GAS .

### Clinical Reasoning

Initial broad differential diagnosis of infectious pharyngitis

1. Viral (most common)
  - a. Think about both primary infection of the pharynx as well as secondary pharyngitis caused by post-nasal drainage, cough, and mouth breathing
  - b. EBV, CMV, adenovirus, HSV, influenza, enterovirus, primary HIV infection, RSV, rhinovirus, parainfluenza, metapneumovirus, measles
2. Bacterial
  - a. Group A Streptococcus (GAS) 15- 30%
  - b. Mycoplasma pneumoniae: 5-16%
  - c. Neisseria gonorrhea: rare, but consider in adolescents who engage in oral sex
  - d. Other rare bacterial causes: other streptococci, Arcanobacterium hemolyticum, Corynebacterium diphtheriae

### Narrowing the Differential Diagnosis

1. Historic and physical exam findings typically associated with GAS
  - a. Age (5 to 15 years)
  - b. Season (late fall, winter, early spring)
  - c. Middle-grade fever (between 101 and 103°F)
  - d. Evidence of acute pharyngitis (erythema, edema, and/or exudates)
  - e. Tender, enlarged (>1 cm) anterior cervical lymph nodes
  - f. Absence of usual signs and symptoms associated with viral upper respiratory tract infections
  - g. Fine “sandpaper” rash
2. The information provided in the question: low grade fever, cough, runny nose, and minimally tender anterior cervical lymph nodes are pointing us towards viral pharyngitis. The presence of cough and runny nose make GAS pharyngitis unlikely. You could consider GAS testing, however, if there are other suggestive historic or physical exam findings: sick contact with strep throat, “sandpaper” rash, or if the runny nose and cough could be attributed to coinciding seasonal allergies.

### 3. Additional testing

There are laboratory tests available for a number of pharyngitis causes: group A Streptococcus, gonorrhea, Mycoplasma, EBV, CMV, HSV, enterovirus, influenza, parainfluenza, RSV, rhinovirus, human metapneumovirus, adenovirus, HIV. In addition, we could also potentially get a CXR to evaluate for pneumonia, CT to look for sinusitis or peritonsillar abscess. Students and preceptor should work through what (if any) testing is needed in this specific case.

4. If the students feel the story is consistent with viral pharyngitis, would additional testing change their management in any way?
5. If after the history and physical exam, GAS remains high on the differential, sending a rapid strep would be reasonable as it would change patient management. Identifying and treating GAS pharyngitis could both reduce the duration of symptoms and prevent rheumatic fever as well as the suppurative complications of GAS pharyngitis.

### Patient Management

1. Respiratory infections are spread via droplets →pt should wash her hands frequently, cover her mouth when coughing, avoid sharing utensils, toothbrushes, etc.
2. Counsel the family regarding natural course of viral pharyngitis (as well as GAS pharyngitis): symptom resolution within 2-5 days.
3. Treatment: Antibiotic therapy indicated for GAS: Penicillins are first line therapy. If penicillin allergy, consider cephalosporin (unless severe PCN allergy), macrolides, or clindamycin
4. Symptomatic management:
  - a. Systemic analgesics, including acetaminophen or ibuprofen. Aspirin should be avoided in children due to risk for Reye syndrome.
  - b. Oral rinse composed of lidocaine, diphenhydramine and Maalox may be helpful. Sprays or lozenges may be attempted as well.
  - c. Could also consider cold beverages

### Diagnosis:

Viral Pharyngitis

### Suggestions for Learning Activities:

- Ask the student(s) the questions listed under “clinical reasoning” to probe their thinking about the case. One way of starting out is to ask the students to think about all the various causes of pharyngitis and writing them out on the board. Then use the history, physical exam, +/- labs to narrow the differential and come up with the most likely and then the final diagnosis
- Ask students what they would do if this patient’s symptoms were not getting any better in 5d? Reconsider your diagnosis: think about bacterial sinusitis with post-nasal drainage causing pharyngitis, about EBV/CMV infection, or about pharyngitis complications such as a peritonsillar abscess

- What if the patient was placed on amoxicillin due to a positive rapid strep test and then developed a rash? Students should think about PCN allergy as well as about the alternative diagnosis of infectious mononucleosis: many kids (some estimate ~80%) with infectious mononucleosis will develop a rash with amoxicillin.
- Some additional clinical questions
  - Review the most common antibiotics prescribed for GAS pharyngitis and their mechanism of action
  - Assign students one complication of GAS pharyngitis each and have them present a 5 min brief overview for the whole group
  - Assign students to critically appraise the literature regarding the role of various therapies in the management of viral respiratory infections: a) vitamin C b) Zn c) decongestants d) antihistamines e) echinacea f) honey g) any other therapies students might have heard about or experienced

**Other Resources:**

- Acute Pharyngitis: Etiology and Diagnosis: Alan L. Bisno, Pediatrics 1996; 97:6 949-954
- Clinical Otolaryngology Online: <http://www.entnet.org/EducationAndResearch/COOL.cfm>. This site is available through the American College of Otolaryngology and Head and Neck Surgery. It contains interactive peer-reviewed cases of patients presenting with common otolaryngologic problems, including pharyngitis



### **Common Acute Pediatric Illness: Sore Throat, Case #3**

Written by Marta King, M.D.

A fourteen-year-old female presents with fever, headache and sore throat. She has exudates on her tonsils, an erythematous posterior pharynx, enlarged posterior cervical lymph nodes and a palpable spleen. What is your most likely diagnosis? How would you manage this patient?

#### **Definitions for Specific Terms:**

**Pharyngitis**- inflammation of the pharynx usually associated with a painful sensation. If the inflammation includes tonsils, it is called pharyngotonsillitis

**Exudate**- fluid made of cells and proteins in an area of inflammation. (Ensure that students are able to differentiate tonsillar exudates from tonsillar crypt debris.)

**Posterior cervical lymph nodes**- chain of lymph nodes that extends in a line posterior to the sternocleidomastoids but in front of the [trapezius](#)

**Splenomegaly**- enlarged spleen. Spleen edge >2cm below the costal margin is abnormal. Spleen tip can be palpated below the left costal margin in normal healthy individuals: 1/3 of neonates, 1/10 of children, and 1/50 adolescents.

#### **Review of Important Concepts:**

After discussing this question the student will be able to:

- list the common causes of infectious pharyngitis and understand how history and physical exam findings can be used to narrow the differential diagnosis
- understand the utility of laboratory studies (especially rapid strep, throat culture, Monospot, EBV titers) in infectious pharyngitis evaluation
- describe the natural course of infectious pharyngitis
- identify of potential complications of infectious mononucleosis and of group A streptococcal pharyngitis

#### **Historical Points**

- Illness time course: symptoms caused by viral pharyngitis (except CMV and EBV) as well as GAS pharyngitis resolve within 2-5 days. A more prolonged time course is suggestive of infectious mononucleosis or secondary pharyngitis caused by sinusitis and post-nasal drainage.
- Sick contacts: always helpful with infectious diseases!
- Immunization status: Measles and diphtheria would be extremely rare causes of pharyngitis. H.flu could cause epiglottitis.
- Review of systems:
  - severe fatigue→think about infectious mononucleosis

- nausea, emesis, abdominal pain→ think about GAS
- associated cough, shortness of breath→think about mycoplasma
- Sexual history including specific questions about oral sex: It's important to interview adolescent patients without parents present for part of the visit. A boyfriend with recent diagnosis of gonorrhea would drastically change our differential and treatment plan! Also acute HIV infection could also presents with fever, pharyngitis and lymphadenopathy. And we won't know unless we ask.

### Physical Exam Findings

1. Vital signs and general appearance: A patient who is very febrile, ill appearing, hypotensive would make you wonder about rare and serious complications of pharyngitis such as internal jugular vein suppurative thrombophlebitis (Lemierre's syndrome), or peritonsillar abscess
2. Nasal congestion, post-nasal drainage→think about upper respiratory infection or sinusitis with post-nasal drainage and secondary pharyngitis
3. Oral vesicular lesions or ulcers→think about enterovirus or HSV
4. Strawberry tongue, other mucosal →think about Group A strep
5. Thick pharyngeal membrane in unimmunized child→ think about diphtheria
6. Uvula deviation or asymmetric tonsils→think about peritonsillar abscess
7. Posterior lymphadenopathy (in contrast to anterior) →think about infectious mononucleosis
8. Fine “sandpaper” rash →think about Group A strep
9. Enlarged spleen →think about infectious mononucleosis more likely. Keep in mind, however that the spleen can be palpated below the left costal margin in normal healthy individuals: 1/3 of neonates, 1/10 of children, and 1/50 adolescents. Spleen edge >2 cm below the costal margin is abnormal. So on physical exam ascertain how enlarged the spleen really is. Has it ever been noted to be enlarged before?

### Clinical Reasoning

Initial broad differential diagnosis of infectious pharyngitis

1. Viral (most common)
  - a. Think about both primary infection of the pharynx as well as secondary pharyngitis caused by post-nasal drainage, cough, and mouth breathing
  - b. EBV, CMV, adenovirus, HSV, influenza, enterovirus, primary HIV infection, RSV, rhinovirus, parainfluenza, metapneumovirus, measles
2. Bacterial
  - a. Group A Streptococcus (GAS) 15- 30%

- b. *Mycoplasma pneumoniae*: 5-16%
- c. *Neisseria gonorrhea*: rare, but consider in adolescents who engage in oral sex
- d. Other rare bacterial causes: other streptococci, *Arcanobacterium hemolyticum*, *Corynebacterium diphtheriae*

### **Narrowing the Differential Diagnosis:**

1. The information provided in the question: teenager, pharyngitis, posterior cervical lymphadenopathy, enlarged spleen are pointing us towards infectious mononucleosis. Are there any other diagnoses on the list that might be less likely, but that the physician would not want to miss? Missing strep pharyngitis could lead to both suppurative (cervical lymphadenitis, peritonsillar or retropharyngeal abscess, otitis media, mastoiditis, internal jugular vein suppurative thrombophlebitis) and nonsuppurative (acute rheumatic fever) complications.
2. Additional testing  
There are laboratory tests available for a number of pharyngitis causes: group A strep, gonorrhea, mycoplasma, EBV, CMV, HSV, enterovirus, influenza, parainfluenza, RSV, rhinovirus, human metapneumovirus, adenovirus, HIV. In addition, we could also potentially get a CXR to evaluate for pneumonia, CT to look for sinusitis, peritonsillar abscess, Lemierre's disease (internal jugular vein septic thrombophlebitis). Students and preceptor should work through what (if any) testing is needed in this specific case. If after the history and physical exam, GAS remains high on the differential, sending a rapid strep would be reasonable as it would change patient management. If the students feel the story is consistent with viral pharyngitis, would additional testing change their management in any way?

### **Patient Management:**

1. Counsel the family regarding natural course of infectious mononucleosis. Most acute symptoms resolve in 1-2w, but spleen enlargement and fatigue and poor functional status can persist for months
2. Mono is spread via saliva → pt should avoid kissing, sharing utensils, toothbrushes, etc.
3. avoid contact sports while the spleen is enlarged in order to avoid splenic laceration/rupture
4. Supportive care: understanding that fatigue is part of the disease process and taking things easy, getting plenty of sleep, taking acetaminophen and ibuprofen as needed for fever and throat pain.
5. Reasons to seek medical care:
  - a. Severe throat pain: rarely would mono require prescription pain medications
  - b. Dehydration: rarely can pain be severe enough to cause inability to take fluids
  - c. Airway obstruction: rarely tonsils can become enlarged enough to obstruct the airway
  - d. Abdominal trauma, sharp abdominal pain: concern about splenic laceration

### **Diagnosis:**

Infectious Mononucleosis

### Suggestions for Learning Activities:

- Ask the student(s) the questions listed under “clinical reasoning” to probe their thinking about the case. One way of starting out is to ask the students to think about all the various causes of pharyngitis and writing them out on the board. Then use the history, physical exam, +/- labs to narrow the differential and come up with the most likely and then the final diagnosis
- Some additional clinical questions
  - What if the patient told you she has had difficulties swallowing because of the pain? How would students assess level of dehydration? How would they manage dehydration?
  - What if when interviewing the patient alone she admitted to having had both vaginal and oral sex with her boyfriend? How about if the boyfriend was 24-years old?
  - What if the patient had new onset snoring/respiratory pauses at night, daytime fatigue?
- Other potential activities
  - Tonsil “grading.” Bring a light and look at tonsils of the students in the group. Bring some photos of larger tonsils (since the students will likely fall into the 0-2 range)

Grade	Size
0	Absent
1	In the tonsillar fossae (between pillars)
2	Outside tonsillar fossae
3	Occupying >75% of posterior pharynx
4	“Kissing” in the midline

- Examining the spleen. Demonstrate the proper technique on a student volunteer. If you have access to a newborn nursery, examine babies as it is likely at least one will have a palpable spleen.
  - Examining the lymph nodes: – ensure the student knows the location of the posterior chain and how to palpate lymph nodes
- Assign students to critically appraise the literature regarding a) the role of steroids in infectious mononucleosis management b) recommendations regarding tonsillectomy in infectious mononucleosis causing airway obstruction c) the role of laboratory studies (cbc with differential, monospot, EBV titers, CMV titers) in the diagnosis of infectious mononucleosis.

### Other Resources:

- Review of infectious mononucleosis. Bravender, T., Epstein-Barr virus, cytomegalovirus, and infectious mononucleosis. Adolesc Med State Art Rev. 21(2): p. 251-64, ix.
- Clinical Otolaryngology Online: <http://www.entnet.org/EducationAndResearch/COOL.cfm>. This site is available through the American College of Otolaryngology and Head and Neck Surgery. It contains interactive peer-reviewed cases of patients presenting with common otolaryngologic problems, including pharyngitis

## **Common Acute Pediatric Illnesses: Otolgia, Case #2**

Written by Aly Spinner, M.D. and Edward Clark, M.D.

A fifteen-month-old was treated for acute otitis media three weeks ago. Today, both tympanic membranes look dull, gray, and have poor mobility. The parents are concerned about his hearing. How would you manage this patient? What if these findings were still present four months later?

### **Definitions for Specific Terms:**

**Acute Otitis Media (AOM)**- Characterized by otalgia (ear pain) and fever, often accompanied by symptoms of an upper respiratory tract infection (URI). Etiology may be viral or bacterial in origin. Viral AOM is often symptomatic, but can lead to bacterial infection that is typically associated with an erythematous, opaque, poorly mobile and bulging tympanic membrane (TM), leading to TM rupture, infection of the mastoids (mastoiditis), or rarely meningitis.

**Otitis Media with Effusion**- Fluid collection in the middle ear space due to negative pressure that occurs with a blocked or poorly functional Eustachian tube. Although not an ongoing infection, the fluid may serve as a nidus for bacterial infection. The presence of fluid may also cause a temporary decrease in hearing. May resolve without surgical drainage, or lead to chronic, thick, glue-like fluid.

**Otitis Externa**- (External otitis or “Swimmer’s Ear” is also characterized by otalgia, but the location of the infection is the outer ear and ear canal. Risk factors for otitis externa include any physical insult or abrasion of the outer ear canal (from cotton swabs or fingernails, for example) and prolonged exposure to water. The ear may be exquisitely tender to the touch. Common pathogens include *Pseudomonas aeruginosa* and *Staphylococcus aureus*.

**Pressure Equalization Tubes (PE)**- (Also called tympanostomy tubes) Small plastic tubes that are placed in the TM under conscious sedation via a small incision (myringotomy). This allows for equalization of pressure in the middle ear while the Eustachian tubes fully develop. Tubes usually fall out on their own between 6 months and 3 years after placement.

**Pneumatic Otoscopy**- A rubber bulb is attached to the otoscope and inserted into the ear canal with the speculum fitting snugly in the canal. The bulb is then gently squeezed and released in rapid succession to visualize the degree of mobility of the TM.

### **Review of Important Concepts**

#### **Historical Points**

- Onset of the ear pain if the child is old enough to indicate to parent
- Ask about nocturnal awakenings, activity level of child
- Inquire about sick contacts, day care attendance, exposure to cigarette smoke, and recent URI
- History of previous ear infections, how many, how often, related to seasons
- Other signs and symptoms – tugging on ears, irritability, anorexia, vomiting, diarrhea, or headache.
- Physical exam findings
- Erythematous, bulging TM with obscured middle ear landmarks

- Poor movement with pneumatic otoscopy.
- May be associated with a fever.

### Clinical Reasoning

1. How concerning is this child's hearing loss? Is there a threat of permanent hearing loss?  
Hearing loss is always a concerning complaint in a child, especially during the years of early language and speech development. The bones of the middle ear that transmit sound waves cannot function properly when they are surrounded by fluid, as in the case of otitis media. Inefficient transmission of sound waves results in mild to moderate hearing loss, especially causing muffled-sounding speech. Fortunately this hearing loss is temporary, but chronic ear infections may eventually erode the bones of the middle ear, resulting in significant and permanent hearing loss. Chronic ear infections are also a risk factor for the development of a cholesteatoma, a retraction pocket or cyst that fills with cellular debris and can erode middle ear structures, causing hearing loss.
2. What are the most common organisms that cause AOM?
  - a. Bacteria are the primary cause of acute otitis media, but viruses play a significant role as well.
  - b. *Streptococcus pneumoniae* is the most common bacterium (40-80%), followed by non-typable *Haemophilus influenzae* and *Moraxella catarrhalis*. Other less common organisms include *Staphylococcus aureus* and *Streptococcus pyogenes*.
3. What are the indications for PE tube placement?  
There are no hard and fast rules by which a child absolutely must have PE tubes placed. The decision must be based on an open discussion between the otolaryngologist and the parents. Tubes should be considered in children with persistent serous otitis media, recurrent bouts of AOM (at least three episodes in 6 months or four episodes in 12 months), complications such as meningitis, facial nerve paralysis, or abscess or persistent hearing loss. Other factors to consider include whether or not the child is in daycare, how many children live at home, and the current season. Many otolaryngologists are hesitant to put tubes in a child if summer is approaching. With tubes in place, ears must be kept dry during prime swimming months, and often children will achieve full eustachian tube development before the next winter cold and flu seasons.
4. What is the first line of treatment for AOM?  
With antibiotic-resistant organisms on the rise due to incorrect usage and over-prescribing, there has been a shift to watchful waiting in a select group of patients as the first line of therapy. Children under the age of 2 should be treated with antibiotics. Children over 2 may be treated with antipyretics and watchful waiting for 2-3 days before beginning antibiotics. If it is determined that an antibiotic is needed, high dose amoxicillin is the first line of treatment, with a switch to amoxicillin-clavulanic acid if there has been no clinical improvement in three full days of treatment. This switch may be necessary to cover for beta-lactam resistant *S. pneumoniae*.
5. What role do adenoidectomies play in a patient with chronic ear infections?  
The adenoids are lymphatic tissue located in the nasopharynx. They grow from birth until age 5-7, after which they usually regress. In children with symptoms of snoring and mouth breathing, adenoidectomy opens up the airway, allowing for improved air circulation. In young children, the adenoids may also be a nidus for ear infections, as they are located very near to the eustachian tube opening and infections of the adenoids may ascend to the middle ear. Removal of the adenoids tends to improve rhinosinusitis and decrease the incidence of otitis media.

6. Trying to use the insufflating bulb is so annoying and challenging on a squirmy, sick child. Why should I bother?

Because I said so! In all seriousness, the insufflation bulb can be a very useful tool in evaluating the ears of a young child. Excessive crying, often elicited by an attempted ear visualization, may cause the child's TMs to appear reddened and inflamed in the absence of an infection. In this case, insufflation may distinguish the two with ease, with an infection causing a decrease in mobility. Its use will also help determine if the membrane is retracted from a previous AOM, or if fluid is currently present. Although unpleasant for all parties involved, use of the insufflating bulb is an important part of the proper ear exam. A good seal between the ear canal and the insufflator is necessary, as the escape of air will compromise the validity of the test. It is also paramount to adequately restrain the child, often on the parent's lap, to ensure no trauma to the ear canal from a thrashing child. Remember, practice makes perfect!

### **Diagnosis:**

Otitis Media with Effusion

### **Patient Management:**

1. Immediate treatment – Close observation
2. Treatment in four months – If on follow up examination this patient continues to have fluid in the middle ear; more steps may need to be taken. At this point it is appropriate to perform hearing testing. If there is evidence of hearing loss, discussion of PE tube placement should begin, as prompt treatment of hearing loss may prevent developmental delays. It is also possible to try a trial of antibiotics before tube placement in a family with reliable follow up.

### **Suggestions for Learning Activities:**

- Ask students the questions from the clinical reasoning section and discuss the answers.
- View videos on the internet of pneumatic otoscopy. Provide otoscopes with insufflating bulbs and have students practice pneumatic otoscopy on their classmates.
- Review the anatomy of the normal exam, and view pictures of acute otitis media, serous otitis media, a tympanic membrane with a PE tube, and a perforated ear drum.

### **Other Resources:**

- Video of insufflation: <http://www.youtube.com/watch?v=4QDwmNjMeS4>
- Eugene C. Toy, et al. Case Files Pediatrics Third Edition. McGraw Hill Medical 2009.

## **Common Acute Pediatric Illnesses: Abdominal Pain, Case #1**

Written by Noemi Adame, M.D.

A ten-month-old presents with bouts of irritability during which he draws up his legs and appears to be in pain. He had a viral illness the previous week. His stools are heme test negative and he is very lethargic. There is abdominal distention and diffuse tenderness. What is your differential diagnosis? What is the most likely diagnosis? How would you evaluate this patient?

### **Definitions for Specific Terms:**

**Irritability**- Inconsolability; over-response by an infant to harmless stimuli; fussiness and fretfulness despite attempts to comfort and console by caregiver. Irritability may be a harbinger of infection including meningitis, increased intracranial pressure, metabolic disturbance, and other medical conditions

**Lethargy**- An altered level of consciousness characterized by decreased interaction with persons or objects in the environment; sluggishness, abnormal drowsiness, stupor

**Intussusception**- Intussusception occurs when a segment of bowel invaginates into the distal bowel usually antegrade, resulting in venous congestion and bowel wall edema.

### **Review of Important Concepts:**

#### **Historical Points**

- Epidemiology of intussusception
  - Occurs primarily in infants and toddlers, but may occur at any age
  - Male to Female ratio is 2:1
  - Only 10-25% occur after the age of 2 years
  - Peak incidence is between 5 to 9 months
  - Rare in children < 3 months or > 3 years
  - Spring and autumn seasonality
  - May be preceded by viral illness or gastroenteritis
- Causes and predisposition for intussusception
  - Usually idiopathic and ileocolic
  - Lead points found in 1.5% to 12%
    - Meckel's diverticulum
    - Polyps
    - Mesenteric nodes
    - Lymphoma
    - Henoch-Schonlein purpura
    - Cystic fibrosis
    - Peutz-Jeghers syndrome
    - Appendiceal stump
- Other causes
  - Viral infection (rotavirus, adenovirus, HHV-6)



- Immunizations (old rotavirus vaccine)
- Clinical presentation
- Classic triad of colicky abdominal pain (may cause the drawing up of the legs), vomiting, and bloody stools is present in < 25% of children.
- Common presentations
  - Abdominal Pain (80-95%)—In younger infants this may manifest as intermittent crying
  - Vomiting +/- billious (> 60%)—May be the only finding in infants
  - Bloody stools (late finding)—Diarrhea may occur in 30% of children with intussusception
  - Atypical presentation
  - Lethargy/altered mental status
  - Painless intussusception
  - Sepsis, shock, and syncope
  - Transient hypertension
- Other causes of irritability and lethargy in young children/infants
  - Increased intracranial pressure
  - Mass
  - Intracranial bleed due to abusive head trauma
  - Infection/meningitis
  - Metabolic disturbance
  - Toxic ingestion
  - Trauma

## Physical Exam Findings

1. Vital signs
  - a. Fever: not often present
  - b. Tachycardia: may indicate severe dehydration or shock
  - c. Tachypnea: may indicate severe dehydration or shock
  - d. Blood Pressure: children with compensated shock may be normotensive
2. General appearance
  - a. The ill-appearing child may be severely dehydrated due to vomiting, poor drinking, diarrhea or third-spacing; in hypovolemic shock; or septic due to bowel ischemia or perforation.
  - b. Irritability is a concerning exam finding in the pediatric patient. (See definition above).
  - c. The child may draw up his or her legs due to abdominal pain.
  - d. It is important to assess level of dehydration.
  - e. Abdominal distention, tenderness, or mass
  - f. Most consistent physical exam finding is a palpable mass in the RUQ
  - g. Ileocolic intussusception often presents with sausage-shaped and ill-defined mass
3. Radiographic evaluation
 

Given the often nonspecific presentation and uncertainty in establishing a clinical diagnosis, radiologic evaluation is necessary to confirm the diagnosis in any case of suspected intussusception.

Plain film findings:

  - a. Target sign: Soft tissue mass in RUQ  
<http://www.hawaii.edu/medicine/pediatrics/pemxray/v1c02.html>
  - b. Empty lower quadrant, reduced air in small bowel, gasless abdomen

- c. Meniscus sign: Crescent of gas within the colonic lumen  
<http://www.hawaii.edu/medicine/pediatrics/pemxray/v1c02.html>
  - d. Small bowel obstruction
  - e. Ultrasound findings
  - f. Doughnut sign: Hypoechoic outer rim of homogeneous thickness with a central hyperchoic core on a transverse plain
  - g. Pseudokidney sign: Hyperechoic tubular center covered on each side by hypoechoic rim producing a kidney-like appearance on a longitudinal plane
  - h. Barium enema—Diagnostic and therapeutic reduction of intussusception
  - i. Air contrast enema—Preferred standard of treatment
4. Complications
- a. Venous congestion and bowel wall edema
  - b. Obstructive process can lead to arterial obstruction, bowel necrosis, and even perforation
  - c. Delay in diagnosis may also decrease the success rate for reduction, necessitating surgical reduction
  - d. Children with signs of perforation, profound shock, or peritonitis should be reduced in the operating room

### Clinical Reasoning

1. What are the top 4 most likely diagnoses and why? Rank the items on the differential from most likely to less likely.
  - a. Intussusception—Most likely diagnosis given presentation of irritability, abdominal pain/distention, and preceding viral illness. Blood in the stool is a late finding.
  - b. Malrotation/volvulus/small bowel obstruction—Bilious vomiting would be the most prominent clinical feature.
  - c. Meningitis—Fever and irritability would be the most prominent feature.
  - d. Gastroenteritis—Not usually associated with findings of acute abdomen.
2. What are some of the complications of intussusception?
  - a. Ischemic bowel
  - b. Perforation
  - c. Peritonitis
  - d. Recurrence
3. Narrowing the differential diagnosis and medical decision-making
  - a. The patient has a history irritability and abdominal pain preceded by a viral illness. On exam he has diffuse abdominal tenderness and distention as well as lethargy. These symptoms are most consistent with intussusception, and he is in a high-risk age group. The absence of bloody stools is not uncommon, as this is usually a late finding due to mucosal sloughing. There are other causes of irritability and lethargy in children, such as increased intracranial pressure, meningitis, abusive head injury, but these would not explain the patient's abdominal findings. Small bowel obstruction can also cause abdominal distention, but vomiting is a more prominent feature, and these patients usually have a previous surgical history.
  - b. To confirm the diagnosis, an ultrasound of the abdomen would be appropriate.
  - c. An air contrast enema would be the most appropriate management for uncomplicated intussusception.

**Diagnosis:**

Intussusception

**Suggestions for Learning Activities:**

- Ask the students the questions listed under the “Clinical Reasoning” to help them arrive at the diagnosis. The questions are designed to narrow the differential diagnosis sequentially.
- Ask the students to list what they think is the patient’s most likely diagnosis on the board or flip chart. Assign someone in the group to list the items on the differential diagnosis. Then, go through the clinical features of the case to rule in or rule out items on their differential. Have them rank the differential items from most likely to least likely. Then ask them what supplemental data (laboratory or radiographic studies) would help confirm or guide their diagnosis.
- Divide the students into two teams. Ask each team to select their first choice for the most likely diagnosis for the patient in the case prompt. Ask them what their next steps would be to manage the patient. Each team should present their response to the group and discuss.
- Try a scavenger hunt! Ask the students to divide into groups of 2-3 and find the following images. The students need to explain the clinical correlation for each item they find.
  - a. Target sign on plain film  
<http://www.hawaii.edu/medicine/pediatrics/pemxray/v1c02.html>
  - b. Meniscus sign on plain film  
<http://www.hawaii.edu/medicine/pediatrics/pemxray/v1c02.html>
  - c. Doughnut sign on ultrasound
  - d. Pseudokidney sign on ultrasound
  - e. Currant jelly stools

**Other Resources:**

- Diarrhea and vomiting caused by gastroenteritis: diagnosis, assessment, and management in children younger than 5 years. National Collaborating Centre for Women’s and Children’s Health. Commissioned by the National Institute for Health and Clinical Excellence. April 2009.
- Applegate, K. Intussusception in children: evidence-based diagnosis and treatment. *Pediatric Radiology*; 2009; 39 (Suppl 2): S140-S143.
- Waseem, M and Rosenberg HK; Intussusception. *Pediatric Emergency Care*; November 2008: 793-800.

## **Common Acute Pediatric Illnesses: Abdominal Pain, Case #2**

Written by Noemi Adame, M.D.

A three-year-old girl has had forty-eight hours of fever, vomiting, and diarrhea. How would you evaluate her hydration status? Discuss management principles based on diagnosis and physical exam findings.

### **Definitions for Specific Terms:**

**Diarrhea-** An alteration in normal bowel movements characterized by an increase in water content, volume, or frequency of stools. A decrease in consistency (i.e. soft or liquid) and an increase in frequency of bowel movements to 3 or more stools per day have been used as a definition for epidemiological investigations.

**Gastroenteritis-** A transient disorder due to enteric infection and characterized by the sudden onset of diarrhea with or without vomiting

**Dehydration-** A state arising from loss of extracellular fluids and/or intracellular fluid. Oral rehydration salt or solution (ORS) and oral maintenance solution-- Specially constituted fluid containing as essential ingredients an organic solute (e.g. a carbohydrate or amino acid) and sodium chloride. Such organic solutes are subject to active intestinal co-transport (absorption) with sodium and so enhance salt and hence water absorption. Most ORS solutions contain glucose as the organic solute.

**Oral rehydration therapy (ORT)-** The administration of fluids by mouth or via nasogastric tube.

### **Review of Important Concepts:**

#### **Historical Points**

- Time-course  
In children with acute gastroenteritis (AGE), diarrhea usually lasts 5-7 days and resolves within 2 weeks
  - The cause is usually a virus such as rotavirus.
  - Vomiting usually lasts for 1-2 days, and stops within 3 days
  - Chronic diarrhea (> 14 days) is often due to causes other than acute infection such as inflammatory bowel disease, which is often associated with weight-loss.
- Previous surgical history: This historical element would point towards small bowel obstruction due to adhesions.
- Recent or current antibiotic exposure: This may cause diarrhea. *C. difficile* is a rare but possible cause of bloody diarrhea.
- Review of Systems
  - Fever: The presence of fever usually indicates an infectious cause. A fever ( $\geq 38$  degrees Celsius in infants < 3 months;  $\geq 39$  degrees Celsius in young children) may indicate sepsis, serious bacterial infection such as pyelonephritis or pneumonia, or a diagnosis other than AGE.

- Abdominal Pain: Abdominal pain is more common in bacterial AGE than viral AGE. Severe abdominal pain or tenderness may indicate a diagnosis other than infectious AGE, such as intussusception or appendicitis.
- Presence of blood in stool:
  - It is important to distinguish if the blood was mixed with the stool or only on its surface.
  - Bloody diarrhea is usually seen with bacterial AGE.
  - Viral AGE is usually non-bloody.
- Vomiting
  - Bilious or persistent emesis
  - May indicate surgical obstruction or ischemic bowel
- Duration > 3 days
  - Suggests obstruction or other causes
- Urine Output: Low urine output may indicate dehydration or a complication such as hemolytic-uremic syndrome (HUS)
- Sick contacts: Suggests infectious cause
- Recent travel: Suggests infectious cause
- Exposure to contaminated water or food source:
  - Suggests infectious cause
  - Important piece of history to establish etiology
- Immunizations: If the child is up to date on immunizations, he or she is likely immunized against Rotavirus
- Immunocompromised patients are at higher risk for opportunistic infections such as cryptosporidium.

## Physical Exam Findings

1. Vital Signs
  - a. Fever: may indicate serious infection or sepsis
  - b. Tachycardia: may indicate severe dehydration or shock
  - c. Tachypnea: may indicate shock or cause other than AGE such as pneumonia
  - d. Blood Pressure: children with compensated shock may be normotensive
2. General appearance:
  - a. The ill-appearing child may be severely dehydrated, in hypovolemic shock, or septic.
  - b. Children who are dehydrated are not as active as usual.
  - c. Abdominal tenderness, distention, rebound, or guarding: May indicate surgical emergency such as intussusception, ischemia, appendicitis, or small bowel obstruction.
  - d. Assessing Degree of Dehydration
  - e. From the NICE Guidelines on the management of Diarrhea in children. 2009. Symptoms and signs with red flags ( ) may help to identify children at increased risk of progression to shock. If in doubt, manage as if there are symptoms and/or signs with red flags.

Increasing severity of dehydration →			
	No clinically detectable dehydration	Clinical dehydration	Clinical shock
<b>Symptoms</b> (remote and face-to-face assessments)	Appears well	■ Appears to be unwell or deteriorating	–
	Alert and responsive	■ Altered responsiveness (for example, irritable, lethargic)	Decreased level of consciousness
	Normal urine output	Decreased urine output	–
	Skin colour unchanged	Skin colour unchanged	Pale or mottled skin
	Warm extremities	Warm extremities	Cold extremities
<b>Signs</b> (face-to-face assessments)	Alert and responsive	■ Altered responsiveness (for example, irritable, lethargic)	Decreased level of consciousness
	Skin colour unchanged	Skin colour unchanged	Pale or mottled skin
	Warm extremities	Warm extremities	Cold extremities
	Eyes not sunken	■ Sunken eyes	–
	Moist mucous membranes (except after a drink)	Dry mucous membranes (except for 'mouth breather')	–
	Normal heart rate	■ Tachycardia	Tachycardia
	Normal breathing pattern	■ Tachypnoea	Tachypnoea
	Normal peripheral pulses	Normal peripheral pulses	Weak peripheral pulses
	Normal capillary refill time	Normal capillary refill time	Prolonged capillary refill time
	Normal skin turgor	■ Reduced skin turgor	–
	Normal blood pressure	Normal blood pressure	Hypotension (decompensated shock)

## Clinical Reasoning

- What are the top most likely diagnoses and why? Rank the items on the differential from most likely to less likely. What are other diagnoses you should consider? Explain why these items are ranked lower in the differential diagnosis.
  - Viral gastroenteritis—Acute non-bloody diarrhea with or without vomiting and fever are the typical clinical features.
  - Bacterial gastroenteritis—Usually bloody diarrhea that may last > 14 days
  - Intussusception—Abdominal pain is a prominent feature, vomiting may be bilious, bloody stools are a late finding, and this patient is outside the peak age group.
  - Appendicitis—Abdominal pain is usually the most prominent feature, along with fever and vomiting. Diarrhea is usually not present.
  - Inflammatory bowel disease—This process presents chronically or insidiously, and does not usually have a sudden onset like the case patient's symptoms.
- How would you assess this patient's hydration status? (See table from NICE guidelines)
  - Symptoms
    - Ask about general well-being or appearance
    - Ask specifics about the number of vomiting and diarrhea episodes
    - Ask about the number of wet diapers or urine output

- b. Signs
  - General appearance/mental status
  - Heart rate
  - Respiratory rate/ Work of breathing
  - Blood pressure
  - Mucous membranes
  - Eyes
  - Skin color
  - Skin turgor
  - Extremities
  - Peripheral pulses
  - Perfusion/capillary refill time
3. How would you manage this patient if evidence of dehydration?
  - a. Fluid management
  - b. Orally rehydrate with ORT either by mouth or nasogastric tube until the symptoms/signs of dehydration resolve
  - c. Replace ongoing losses with ORT, such as 10 ml/kg ORT for every episode of vomiting or loose stool
  - d. Offer ORT in frequent small amounts
4. Laboratory tests
  - a. None indicated if child moderately dehydrated
  - b. If the child is in clinical shock, obtaining a chemistry panel and rapid intravenous fluid resuscitation is indicated
5. Imaging

None indicated
6. Dietary
  - a. Once the child is rehydrated, continue regular, unrestricted diet
  - b. Avoid fruit juice or sodas with high osmotic load due to sugar
7. Medications/Pharmacological interventions
  - a. Ondansetron: Two trials suggest that ondansetron decrease the vomiting associated with ORT but may exacerbate diarrhea.
  - b. Probiotics: Evidence not strong enough to recommend in developed countries.

### **Suggestions for Learning Activities**

- Ask the students the questions listed under the “Clinical Reasoning”. The questions are designed to stimulate higher-level clinical reasoning such as constructing a ranked/focused differential and clinical decision-making.
- Divide the students into two teams. Using the case prompt or different scenarios that illustrate mild, moderate, or severe dehydration or various causes (i.e. viral v. bacterial), ask each team to formulate a management plan for the patient, including fluid management, laboratory testing,

imaging studies, dietary therapy, and medications/pharmacological interventions. Each team will then present their plan to the entire group and discuss/justify their responses.

- Ask the students if they think IVF rehydration is superior to ORT. Have them formulate a PICO question, do a quick literature search, appraise the literature, and appraise its quality and applicability to this patient. (See Other Resources below).
- Ask the students if they think probiotics are useful in the treatment of acute gastroenteritis in children. Have them formulate a PICO question, do a quick literature search, appraise the literature, and appraise its quality and applicability to this patient. (See references below).

### **Other Resources:**

- Diarrhea and vomiting caused by gastroenteritis: diagnosis, assessment, and management in children younger than 5 years. National Collaborating Centre for Women's and Children's Health. Commissioned by the National Institute for Health and Clinical Excellence. April 2009.
- Center for Disease Control. Morbidity and Mortality Weekly Report. Managing acute gastroenteritis among children. Oral rehydration, maintenance, and nutritional therapy. November 21, 2003. No. RR-16.
- Hartling L, Bellemare S, Wiebe N, Russell K, Klassen TP, Craig W. Oral versus intravenous rehydration for treating dehydration due to gastroenteritis in children. Cochrane Database of Systematic Reviews 2006;3:CD004390.



## **Common Acute Pediatric Illnesses: Abdominal Pain, Case #4**

Written by Lavjay Butani, M.D.

An eight-year-old female presents with abdominal pain, purpuric lesions on the buttocks and lower extremities, and knee and ankle pain. She has also noted her urine to be darker than usual. What is the most likely diagnosis? How would you evaluate this patient? What treatment options are available?

### **Definitions for Specific Terms:**

**Purpura**- A hemorrhagic area in the skin which is greater than 3 millimeters in diameter and which does not blanch when pressed upon. When raised above the surface of the skin, it is referred to as palpable purpura.

**Petechiae**- Pinpoint flat round red spots under the skin surface caused by intradermal hemorrhage, less than 3 millimeters in diameter and which do not blanch when pressed upon.

**Hematuria**- the presence of > 5 red blood cells per high powered field on a spun urine specimen or > 5/mm<sup>3</sup> on an unspun specimen.

### **Review of Important Concepts:**

The teaching points for the student would be

- to understand that the finding of palpable purpura on physical examination is indicative of a vasculitic process and
- that the constellation of abdominal pain, palpable purpura and arthritis in a child are suggestive of HSP (which is the most common pediatric vasculitis) with possible long-term ramifications on renal health.

### **Historical Points**

- Preceding illnesses - often HSP occurs after URI/strep infections
- Clarify joint pain (arthralgia: which is more common in children and much less specific for immunologic diseases from arthritis-joint swelling/redness)
- Investigate 'dark' color of urine-red or 'tea colored' (hematuria) versus dark yellow (concentrated urine from dehydration)
- Ask for history of swelling/oliguria (from acute glomerulonephritis)
- Ask for color of stools (bloody stools often seen from GI vasculitis)
- Ask about systemic systems - weight loss/gain, fatigability/fever/ bleeding from other sites (rule out leukemia or other marrow infiltrative processes or DIC).

### **Physical Exam Findings**

1. Vital Signs
  - a. BP
  - b. look for edema
  - c. arthritis
  - d. rectal exam-hemoccult

- e. abdominal masses (intussusception), hepatosplenomegaly
- f. lymphadenopathy- palpable versus non-palpable purpura.

### Clinical Reasoning

1. How does the nature of the skin lesions help in the differential diagnosis?
  - a. Petechiae and non-palpable are usually seen with platelet abnormalities (quantitative or qualitative) or with coagulopathies (in addition to ecchymoses).
  - b. Palpable purpuric lesions are a hallmark of vasculitis.
2. What testing should be performed at this stage?
  - a. A CBC to rule out thrombocytopenia should still be considered in someone with palpable purpura to rule out potentially life threatening disorders.
  - b. A PT and aPTT can also help rule out a potential bleeding disorder.
  - c. Visual inspection of the urine and a urinalysis to determine if the patient has hematuria or proteinuria.
  - d. If either of these is present, a chemistry panel is indicated to evaluate renal function and the serum albumin.
3. What might be the etiology of the abdominal pain?  
GI vasculitis versus intussusception (2% of all patients with HSP will develop this as a complication).
4. How would you manage this child?
  - a. Supportive therapy, pain control, hydration.
  - b. Short courses of steroids often help in faster resolution of severe abdominal pain, but there is no clear evidence-based support for this.
5. What would you counsel this child/family about with respect to long term consequences?
  - a. Renal disease is the ONLY long-term sequela that is seen with HSP. This may develop anytime after the disease onset, but typically occurs within 4-8 weeks of onset of the skin rash. No good predictors of long term sequelae have been found on a consistent basis, although a nephrotic-nephritic presentation (nephritic-hypertension, oliguria, elevated serum creatinine + nephrotic-hypoalbuminemia, heavy proteinuria and edema) and the persistence of heavy proteinuria are felt to be indicative of a higher risk for development of chronic kidney disease.
  - b. The child needs close follow-up for monitoring of urinalysis and blood pressure and may need pediatric nephrology input if she has gross hematuria for management and determination of the need for a renal biopsy.

### Diagnosis:

HSP

### Suggestions for Learning Activities:

- Ask the student(s) the questions listed under “clinical reasoning” to probe their thinking about the case

- If the child's platelet count comes back at 10,000/mm<sup>3</sup>, how would that change your approach to this child's management. What if her hemoglobin was 7 grams/dl?
- Have students compare and contrast abdominal x-ray findings of GI vasculitis (thumb-printing of the mucosa) from that in intussusception.
- Assign students to critically appraise literature on a) role of steroids in preventing renal disease in children with HSP, and b) imaging modality of choice for intussusception in HSP and non-HSP patients and why that may differ.

**Other Resources:**

- Lanzkowsky S et al: Henoch-Schonlein Purpura. Pediatrics in Review 1992; vol 13, number 4, page 130-137

## **Common Acute Pediatric Illnesses: Abdominal Pain, Case #5**

Written by Lavjay Butani, M.D.

The mother of a fourteen-month-old baby feels an abdominal mass while giving her son a bath. On physical examination you palpate a mass in the left upper abdomen. What is your differential diagnosis? How would you evaluate this child?

### **Review of Important Concepts:**

The teaching points for the student would be to

- Recognize that the differential for a child with a palpated abdominal mass varies from life threatening malignant diseases to more 'benign' conditions such as congenital anomalies of the GI and genitourinary tract.
- Know which types of imaging studies are indicated in which situations.

### **Historical Points**

- Age of child (neuroblastoma and Wilms' tumor in infancy/toddler age group, neonates more likely to have congenital malformations-hydronephrosis, GI duplications cysts)
- Associated symptoms (Hematuria in Wilms' tumor, constipation, constitutional features- fever, rash or failure to thrive in some oncologic conditions, vomiting with GI obstruction, fever or change in urine smell/odor/appearance for UTI associated with renal malformations, jaundice with hepatoblastoma)
- General appearance, weight gain/loss, appetite, prenatal US-if done may pick up many congenital anomalies
- Family history of cancers

### **Physical Exam Findings**

1. Vital signs:
  - a. Growth parameters
  - b. BP-hypertension in Wilms' tumor/neuroblastoma
  - c. HEENT-opsoclonus, aniridia for Wilms' tumor
  - d. GI-location of mass may help determine origin
  - e. GU-varicocele in prepubertal age in male group may indicate Wilms', vaginal inspection if pelvic mass/vaginal bleeding
  - f. Skin: rash with neuroblastoma, presence of lymphadenopathy
  - g. Abdominal: hepatosplenomegaly
  - h. Neurologic -myoclonus, anal wink/spine exam and lower extremity neurologic exam for spina bifida occulta causing neurogenic bladder and hydronephrosis
  - i. Rectal exam for constipation or bladder/prostatic rhabdomyosarcoma
  - j. Extremity exam for hemi-hypertrophy

### **Clinical Reasoning**

1. How would you begin the laboratory evaluation of this patient?
  - a. CBC,

- b. renal function panel,
  - c. urinalysis,
  - d. urine for HVA and VMA,
  - e. HCG for hepatoblastoma if suspected
2. What imaging studies would be most appropriate?
  - a. Abdominal X-ray
  - b. US
  - c. Abdominal CT
  - d. Based on clinical suspicion-in general abdominal x-ray and US excellent to start with and involve less radiation than CT.
3. How would you confirm the diagnosis if the mass is solid on abdominal US?
  - a. What further imaging may be needed and why?
  - b. For staging and diagnosis purposes a biopsy of the mass and an abdominal and chest CT would be necessary.

**Diagnoses:**

1. Neuroblastoma,
2. Wilms' tumor,
3. Hydronephrosis,
4. Splenomegaly (less likely),
5. Duplication or mesenteric cyst (also less likely)

**Suggestions for Learning Activities:**

- Ask the student(s) the questions listed under “clinical reasoning” to probe their thinking about the case
- Role model discussing the varied diagnoses and their implications with a family before any work-up has been performed
- Discuss how to give ‘bad news.’ Review literature for effective techniques of giving bad news
- Review gross and microscopic pathology images of neuroblastoma, teratoma, Wilms' tumor
- Research and reflect on what has made the greatest difference in improving long-term survival in children with cancers over the past several decades

**Other Resources:**

- Abdominal Masses (Chapter 43) by Roger Berkow. In Pediatric Clerkship Guide, 2nd edition, Editor: Woodhead JC. Mosby Elsevier.
- Breaking bad news. A review of the literature, Ptacek JT, Eberhardt TL: JAMA. 1996 Aug 14;276(6):496-502.

## **Common Acute Pediatric Illnesses: Diarrhea, Case #1**

Written by Noemi Adame, M.D.

A six-year-old boy present with pallor and irritability following a week of abdominal pain and blood tinged diarrheal stools. What would you be most concerned about? How would you evaluate and manage this patient?

### **Definitions for Specific Terms:**

**Pallor**- Unnatural lack of color in the skin; ashen hue

**Irritability**- Inconsolability; over-response by an infant to harmless stimuli; fussiness and fretfulness despite attempts to comfort and console by caregiver; irritability may be a harbinger of infection including meningitis, increased intracranial pressure, metabolic disturbance, and other medical conditions

**Diarrhea**- An alteration in normal bowel movements characterized by an increase in water content, volume, or frequency of stools. A decrease in consistency (i.e. soft or liquid) and an increase in frequency of bowel movements to 3 or more stools per day have been used as a definition for epidemiological investigations.

**Gastroenteritis**- A transient disorder due to enteric infection and characterized by the sudden onset of diarrhea with or without vomiting

**Dehydration**- A state arising from loss of extracellular fluids and/or intracellular fluid.

**Oral rehydration salt or solution (ORS)**- Specially constituted fluid containing as essential ingredients an organic solute (e.g. a carbohydrate or amino acid) and sodium chloride. Such organic solutes are subject to active intestinal co-transport (absorption) with sodium and so enhance salt and hence water absorption. Most ORS solutions contain glucose as the organic solute.

**Oral rehydration therapy (ORT)**- The administration of fluids by mouth or via nasogastric tube

### **Review of Important Concepts:**

#### **Historical Points**

1. Time-course
  - a. In children with acute gastroenteritis (AGE), diarrhea usually lasts 5-7 days and resolves within 2 weeks
  - b. Vomiting may last for 1-2 days, and usually stops within 3 days
  - c. Chronic diarrhea (> 14 days) is often due to causes other than acute infection such as inflammatory bowel disease, which is often associated with weight-loss.
2. Previous surgical history: This historical element would point towards small bowel obstruction due to adhesions.

3. Recent or current antibiotic exposure: This may cause diarrhea. *C. difficile* is a rare but possible cause of bloody diarrhea.
4. Review of Systems
  - a. Fever: The presence of fever usually indicates an infectious cause. A fever ( $\geq 38$  degrees Celsius in infants  $< 3$  months;  $\geq 39$  degrees Celsius in young children) may indicate sepsis, serious bacterial infection such as pyelonephritis or pneumonia, or a diagnosis other than AGE.
  - b. Abdominal Pain: Abdominal pain is more common in bacterial AGE than viral AGE. Severe abdominal pain or tenderness may indicate a diagnosis other than infectious AGE, such as intussusception.
  - c. Amount of blood in stool:  
It is important to distinguish if the blood was mixed with the stool or only on its surface.
    - Bloody diarrhea is usually seen with bacterial AGE.
    - Viral AGE is usually non-bloody.
  - d. Vomiting
    - Bilious or persistent emesis  
May indicate surgical obstruction or ischemic bowel
    - Lasting  $> 3$  days  
Suggests obstruction or other causes
  - e. Urine Output: Low urine output may indicate dehydration or a complication such as hemolytic-uremic syndrome (HUS)
  - f. Non-blanching rash: May indicate low platelets (seen with HUS)
5. Sick contacts: Suggests infectious cause
6. Recent travel: Suggests infectious cause
7. Exposure to contaminated water or food source: Suggests infectious cause  
Important piece of history to establish etiology
8. Immunizations  
Immunocompromised patients are at higher risk for opportunistic infections such as cryptosporidium.

## Physical Exam Findings

1. Vital Signs
  - a. Fever: Not always but, may indicate serious infection or sepsis
  - b. Tachycardia: may indicate severe dehydration or shock
  - c. Tachypnea: may indicate shock or cause other than AGE such as pneumonia
  - d. Blood Pressure: children with compensated shock may be normotensive
2. General appearance:
  - a. The ill-appearing child may be severely dehydrated, in hypovolemic shock, or septic.
  - b. Irritability is a concerning exam finding in the pediatric patient. (See definition above)
  - c. Pallor: This finding may indicate acute illness or anemia (seen with HUS)
  - d. Abdominal tenderness, distention, rebound, or guarding: May indicate surgical emergency such as intussusception, ischemia, appendicitis, or small bowel obstruction.
  - e. Assessing Degree of Dehydration

- f. Non-blanching rash may be petechial due to low platelets (seen in HUS).

Increasing severity of dehydration →			
	No clinically detectable dehydration	Clinical dehydration	Clinical shock
<b>Symptoms</b> (remote and face-to-face assessments)	Appears well	❑ Appears to be unwell or deteriorating	–
	Alert and responsive	❑ Altered responsiveness (for example, irritable, lethargic)	Decreased level of consciousness
	Normal urine output	Decreased urine output	–
	Skin colour unchanged	Skin colour unchanged	Pale or mottled skin
	Warm extremities	Warm extremities	Cold extremities
<b>Signs</b> (face-to-face assessments)	Alert and responsive	❑ Altered responsiveness (for example, irritable, lethargic)	Decreased level of consciousness
	Skin colour unchanged	Skin colour unchanged	Pale or mottled skin
	Warm extremities	Warm extremities	Cold extremities
	Eyes not sunken	❑ Sunken eyes	–
	Moist mucous membranes (except after a drink)	Dry mucous membranes (except for 'mouth breather')	–
	Normal heart rate	❑ Tachycardia	Tachycardia
	Normal breathing pattern	❑ Tachypnoea	Tachypnoea
	Normal peripheral pulses	Normal peripheral pulses	Weak peripheral pulses
	Normal capillary refill time	Normal capillary refill time	Prolonged capillary refill time
	Normal skin turgor	❑ Reduced skin turgor	–
	Normal blood pressure	Normal blood pressure	Hypotension (decompensated shock)

### Clinical Reasoning

- What are the top 4 most likely diagnoses and why? Rank the items on the differential from most likely to less likely.
  - Bacterial AGE—Acute bloody diarrhea
  - Viral AGE—Ranked second because viral AGE is not usually bloody
  - Intussusception—Can cause “currant jelly” stools and irritability but is usually associated with vomiting due to the obstruction.
  - Ischemic bowel/Other surgical—Also possible, but vomiting and possibly fever would be prominent features. The patient would most likely have a surgical history.
- What are some complications of bacterial AGE?
  - HUS
  - Septicemia
- Narrowing the differential diagnosis and medical decision-making



- a. The patient has a history of acute abdominal pain and blood-tinged diarrhea.
  - These clinical features are consistent with bacterial AGE, less consistent with inflammatory bowel disease, where the presentation is usually chronic.
  - Viral AGE is usually not bloody.
- b. In the absence of vomiting or an acute abdominal exam, intussusception or small bowel obstruction or ischemia is unlikely; especially the latter if the patient does not have a surgical history.
- c. The pallor and irritability may be due to the degree of dehydration, but could also be due to HUS, which causes anemia and acute renal failure leading to these symptoms. The most common cause of HUS is *E. coli* O157:H7 infection.
- d. To confirm the diagnosis, a stool culture would be appropriate.
- e. A CBC with manual differential and chemistry panel would determine if the patient has HUS.

### **Diagnosis:**

Bacterial AGE complicated by HUS.

### **Suggestions for Learning Activities**

- Ask the students if they think IVF rehydration is superior to ORT. Have them formulate a PICO question, do a quick literature search, appraise the literature, and appraise its quality and applicability to this patient. (See references below)
- Divide the students into two teams. Ask each team to formulate a management plan for the patient in the case prompt, including fluid management, laboratory testing, imaging studies, dietary therapy, and medications/pharmacological interventions. Each team will then present their plan to the entire group and discuss/justify their responses.

### **Other Resources:**

- Diarrhea and vomiting caused by gastroenteritis: diagnosis, assessment, and management in children younger than 5 years. National Collaborating Centre for Women's and Children's Health. Commissioned by the National Institute for Health and Clinical Excellence. April 2009.
- Center for Disease Control. Morbidity and Mortality Weekly Report. Managing acute gastroenteritis among children. Oral rehydration, maintenance, and nutritional therapy. November 21, 2003. No. RR-16.
- Hartling L, Bellemare S, Wiebe N, Russell K, Klassen TP, Craig W. Oral versus intravenous rehydration for treating dehydration due to gastroenteritis in children. Cochrane Database of Systematic Reviews 2006;3:CD004390.

## **Common Acute Pediatric Illnesses: Rashes, Case # 1**

Written by Jon Gold, M.D.

A four-year-old girl presents to your clinic with a diffuse pruritic rash. She has numerous evanescent raised erythematous lesions with serpiginous borders and blanched centers.

What other information would you like to know about this patient? What other physical findings would concern you? What is the appropriate diagnosis and treatment of this condition?

### **Definitions for Specific Terms:**

**Evanescent lesion**- Evanescent refers to the fact that the lesion comes and goes over time.

**Erythematous lesion**- Erythematous means red.

**Serpiginous border**- Serpiginous is wavy, like a snake (or serpent).

**Blanched centers**- Blanched centers are pale or white. A lesion that blanches is one whose color disappears with direct pressure. This indicates that the blood is contained within vessels.

**Wheal**- A wheal is a raised area of skin due to edema of the subcutaneous tissue.

**Flare**- Flare is a flushed or red appearance of the skin usually due to vasodilation.

### **Review of Important Concepts:**

#### **Historical Points**

- Duration: Urticaria can be divided into acute (less than 6 weeks duration) and chronic (more than 6 weeks duration). The differential diagnosis and treatment vary depending on which of these categories the patient belongs.
- Timing: Individual hives almost always disappear within 24 hours. If an individual lesion lasts more than 24 hours, a different diagnosis should be considered.
- Triggers:
  - In acute urticaria, the most common triggers are foods (e.g. milk, eggs, nuts, peanuts, shellfish), drugs (can be any but consider especially penicillins, NSAID's) and infections (can be viral, bacterial, or fungal) but can also include insect bites or stings, contact rashes (e.g. latex) or transfusion reactions.
  - In chronic urticaria, the most common identified triggers are physical stimuli (e.g. pressure, cold, solar, aquagenic) but the vast majorities are idiopathic (and a subset of these are thought to be autoimmune).
- A careful history is crucial. In the absence of a clear history pointing toward a particular inciting agent, an extensive workup is unlikely to be helpful.

## Physical Exam Findings

As with any skin disease, morphology, distribution, time course and associated findings are the key.

1. Morphology:
  - a. The classic lesion in urticaria is an erythematous, edematous, round or oval lesion (often described as wheal and flare).
  - b. These lesions often coalesce (come together) to form a serpiginous or polycyclic pattern.
  - c. Approximately 40% of patients will have associated angioedema, which is a thick, nonpitting edema without redness and without clear borders involving structures deeper than the skin (eg lips, tongue, eyelids, genitals)
2. Distribution: Urticarial lesions are generally diffuse except when triggered by a particular physical stimulus (eg: cold).
3. Time course:
  - a. Duration: Urticaria can be divided into acute (less than 6 weeks duration) and chronic (more than 6 weeks duration). The differential diagnosis and treatment vary depending on which of these categories the patient belongs.
  - b. Timing: Individual hives almost always disappear within 24 hours. If an individual lesion lasts more than 24 hours, a different diagnosis should be considered.
4. Associated findings. Hives are generally itchy. Lesions that burn rather than itch or asymptomatic should prompt consideration of another diagnosis.

## Clinical Reasoning

1. What is the differential diagnosis for this patient?  
While a serpiginous lesion on the skin and the pale centers might suggest a large number of conditions including cutaneous larva migrans, erythema chronicum migrans associated with Lyme disease, erythema marginatum associated with rheumatic fever and erythema multiforme, it is the evanescent nature of the rash that is the key. Very few conditions besides urticaria cause a similar rash that comes and goes.
2. What other physical findings would concern you?
  - a. Angioedema can occur in the deep structures of the airway and potentially impair respiration.
  - b. Urticaria can also be associated with anaphylaxis which is potentially life threatening. Signs of anaphylaxis might include hypotension, wheezing, cardiac arrhythmias or mental status changes.
3. What are the treatment options for this condition?
  - a. The most important treatment is avoidance of any known or suspected trigger.
  - b. Antihistamines are often effective. Second generation antihistamines (eg cetirizine, loratidine, fexofenadine) are preferred because they are long-acting and nonsedating.
  - c. In severe cases a short course of oral corticosteroids can be helpful
  - d. Patients who have associated angioedema or anaphylaxis should also carry an injectable form of epinephrine for emergencies

### Suggestions for Learning Activities

- Have students answer the questions under the clinical reasoning section to probe their knowledge of the case.
- Show the students examples of various skin findings included under the differential diagnosis. Ask them to describe the morphology and distribution of the lesions shown. Ask them to provide a diagnosis and what made them choose that particular diagnosis.
- Have the students write an allergy action plan for a child with a severe life-threatening allergy.

### Other Resources

- Amar SM and Dreskin SC. Urticaria. Prim Care Clin Office Pract 35 (2008) 141-157
- Atkins D, Frank MM et al. Urticaria (hives) and Angioedema. In Kleigman: Nelson's Textbook of Pediatrics (19th ed) (2011) 811.
- [www.dermatlas.org](http://www.dermatlas.org) –an indexed list of images that (among other uses) can be used for learning activity 3.b.

**Common Acute Pediatric Illnesses: Rashes, Case #2**

Written by Becky Latch, M.D.

A four-year-old presents with a dry, erythematous, itchy rash in the antecubital and popliteal fossae. What are the most likely diagnosis and appropriate therapy?

**Review of Important Concepts:****Historical Points**

- Onset of rash and events surrounding appearance of rash, such as exposure to a new soap, detergent or lotion.
- Past medical history: Has this rash been present before?
- Other associated symptoms or history, such as a history of allergic rhinitis, asthma or food allergies
- Family medical history: Do other family members have similar findings? Have other family members been diagnosed with eczema or atopic dermatitis?

**Physical Exam Findings**

1. Excoriated areas are evidence that the rash is pruritic and the patient has scratched their skin. These areas are especially prone to secondary infection.
2. Signs of secondary infection include warmth, erythema, crusting of lesions and/or purulent drainage from the wounds.
3. Eczematous skin may become lichenified as patients rub and scratch at it. Lichenification is a thickening and hardening of the skin with exaggeration of normal markings.

**Clinical Reasoning**

1. Differential diagnosis for a pruritic rash in a four-year-old is very broad and could include contact dermatitis, viral exanthem, tinea corporis, scabies, and atopic dermatitis (eczema).
2. A rash that is localized in the antecubital and popliteal fossae is consistent with atopic dermatitis in older children. In infants, atopic dermatitis involves the face, scalp, cheeks and extensor surfaces of the extremities.
3. The pruritic nature of the rash is often more significant than the appearance; atopic dermatitis is sometimes called “the itch that rashes.” The itching can have a significant impact on the child’s quality of life.
4. Atopic Dermatitis is one of several atopic diseases. Patients with moderate to severe atopic dermatitis are also at risk for allergic rhinitis, asthma and food allergies.
5. Diagnosis and Management: Atopic dermatitis management may include topical steroids and intense skin hydration. Thick emollients such as petroleum jelly can be beneficial. In addition,

identifying and limiting exposure to triggers such as environmental and food allergies can be helpful in minimizing or controlling symptoms.

**Suggestions for Learning Activities:**

- Ask students to describe the typical atopic dermatitis rash on an infant and then on an older child. Discuss the different presentations according to patient age.
- Discuss important terms for describing rashes such as erythematous, violaceous, macular, papular, pustular, petechial, purpuric, pruritic and how these terms can be used to put rashes into different categories.

**Other Resources:**

- Dermatology Online Atlas (<http://dermatlas.med.jhmi.edu/derm/>)
- Krakowski A, Eichenfield L, Dohil, M. Management of Atopic Dermatitis in the Pediatric Population. Pediatrics, October 2008; 122: 812-824

## **Common Acute Pediatric Illness: Rashes, Case #3**

Written by Jon Gold, M.D.

An eighteen-month-old presents with many golden-yellow crusted-weeping lesions around the nose which seem to be spreading according to the child's parents. Discuss the likely diagnosis and management considerations.

### **Definitions for Specific Terms**

**Crusted lesion**- A crust is a hard shell formed by the drying of an exudate or other body secretion (i.e. a scab).

**Plaque**- A plaque is a solid raised lesion more than 1 cm in diameter.

**Bulla**- A bulla is an elevated fluid-filled lesion more than 1 cm in diameter (ie a blister).

### **Review of Important Concepts:**

#### **Historical Points**

- Predisposing factors: Does the patient have
  - recent trauma to skin?
  - underlying skin condition (eg: atopic dermatitis)?
  - recent antibiotic use (change in skin flora)?
  - underlying immunocompromise?
- Environment
  - Warm, humid climate
- Sick contacts

#### **Physical Exam Findings**

As with any skin disease, morphology, distribution, time course and associated findings are the key.

1. Morphology:
  - a. Impetigo can be bullous or nonbullous—nonbullous impetigo accounts for 70% of cases.
  - b. Almost all bullous impetigo is caused by *Staphylococcus aureus*.
  - c. Nonbullous impetigo is classically described as a honey-crusted plaque.
2. Distribution
  - a. Nonbullous impetigo typically occurs on the face and extremities and in areas of trauma.
  - b. Bullous impetigo typically occurs in areas of intact skin.
3. Time course
 

Usually acute onset
4. Associated findings
 

Patients with impetigo are generally well-appearing.

## Clinical Reasoning

1. What is the differential diagnosis for this patient?
  - a. Impetigo
  - b. Contact dermatitis
  - c. Herpes stomatitis
  - d. Varicella
  - e. Tinea corporis
2. What are the typical organisms that cause this condition?
  - a. Staphylococcus aureus
  - b. Streptococcus pyogenes (also known as Group A beta-hemolytic Strep)
3. What are the treatment options for this condition?
  - a. A variety of topical antibiotics (eg mupirocin, retapamulin) and oral antibiotics (eg 1st generation cephalosporins, amoxicillin-clavulanate, clindamycin, trimethoprim-sulfamethoxazole) are available.
  - b. Any choice must have reasonable Staphylococcus aureus coverage and, depending on the community, coverage for MRSA should be considered.
4. When should topical versus oral antibiotics be considered?
 

Topical antibiotics are an option if the lesions are well-localized and the patients are not too sick.
1. What are the potential complications of this condition?
  - a. Suppurative complications can include cellulitis, lymphangitis, regional lymphadenitis, or rarely osteomyelitis, septic arthritis or sepsis.
  - b. Non-suppurative complications include acute post-streptococcal glomerulonephritis or rarely toxic shock syndrome.

## Suggestions for Learning Activities:

- Have students answer the questions under the clinical reasoning section to probe their knowledge of the case.
- Show the students examples of various skin findings included under the differential diagnosis. Ask them to describe the morphology and distribution of the lesions shown. Ask them to provide a diagnosis and what made them choose that particular diagnosis. ( [www.dermatlas.org](http://www.dermatlas.org) )
- Ask the students to find out the rates of CA-MRSA in their community. Ask them how this information would impact their antibiotic choice in the case provided above.

## Other Resources:

- Cole C and Gazewood J. Diagnosis and Treatment of Impetigo. Am Fam Physician. 2007 Mar 15;75(6):859-64.
- [www.dermatlas.org](http://www.dermatlas.org) –an indexed list of images that (among other uses) can be used for learning activity 3.b.



## **Common Acute Pediatric Illness: Rashes, Case #4**

Written by Shoshana Melman, M.D.

A five-year old boy presents following a dog bite on the back of his hand. What is the initial management for this patient? How would your management change if this were a superficial wound on his leg? What if the bite was from a cat?

### **Definitions for Specific Terms:**

**Dog bite or Cat bite**- The clamping and/or piercing of skin and underlying tissues by the upper and lower mandible of the respective animal.

### **Review of Important Concepts:**

#### **Historical Points**

- With regards to the animal, ask about its location, where and when the bite occurred, any known provocation, and the animal's rabies vaccination status, general health and behavior. The type of animal is important. In the United States, among purebred dog breeds, Rottweilers, Pit Bulls and German Shepherds cause the majority of bite-related fatalities.
- Determine the location of the bite (most often on the upper extremities and face), and pertinent patient factors (such as patient tetanus and rabies vaccination history and any history of diabetes, immunocompromise or peripheral vascular disease).

#### **Physical Exam Findings**

1. First, ensure the patient's overall medical stability.
2. Then evaluate the extent of the wound, including injuries to underlying bones, tendons and joints.
3. Scalp lesions have the propensity to bleed significantly leading to hemodynamic compromise.
4. Search for foreign bodies (including teeth).
5. Check neurovascular status.
6. Assess for signs of infection (including possible abscesses, red streaking due to lymphangitis, or lymphadenitis).

#### **Clinical Reasoning**

1. Of the estimated 4.7 million animal bites in the United States each year, over half involve children. One of the most common complications is infection of the bite wound.
  - a. Although dogs inflict approximately 80% of animal bites and can exert considerable crushing force, dog-bite wounds are usually accessible for good wound irrigation, leading to only a 10-15% rate of subsequent infection.

- b. In contrast, cats cause only 5-10% of U.S. animal bites, but their long, slender teeth more often produce narrow, deep, difficult-to-clean puncture wounds, leading to infection rates as high as 50%.
2. To help decrease the likelihood of infection
  - a. First-aid care at the time of injury includes prompt careful cleansing of the wound with soap and water.
  - b. In the clinical setting, forcefully clean non-puncture wounds with copious amounts of sterile saline.
  - c. Debride devitalized tissue.
  - d. Send cultures from bite wounds more than 8-12 hours old and from those that appear to be infected.
  - e. Consider the possible need for x-rays for suspected fractures, for penetrating injuries over bones and joints, and to rule-out foreign bodies.
3. Study data to date has been insufficient to develop definitive recommendations regarding surgical closure of animal bites.
  - a. Following thorough cleansing and debridement, low-risk wounds with no signs of infection often may be sutured. This approach is especially common with facial bite wounds, because they seldom become infected but are cosmetically important.
  - b. Infected non-facial wounds can often be treated with approximation of margins and closure by delayed primary or secondary intent. Operative debridement and exploration is sometimes necessary.
  - c. Request consultation as needed from pediatric subspecialists including Surgery for deep or complicated wounds, Orthopedics for wounds involving bones, joints and tendons, Ophthalmologists for vision complaints or wounds involving the eye or surrounding structures and Plastic Surgery for cosmetically sensitive wounds.
4. Bite wounds of the hand have a high rate of serious complications such as major infections, because of the close proximity of the injured skin to underlying structures including bones and joints. Especially worrisome are cat bites to the hand; sharp narrow cat teeth can effectively deliver bacteria directly into bones and joints, resulting in osteomyelitis and/or septic arthritis. Therefore, for bite wounds of the hand, obtain consultation with an appropriate consultant, such as a hand surgeon.
5. Bacterial organisms likely to cause infection following dog or cat bites include *Pasteurella multocida*, *Staphylococcus aureus*, *Streptococcus* species and anaerobes. (Additionally, on rare occasions cat bites can become infected with *Bartonella henselae*, leading to Cat-scratch disease.)
  - a. Antibiotic prophylaxis for animal bites is somewhat controversial. Prophylaxis is commonly recommended for cat bites, bites of the face, hands, feet, genital areas, bites that appear infected, bites in immunocompromised patients, moderate or severe bites (especially those with edema or caused by a crush injury) and puncture wounds, especially if there has been penetration of bones, tendon sheaths or joints.
  - b. Amoxicillin-clavulanic acid is a common first choice; in penicillin-allergic patients, trimethoprim-sulfa or an extended-spectrum cephalosporin can be combined with clindamycin.
  - c. Tetanus prophylaxis (including administration of a tetanus-toxoid containing vaccine and possibly tetanus immune globulin) may be needed depending on the patient's prior tetanus vaccination history and the extent and degree of contamination of the wound. Rabies

prophylaxis may be indicated, depending on the individual circumstances of the bite. Local or state health officials and/or Infectious Disease specialist may be consulted and can provide regional rabies prevalence rates and affected species.

4. Elevation of bite-injured areas can help minimize swelling; for hand wounds, a sling provides passive elevation. Routinely follow-up significant animal bite wounds in 24-48 hours to permit monitoring of healing and surveillance for potential developing infections.

#### **Suggestions for Learning Activities:**

- Role-play counseling of parents and children about methods of preventing dog and cat bites. Such methods include selecting non-aggressive breeds, neutering male dogs to decrease aggressive behavior, ensuring ongoing rabies pet vaccination, carefully supervising young children interacting with animals, treating pets respectfully and avoiding contact with unknown animals.
- Have students discuss factors that could be responsible for the higher incidence rates of animal bites among children (for example their smaller stature leading to increased access to uncovered areas such as hands and faces, their typically strong interest in animals and the decreased ability of young children to defend themselves.)

#### **Other Resources:**

- Committee on Infectious Disease. Red Book Online (Elk Grove Village, IL: American Academy of Pediatrics, 2009), accessed July 15 2011, <http://aapredbook.aappublications.org/cgi/content/full/2009/1/2.12?maxtoshow=&hits=10&RESULTFORMAT=&fulltext=animal+bites&searchid=1&FIRSTINDEX=0&fdate=1/1/2009&tdate=1/31/2009&resourcetype=HWCIT>
- Kannikeswaran N, Kamat D. Mammalian Bites. Clin Pediatr. 2009; 48:145

## **Common Acute Pediatric Illness: Rashes, Case #5**

Written by Shoshana Melman, M.D.

A two year-old girl is bitten by a bat while playing in her yard in the early evening. Would you recommend rabies prophylaxis?

### **Definitions for Specific Terms:**

**Rabies**- An acute, preventable, progressive, usually fatal infectious encephalomyelitis (inflammation of the brain and spinal cord) caused by a virus of the family Rhabdoviridae, genus Lyssavirus (from the Greek work “lyssa”, which means “madness.”). Each year, an estimated 55,000 people worldwide, almost half of whom are children, die from rabies. The United States has had a marked decrease in cases over the past 50 years or so, resulting both from rabies pet-immunization programs and the availability of prophylactic medications; only 25 cases were reported from 2000 – 2007.

**Dysphagia**- Difficulty swallowing

### **Review of Important Concepts:**

#### **Historical Points**

- Important questions to ask include the type of animal causing the exposure, the vaccination status of dogs, cats or ferrets, and the animal’s whereabouts if known. Inquire regarding any provocation to the animal; unprovoked bites, especially by sick or feral dogs and cats or those displaying bizarre behavior, pose increased concern regarding possible rabies exposure. In the United States, animals most likely to transmit the rabies virus include skunks, raccoons, bats and foxes. In contrast, animals unlikely to transmit rabies include squirrels, rats, mice, hamsters, guinea pigs, gerbils, chipmunks, rabbits and hares (all of which typically flee at the first sign of trouble or are killed by a rabid attacking animal). Transmission almost always occurs via an animal bite; rare other causative exposures may include saliva contamination of mucous membranes or of non-intact skin, transplantation of infected tissue, or aerosol transmission (such as in a laboratory or bat cave). The biting animal’s infected saliva typically inoculates the rabies virus into the wound, where it enters neural tissue and ultimately travels to the central nervous system to cause encephalomyelitis.
- The typical incubation period is about 4-6 weeks but can range from days to years; this delayed onset of symptoms is sufficient to make post-exposure prophylaxis (PEP) an effective preventative strategy. However, once the patient develops central nervous symptoms (such as anxiety, dysphagia, seizures and sometimes paralysis), administration of PEP is highly unlikely to improve the prognosis; progression to death is almost inevitable.

#### **Physical Exam Findings**

Closely examine the wound, including for evidence of complications such as tissue destruction, foreign bodies or infection.

## Clinical Reasoning

1. What are the initial steps in clinical care?
  - a. First ensure the patient's overall medical stability. In patients with fresh bites, immediately irrigate the wound gently with copious amounts of soap and water; if available, use a virucidal agent such as povidone-iodine. Thorough immediate washing is also important if bat saliva should come in contact with eyes, nose or mouth.
  - b. Evaluate possible need for Tetanus toxoid and for antibiotics to combat possible infection.
  - c. Suturing is generally avoided. Report suspected cases of rabies exposure to public health officials.
2. Decision-making regarding administration of rabies PEP depends on the individual circumstances of the exposure.
  - a. In the United States, if the exposure was caused by an apparently healthy dog, cat or ferret that can be captured, the animal is typically held for ten days of observation; if no signs of rabies develop, the patient will generally not need rabies PEP. Captured wild mammals suspected of having rabies symptoms are killed and their brain tissues are examined for virus-specific fluorescent antigen; if test results are negative, no PEP is needed.
  - b. If the animal implicated in the exposure cannot be captured, the decision regarding rabies immunization of the patient often depends on the regional prevalence of rabies in that species; consultation with local or state health officials familiar with this information can help determine the best clinical approach. PEP is regularly recommended following all bites by bats, by mammalian predators and by domestic animals that may be rabid.
3. If indicated, PEP should be started as soon as possible after rabies exposure, but may still be effective if delayed, and should be administered without regard to the interval since the exposure. If prophylaxis was started, and the implicated animal is then found not rabid by appropriate lab testing, prophylaxis may be stopped.
  - a. PEP includes both passive protection with human rabies immune globulin (HRIG) and active immunization with rabies vaccine. Human rabies immune globulin (HRIG) is administered at a dose of 20 IU/kg body weight; if possible, the entire dose is infiltrated into and around the bite wound; any leftover HRIG may be injected at another site intramuscularly. Then, per updated 2011 policy recommendations from the American Academy of Pediatrics, 1.0 ml/dose of human diploid cell vaccine or purified chick embryo cell vaccine is administered intramuscularly in a series of 4 doses (decreased from 5 previously), on day 0 (first day of prophylaxis), with subsequent doses on days 3, 7, and 14 after the first dose. The deltoid area is used for older children and adults; the lateral thigh may be used in young children. As per previous AAP recommendations, modified regimens are recommended for patients who have previously received rabies prophylaxis and immunocompromised patients should continue to receive five doses of rabies vaccine.
  - b. Although uncommon, pre-exposure rabies vaccination may be indicated for some patients, such as spelunkers, those who handle unimmunized at-risk animals (for example veterinarians), and those planning repeat travel to or residence in at-risk destinations.
4. Following possible bat exposures, since tiny teeth may leave minimal trace of a bite, PEP should strongly be considered for all exposed infants, younger children and communication-impaired children, and for all individuals exposed to a bat while asleep. With regards to the two year-old girl

in this clinical vignette, since we were not told that the bat that bit her was caught and could be tested for rabies, PEP should be administered.

**Suggestions for Learning Activities:**

- Ask students to investigate recently reported data in their state, including overall incidence rates of rabid animals and identification of the most commonly rabid type of state animal.
- Have students use the “Rabies Kids” site (<http://www.cdc.gov/rabiesandkids/>) of the Centers for Disease Control and Treatment to give a short simple children’s talk about rabies, including preventative information, such as avoiding stray and wild animals, keeping garbage well-secured and having their own pets immunized against rabies.

**Other Resources:**

- American Academy of Pediatrics Committee on Infectious Disease. Policy Statement: Rabies-Prevention Policy Update: New Reduced-Dose Schedule. *Pediatrics*. 2011; 127:(4): 785-787
- Committee on Infectious Disease. Red Book Online (Elk Grove Village, IL: American Academy of Pediatrics, 2009), accessed July 15 2011, <http://aapredbook.aappublications.org/cgi/content/full/2009/1/3.108?maxtoshow=&hits=10&RESULTFORMAT=&fulltext=rabies&searchid=1&FIRSTINDEX=0&fdate=1/1/2009&tdate=1/31/2009&resourcetype=HWCIT>
- Centers for Disease Control and Prevention. Rabies Site. (<http://www.cdc.gov/rabies/>) Updated July 28, 2010. Accessed July 10, 2011

## **Common Acute Pediatric Illness: Rashes, Case #6**

Written by Kirsten Hawkins, M.D.

A fifteen-year-old boy is concerned that his acne is worsening. He has multiple open and closed comedones scattered over his face. How would you counsel and treat this patient?

### **Definitions for Specific Terms:**

#### **Comedones-**

Open comedo or blackhead: Brownish or black non-inflammatory papule with central distended pore that forms when the pressure of sebum and dead cells forces the plug to the surface of the skin. The color of the blackhead is caused by skin pigment and dead skin cells. Blackheads cannot be washed or scrubbed away.

Closed comedo or whitehead: Small, non-inflammatory, skin colored or whitish papule with small central pore

**Pimple-** A papule is formed when the pressure from sebum and dead cells becomes too great, the trapped material may seep through the walls of the follicle and cause redness and discomfort. A pimple is a papule topped by a pus-filled lesion that may be red at the base

**Nodules-** Large, painful, solid lesions that are lodged deep within the skin

**Cysts-** Deep, painful, pus-filled lesions that can cause scarring.

### **Review of Important Concepts:**

#### 1. Characterization of acne – How is acne defined and characterized?

Acne is graded as mild, moderate, moderately severe, and severe based on whether there is inflammation present, the number of lesions, the extent of body involvement and the presence of scarring. Mild acne consists of comedones (non-inflammatory lesions) with generally less than 10 papules and pustules. In moderate acne there are moderate numbers of papules and pustules (10-40) and there may be mild disease of the trunk. Moderately severe acne is characterized by numerous papules and pustules (40-100) and occasional larger, deeper inflammatory lesions. Moderately severe acne usually involves the face, chest, and back. In severe acne there are many large, painful nodular or pustular lesions along with smaller papules, pustules, and comedones.

#### 2. What causes acne?

Acne is a disease of the pilosebaceous unit characterized by sebaceous gland hyperplasia with increased sebum production, altered follicular growth and desquamation, colonization with *Propionibacterium acnes* and an inflammatory immune response. The hair follicle is lined with keratinocytes that can occlude the canal. This follicular plugging and increased sebum production causes follicular enlargement or the “microcomedo”. The immune response is both cell-mediated (with both immediate and delayed type hypersensitivity reactions) and humoral with anti *Propionibacterium acnes* antibodies starting a complement cascade resulting in an inflammatory reaction. *P. Acnes* also releases chemotactic factors including cytokines IL-1, IL-8, and TNF- $\alpha$ . Neutrophils accumulate in comedo and cause further follicular damage. The severity of acne is

related to the interactions between bacterium and antibody, complement and cell-mediated immune response, NOT bacterial count.

### 3. How do you treat acne?

#### a. Acne Treatment Table

##### Mild Acne

Comedonal	Benzoyl Peroxide (or topical retinoid)
Inflammatory	Benzoyl Peroxide (or topical BP/antibiotic)
Mixed	Benzoyl Peroxide (or topical BP/antibiotic) +/- topical retinoid

##### Moderate Acne

Mixed	Benzoyl Peroxide or topical BP/antibiotic (or oral abx) AND Topical retinoid
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##### Moderately Severe Acne

Mixed	Oral Antibiotic+ Topical Retinoid Consider OCP in female; BP as adjunct
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##### Severe Acne

Mixed	Oral Retinoid +Oral Antibiotic + Topical Retinoid Consider OCP in female; BP as adjunct
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#### b. How do antibiotics work in the treatment of acne?

Topical antimicrobial agents are effective in the treatment of inflammatory disease. Benzoyl peroxide is a bactericide and is an excellent first-line medication. Oral antibiotics have anti-inflammatory properties. Antibiotic resistance is common and an antibiotic may need to be changed if there is no clinical response. Oral antibiotics should be used for short term (3-6 months) while topical antibiotics and topical retinoids are used for maintenance therapy. Erythromycin can cause GI distress; Tetracycline must be taken on empty stomach; Doxycycline can cause photosensitivity and esophagitis; and Minocycline can cause headaches, dizziness, lupus-like syndrome, skin pigmentation, and autoimmune hepatitis.

#### c. How do topical retinoids work in the treatment of acne?

Topical retinoids correct abnormalities in the follicular keratinocyte. They are effective in both the treatment and prevention of the primary lesion of acne, the comedo, and limit the formation of inflammatory lesions. Topical retinoids should be started with an every 3rd night schedule and gradually increased to nightly as tolerated.

#### d. How do oral retinoids work?

Isotretinoin reduces the size and secretions of sebaceous glands, secondarily inhibit the growth of *P. acnes* and the resulting inflammation, and prevent comedogenesis through normalization of the differentiation of follicular keratinocytes. Isotretinoin is the only treatment that leads to remission that may be permanent. Oral retinoid use requires subspecialist referral to a provider who participates in the ipledge program (a mandatory program to reduce risk of pregnancy related complications of oral retinoids). Side effects include hypertriglyceridemia and depression.



4. What information and anticipatory guidance should you give the parents of a child with acne?
  - a. Remember to tell patients that therapy can take 6-8 weeks before change is visible and that the acne may get worse before it gets better.
  - b. Have them come back to clinic in 2 months for follow-up.
  - c. Benzoyl peroxide can cause bleaching of hair, clothes, linens and towels.
  - d. Gels that contain acetone or alcohol can be very drying (though quite effective).
  - e. Cream or lotion may be better for patients with dry skin.

### **Suggestions for Learning Activities**

- Have the student review medications that are associated with acne. (Steroids, anti-epileptics, lithium, isoniazid, and rifampin)
- Have the students discuss the social, emotional and psychological impairments related to acne.

### **Other Resources**

- Expert Committee Recommendations for Acne Management. Zaenglein AL.Thiboutot.DM. Pediatrics 2006;118;1188-1199, <http://www.pediatrics.org/cgi/content/full/118/3/1188>
- James, W. N Engl J Med, Volume 352(14).April 7, 2005.1463-1472
- <http://www.nejm.org/doi/pdf/10.1056/NEJMcp033487>

## **Common Pediatric Acute Illnesses: Limb & Joint, Case #2**

Written by Jennifer Soep, M.D.

An athletic twelve-year-old boy complains of pain just below the right knee when running and playing soccer. There is no joint swelling or redness. There is pain on palpating the right tibial tuberosity. Discuss the most likely cause and treatment.

### **Definition for Specific Terms:**

**Tibial tuberosity**- Oblong elevation on the proximal, anterior aspect of the tibia to which the patellar tendon attaches.

### **Review of Important Concepts:**

#### **Historic Points**

- Time course of presentation—duration of symptoms will determine if this is acute or chronic. Has this happened before?
- Relation to time of day/activity—the fact that his symptoms are worse with activity suggests a mechanical issue. If his symptoms were worse in the morning and/or after periods of inactivity, then would be more concerned about inflammatory process.
- Associated symptoms—does he have other joint pain, fever, rash, weight loss, etc. to suggest that this is part of a systemic illness?

#### **Physical Exam Findings**

1. Signs of inflammation: It is important to examine the knee for signs of inflammation such as swelling, redness, warmth, effusion, pain with movement, and decreased range of motion.
2. Tenderness at the tibial tuberosity: Tenderness at the tibial tuberosity suggests some type of injury/inflammation at the patellar tendon insertion.

#### **Clinical Reasoning**

1. What is the most likely cause of his presentation and physical findings?  
His clinical picture is most consistent with Osgood Schlatter Syndrome (OSS). This is a traction apophysitis of the tibial tubercle due to repetitive strain and chronic avulsion of the secondary ossification center of the tibial tuberosity. It occurs due to the strong pull of the quadriceps muscle during sporting activities. It presents in growing children (typically girls 8-12 years and boys 12-15 years) with pain, swelling, tenderness over the tibial tuberosity. Pain is increased with activities that involve jumping and/or kneeling and often begin soon after a child has begun a new sporting activity.
2. Should additional tests be performed?
  - a. OSS is a clinical diagnosis based on history and physical exam and therefore, additional testing is often not required. However, plain x-rays of the knee may be indicated if symptoms are

unilateral to rule out other conditions such as acute tibial apophyseal fracture, infection, or tumor.

- b. In OSS, x-rays (best seen on lateral view) show irregularity of the apophysis with separation from the tibial tuberosity in early stages and fragmentations later. There may also be anterior soft tissue swelling.

3. Are there other conditions that should be on the differential diagnosis?

Other conditions to consider include:

- a. Sinding-Larsen-Johansson syndrome (traction apophysitis of the inferior patellar pole)
- b. Hoffa's syndrome (injury to Hoffa's fat pad), tibial tubercle fracture
- c. Juvenile idiopathic arthritis (particularly enthesitis-associated arthritis subtype)

4. What is the recommended treatment for this condition?

Most patients respond to conservative, nonoperative treatment including limitation of activity, ice, non-steroidal anti-inflammatory medications and physical therapy.

**Suggestions for learning activities:**

- Review the exam of the knee joint.
- Find relevant radiographs online or through the local Radiology department.
- If he had bilateral knee pain and swelling how would that change your approach to his diagnosis and treatment?

**Other Resources:**

- Gholive PA et al. Osgood Schlatter Syndrome. Current Opinion in Pediatrics 2007, 19:44-50.

### **Common Acute Pediatric Illness: Limb & Joint, Case #3**

Written by Jennifer Soep, M.D.

A seven year-old boy complains of pain in his hip and walks with a limp. There is no history of trauma or fever and his past history is non-contributory. What is in your differential diagnosis and how would you evaluate this patient?

#### **Definition for Specific Terms:**

**Limp**- A limp is any alteration in the normal two component (stance and swing phases) rhythmic gait. The most common type of limp is an “antalgic gait” during which there is shortening of the stance or weight-bearing phase secondary to pain in the weight-bearing extremity. Other types of limp include spastic, short-leg, stooped, foot drop, toe-walking, vaulting and Trendelenberg.

#### **Review of Important Concepts:**

##### **Historic Points**

- Time course of presentation: Duration of symptoms will determine if this is acute or chronic. Has this happened before?
- Relation to time of day/activity: If his symptoms are worse with activity, then that would suggest a mechanical issue and if his symptoms are worse in the morning and/or after periods of inactivity, then that should raise concern for an inflammatory process. Has he recently started any new activities or does he participate in regular exercise/sports that could be causing or contributing to his symptoms?
- Associated symptoms: Does he have other joint pain to suggest that this is affecting multiple joints or just isolated to one hip? Any back, foot or heel pain? Any GI symptoms or neurologic symptoms to suggest that this is referred pain?
- Family history: Is there a family history of any joint or bone abnormalities?

##### **Physical Exam Findings**

1. Examination of the hip  
It is important to perform a complete examination of the hip including palpation, range of motion, strength. The examiner should look for leg length discrepancy and muscle atrophy. The examiner will not see overt signs of inflammation (such as swelling, warmth or redness), since the hip is such a deep joint.
2. Examination of surrounding areas
  - a. One should examine the abdomen to rule out referred pain from a primary abdominal/pelvic process.
  - b. The examiner should examine the other joints in his lower extremity to evaluate for tenderness, swelling, warmth, weakness, or abnormal reflexes.
  - c. The back should also be examined.
3. Observation of his gait  
Observe him walking to determine the type of limp.

## Clinical Reasoning

1. What is the differential diagnosis of his hip pain and limp?
  - a. Transient synovitis
  - b. Juvenile idiopathic arthritis
  - c. Leukemia
  - d. Sprain
  - e. Overuse
  - f. Legg-Calves-Perthes Disease
  - g. Slipped Capital Femoral Epiphysis
  - h. Discitis
  - i. Bone tumor (benign such as osteoid osteoma or malignant such as osteosarcoma)
  - j. Intraabdominal/pelvic process
  - k. Given his lack of fever, infectious etiologies such as septic joint and osteomyelitis are less likely
  - l. Since there was no history of injury, a fracture or other traumatic cause are not likely
2. How would you evaluate this patient?
  - a. The work-up would depend on how long he has been having symptoms and how severe they are. If this is acute in nature and not very severe, no additional work-up may be necessary. However, if the symptoms are more chronic and/or severe, then screening labs should be considered including CBC, ESR, CRP to evaluate for systemic inflammation and at least an AP view of the hips and pelvis should be performed to evaluate for an effusion and any obvious bony abnormalities.
  - b. Additional imaging studies to consider would be ultrasound (to evaluate for an effusion) or MRI (to more closely delineate bone/joint/ligament/tendon abnormalities).

## Suggestions for Learning Activities:

- Review the exam of the hip joint.
- View videos of different types of limp on YouTube.
- If he had a history of fever, how would that change your approach to his diagnosis and work-up?
- What would you expect to find on x-ray if he has Legg-Calves-Perthes Disease? Slipped Capital Femoral Epiphysis?
- Find representative x-rays on-line or at the local Radiology department.

## Other Resources:

- Tse SML, Laxer RM: Approach to acute limb pain in childhood. *Pediatr Rev* 2006;27:170.
- Hill D, Whiteside J: Limp in children: differentiating benign from dire causes. *Journal of Family Practice* 2011;60(4):193-7.

## **Common Acute Pediatric Illness: Limb & Joint, Case #6**

Written by Jennifer Soep, M.D.

A five-year-old girl presents with a warm, swollen knee. Discuss your differential diagnosis and evaluation of this child. How would your differential diagnosis change if she later developed swelling of the ankle and wrist?

### **Review of Important Concepts:**

#### **Historic Points**

- Time course of presentation:  
Duration of symptoms will determine if this is acute or chronic. Has this happened before? Any preceding injury? Will she walk on it?
- Associated symptoms:
  - Does she have fever or rash?
  - Any preceding illness such as upper respiratory infection, gastroenteritis, or sore throat to suggest a reactive process?
  - What makes it better or worse and what time of the day is it worse?
  - Any tick bites, cat scratches, unpasteurized dairy product to suggest specific infectious diseases?

#### **Physical Exam Findings**

1. Perform a complete examination of the knee:  
Feel for warmth. Normally, the knee should be cooler than the shin so if it is warmer, that suggests inflammation of the knee
2. Assess range of motion.  
Children with a septic joint usually have severe pain with movement and significant limitation in movement
3. Check for a fluid wave that would be consistent with an effusion
4. Look for leg length discrepancy  
Measure from the anterior superior iliac spine to the medial malleolus; the involved leg can grow longer in chronic arthritis (that occurs over a long period of time not acutely and this case is acute).
5. Evaluate for muscle atrophy that would suggest that she has had long-standing decreased range of motion and therefore decreased muscle use.
6. Observation of her gait  
One should observe her walking to determine the type of limp
7. Examine the skin for rashes that may suggest systemic causes of her knee swelling such as erythema marginatum (rheumatic fever), erythema migrans (Lyme Disease) or the salmon-colored, migratory rash associated with systemic juvenile idiopathic arthritis.

## Clinical Reasoning

1. What is the differential diagnosis of her warm, swollen knee?
  - a. If there is significant pain with movement and/or limited range of motion and fever, then septic arthritis must be strongly considered.
  - b. Other diagnoses on the differential include:
    - Post-viral arthritis
    - Post-strep arthritis
    - Rheumatic fever
    - Juvenile idiopathic arthritis
    - Lyme arthritis
    - Osteomyelitis
    - Trauma
2. How would your differential diagnosis change if she later developed swelling of the ankle and wrist?
  - a. If she presents with multiple joints involved, an infectious etiology such as a septic arthritis or osteomyelitis become less likely. But, one can have septic arthritis of several joints
  - b. HSP often involves knees and ankles as does a traumatic cause.
  - c. If this is an additive process, then juvenile idiopathic arthritis would become more likely since this could involve multiple joints.
  - d. If, in contrast, it is a migratory pattern, then a reactive arthritis, either post-viral or rheumatic fever, needs to be considered.
3. How would you evaluate this patient?  
Laboratory work-up should include:
  - a. CBC, ESR and CRP to screen for systemic inflammation.
  - b. If septic arthritis is being considered, then the joint must be tapped and the fluid sent for cell count, differential, glucose and culture.
4. Other testing that may be indicated to help with the diagnosis:
  - a. Throat culture, antistreptolysin O and antiDNase B if post-strep arthritis or rheumatic fever is being considered
  - b. EKG and echocardiogram to evaluate for heart involvement
  - c. Lyme antibodies and Western Blot if the patient has traveled to a Lyme endemic area  
Rheumatoid Factor
  - d. ANA
  - e. HLB-27
  - f. Parovirus Titers
  - g. MRI to evaluate for bone/joint/ligament/tendon abnormality

## Suggestions for Learning Activities:

- Review the exam of the knee joint.
- View pictures on-line of the rashes that could be seen with arthritis. (that occurs over a long period of time not acutely and this case is acute).
- Review the expected results of synovial fluid analysis in cases of a normal joint, septic arthritis, juvenile idiopathic arthritis.

- If this is a septic arthritis, what are the likely organisms and what antibiotic would you choose to begin treatment?

**Other Resources:**

- Tse SML, Laxer RM: Approach to acute limb pain in childhood. *Pediatr Rev* 2006;27:170.
- John J, Chandran L: Arthritis in children and adolescents. *Pediatr Rev* 2011;32:470.



## **Common Acute Pediatric Illness: Heart Murmurs, Case #1**

Written by Austin Raunika, M.D.

On routine physical exam a five-year-old girl is found to have a heart murmur. How would you distinguish between an innocent and a pathologic murmur? What information and anticipatory guidance should you give the parents of a child that has an innocent murmur?

### **Definitions for Specific Terms:**

**Murmur**- An abnormal sound heard when listening to the heart or neighboring large blood vessels caused by turbulent blood flow.

### **Review of Important Concepts:**

1. Characterization of murmurs – How are murmurs characterized?  
Murmurs are defined by the quality, timing in the cardiac cycle, location where best heard, radiation, and grade (or severity) of the murmur.
2. Grading of murmurs - How are murmurs graded?  
Murmurs are graded on a 6 point scale.
  - 1/6 is faintly heard
  - 2/6 is easily heard
  - 3/6 is loud
  - If you can palpate a thrill (turbulence), then you would grade the murmur 4-6/6 where 4/6 = thrill + murmur heard with flat of stethoscope
  - 5/6 = thrill + murmur heard with edge of stethoscope
  - 6/6 = thrill + murmur heard by stethoscope no longer in contact with the chest

### **Clinical Reasoning**

1. How can you distinguish an innocent from a pathologic murmur?
  - a. Pathologic murmurs should be considered if the murmur is loud >3+, coarse in quality, associated with a thrill (palpable turbulence), holosystolic, diastolic (decrecendo or mid-diastolic).
  - b. In addition, these should be concerning if a murmur is continuous at a site other than commonly heard with the normal cervical venous hum, or is associated with any cardio-respiratory symptoms.
  - c. For infants, concerning signs might include rapid breathing, difficulty feeding, cyanosis, or failure to thrive.
  - d. For older children, difficulty exercising, chest pain, or fatigue should elicit concern.
2. What are some of the common innocent murmurs? Describe them.
  - a. The pulmonary flow murmur is a systolic murmur at the upper left sternal border.
  - b. The Still's murmur is a musical or vibratory murmur at low to mid left sternal border.
  - c. The cervical venous hum is a continuous murmur heard at the right base of the neck and is best heard in the upright position typically resolving when supine.

- d. In the newborn/infant a soft systolic murmur heard best at the upper left sternal border radiating to the axilla is most likely normal/physiologic branch pulmonary artery stenosis that will likely resolve as branch pulmonary arteries grow to normal size.
3. What information and anticipatory guidance should you give the parents of a child with an innocent murmur?
  - a. Innocent murmurs do not require SBE prophylaxis.
  - b. Innocent murmurs do not need cardiac medications.
  - c. Innocent murmurs do not need sports/activity restrictions (are not an excuse to be physically inactive).
  - d. Innocent murmurs may get louder or softer depending upon hydration, activity, and illness/fever.
  - e. Innocent murmurs will most likely resolve over time but may last a lifetime.
  - f. Innocent murmurs should be followed by primary care provider for ongoing reassurance or referral in the uncommon event they were to change in a concerning fashion.

**Suggestions for Learning Activities:**

- Have the student review the type of heart defect associated with the following syndromes, as well as, the physical findings of the syndrome and the descriptions of the murmurs:
  - Turner syndrome: Coarctation
  - Noonan syndrome : Supravalvar pulmonary stenosis
  - Down syndrome: Complete AV canal
  - Williams syndrome: Supravalvar aortic stenosis.

**Others Resources:**

The Auscultation Assistant: [www.wilkes.med.ucla.edu/intro.html](http://www.wilkes.med.ucla.edu/intro.html)  
Heart Murmurs. Menashe Pediatrics in Review.2007; 28: 19-22

## **Common Acute Pediatric Illness: Heart Murmurs, Case #2**

Written by Austin Raunika, M.D.

You are examining an otherwise healthy one-month-old child and detect a systolic murmur along the upper left sternal border that radiates to the back. What would you tell these parents and how would you manage the patient?

### **Definitions for specific terms:**

**Murmur** - An abnormal sound heard when listening to the heart or neighboring large blood vessels caused by turbulent blood flow.

### **Review of important concepts:**

1. Characterization of murmurs – How are murmurs characterized?  
Murmurs are defined by the quality, timing in the cardiac cycle, location where best heard, radiation, and grade (or severity) of the murmur.
2. Grading of murmurs - How are murmurs graded?  
Murmurs are graded on a 6 point scale.
  - 1/6 is faintly heard
  - 2/6 is easily heard
  - 3/6 is loud
  - If you can palpate a thrill (turbulence), then you would grade the murmur 4-6/6 where 4/6 = thrill + murmur heard with flat of stethoscope
  - 5/6 = thrill + murmur heard with edge of stethoscope
  - 6/6 = thrill + murmur heard by stethoscope no longer in contact with the chest

### **Clinical Reasoning**

1. What clinical information should you ask when you hear a heart murmur in an infant?  
You should ask about cyanosis, growth, difficulty feeding, or sweating with feeds. Review past medical history and family history to ensure there are no concerning issues or to alleviate family concerns in the context of the infant's exam.
2. What will be important in the physical examination of this infant?
  - a. Check the brachial and femoral pulses to ensure they are equal without delay and confirm 4 extremity blood pressures with lower extremity are equal to or higher than the upper extremity blood pressures in normal patients.
  - b. Check pre and post ductal pulse oximetry.
3. What is your differential diagnosis in this patient?  
The differential diagnosis for a systolic murmur in this one month old includes:
  - a. Pulmonary flow murmur
  - b. Physiologic pulmonary artery stenosis with transmission into the lung field
  - c. Pulmonary valve stenosis

- d. A small PDA where only the systolic component of flow is heard, and rare in early infancy but an atrial septal defect with volume load to the pulmonary valve with murmur of relative pulmonary stenosis (possibly with wide or fixed split S2).
  - e. If on careful examination, the murmur is thought to be actually loudest over the back and radiating anteriorly to the chest, one should consider the possibility of coarctation of the aorta where the murmur is created by the turbulence across the kink of the (left of midline descending) aorta.
4. What would you tell these parents and how would you manage the patient?
- a. Systolic murmurs that are soft and not associated with symptoms can be followed over time.
  - b. Share with family your clinical diagnosis, possible other diagnoses, and how you will follow the child.
  - c. Make sure you explain what a murmur is, how common murmurs are, and the anticipated good long-term prognosis.
  - d. Address need for continued well-child and sick-child visits, need for immunizations, no need for SBE prophylaxis, no need for cardiac consultation at this time and the criteria you will use for referral for second opinion with the cardiologist.

#### **Suggestions for Learning Activities:**

- Review the innocent murmurs of childhood and consider pathologic murmurs that would be in the differential for each one.
  - Carotid bruit vs Aortic Valvular Stenosis, Subvalvular Aortic Stenosis, Idiopathic hypertrophic subaortic stenosis (IHSS)
  - Venous Hum vs Patent ductus arteriosus, AV fistulae
  - PPS vs significant PPS, ASD, AVM, TAPVR, Coarctation of thoracic aorta
  - Pulmonary flow or ejection vs Pulmonic valvular stenosis, ASD
  - Stills Murmur vs VSD, Mitral insufficiency, IHSS
  - Aortic ejection vs Aortic valvular stenosis

#### **Other Resources:**

- The Auscultation Assistant: [www.wilkes.med.ucla.edu/intro.html](http://www.wilkes.med.ucla.edu/intro.html)
- Heart Murmurs. Menashe Pediatrics in Review.2007; 28: 19-22

## **Common Acute Pediatric Illness: Lymphadenopathy, Case #2**

Written by Wilbur Pan, M.D.

A six-year-old, previously healthy, girl presents with a 3 by 5 cm tender anterior cervical lymph node. What historical and physical examination information is essential to develop an appropriate differential diagnosis?

### **Definition for Specific Terms:**

**Lymphadenopathy**- Abnormally enlarged lymph nodes. Note: the age of the patient must be taken into account when deciding if a lymph node is larger than normal

**Adenopathy**- Swelling and morbid change in lymph nodes

**Adenitis**- Inflammation of lymph nodes

### **Review of Important Concepts:**

#### **Historical Points**

- There are many important details in the history that must be determined in working up an enlarged lymph node. This includes:
  - how long ago it was first noticed
  - how quickly it grew
  - whether it has changed over time, especially if it had decreased in size
  - associated pain, if any
  - other locations where enlarged lymph nodes were found
  - associated skin changes, especially erythema
  - how it feels to the parents and the patient
- More broadly, a history designed to elicit a potential cause for lymphadenopathy should also be obtained. The most common cause of lymphadenopathy is infections, and so a history appropriate for an infectious workup (fever, exposures especially to strep, pain, erythema) is needed. Has the patient been exposed to TB? When was the last time the patient had a PPD placed and what were the results? If this turns out to be negative, further history looking for less common causes of lymphadenopathy (autoimmune, hematologic, malignancy, metabolic disorders) should be obtained.

#### **Physical Exam Findings**

1. First, is it a lymph node?
  - a. There are normal and abnormal anatomic structures that can be mistaken for lymph nodes on physical exam, including: cervical ribs, cysts, goiter, sternocleidomastoid muscle in torticollis, bony prominences on shoulders and skull, and neurofibromas. These are the characteristics that should be described when evaluating a lymph node:
    - size (use a ruler)
    - tender/nontender

- warm or cool to the touch
  - presence or absence of erythema
  - presence or absence of fluctuence
  - if the lymph node(s) are discrete or matted
  - if the lymph node(s) are mobile/fixed
  - if the lymph node(s) are soft/hard
2. A common pitfall in evaluating lymph nodes is not taking into account the expected findings on physical exam according to the age of the patient. Most newborns and young infants will not have palpable lymph nodes. But children in the toddler to preschool period often will have palpable lymph nodes in the cervical and inguinal areas. After that age, lymph nodes begin to become less palpable. So the description of abnormal “small shotty lymphadenopathy” in a 3 year old coming in for a well child check is not accurate, as small, shot-sized lymph nodes are expected on physical exam. This would not be lymphadenopathy, as the use of the term “lymphadenopathy” implies an abnormality. Lymph nodes palpated in the supraclavicular area is an abnormal location and is always concerning.

### Clinical Reasoning

What other information would you want to obtain when evaluating this patient?

So far, we have the size of the lymph node, its location, and that it’s tender. The other aspects of the H/P as described above should be obtained.

1. In this vignette, what is the most likely cause for the lymphadenopathy described?  
Given the enlarged lymph node and tenderness, infection is the most likely possibility.
2. Any diagnostic testing that should be obtained?
  - a. Assuming that there are no surprises on obtaining a more complete H/P, a Rapid Strep test and/or culture; treat if positive, and/or follow with careful observation for 2-3 weeks may be the first approach.
  - b. After follow up in 2-3 weeks if the node persists, then consider broadening the workup with a CBC/diff/Plt, ESR, and CRP is a reasonable start.
  - c. Consider placing a PPD to rule out atypical TB.
  - d. Consider checking for cat scratch disease. Viral titers (EBV, CMV) based on clinical suspicion can be sent.
  - e. Imaging studies such as an ultrasound (quickest), CT (more detail but consider radiation exposure) or CXR (evaluate for mediastinal mass) can be considered.
3. What would be your next step in management?
  - a. If the strep test is positive, a trial of antibiotics is reasonable, with a recheck in 2-3 weeks.
  - b. If the strep test is negative then the use of antibiotics may be considered but keep in mind that you do not have a diagnosis and further work up is needed.
  - c. An alternative would be observation and pain control with a recheck in 2-3 weeks with a review of the history and exposures.

### Diagnosis:

6 y/o girl with lymphadenitis

**Suggestions for Learning Activities:**

- Ask the students the clinical reasoning questions above.
- Since missing a malignancy is a common worry among pediatricians when seeing a patient with lymphadenopathy, describe a history and characteristics of lymphadenopathy that would be less likely due to infection and more likely for malignancy.
- Discuss the pros and cons of needle vs. open biopsy to obtain a pathologic diagnosis if malignancy is expected. Open biopsy is almost always preferred.

**Other Resources:**

- Kliegman: Nelson Textbook of Pediatrics, 19th ed., Chapter 484 - Lymphadenopathy
- McMillan: Oski's Pediatrics, 4th ed., Chapter 295 - The Spleen and Lymph Nodes

## **Common Acute Pediatric Illnesses: Splenomegaly, Case #2**

Written by Wilbur Pan, M.D.

A two-year-old boy with sickle cell disease presents with the sudden onset of pallor and has an enlarged spleen on examination. What would you be most concerned about?

### **Definition for Specific Terms:**

**Pallor:** an unusual absence of color in the skin, often seen more easily in the mucosal membranes.

**Sickle cell disease:** comprises a group of inherited blood disorders caused by the Hgb S mutation in the  $\beta$ -globin gene.

### **Review of Important Concepts:**

The major teaching point of this vignette is to recognize the signs and symptoms of splenic sequestration in a child with sickle cell disease. This is an event caused by sickling occurring in the spleen, causing vasoocclusion which reduces the blood flow leaving the spleen. As more blood enters the spleen, it becomes trapped and is essentially removed from the circulation. Many of the history and physical exam findings are similar to what you would see in rapid blood loss and hypovolemic shock, even though the blood has not left the body.

### **Historical Points**

- History of sickle cell disease in the patient
- Onset of pallor
- Other aspects of the history not given in this vignette that might occur in splenic sequestration would include:
  - Signs and symptoms often associated with rapid blood loss: weakness, irritability, unusual sleepiness left sided abdominal pain or shoulder pain caused by the sudden enlargement of the spleen.
  - History of fever? Fever should not be associated with splenic sequestration but if the history was elicited then you would have to consider the possibility of subsequent sepsis complicating the illness since the patient is considered immunocompromised due to functional asplenia.

### **Physical Exam Findings**

1. Vitals: look for vital sign changes associated with sudden blood loss: tachycardia, falling blood pressure, and rule out fever.
2. Enlarged spleen: often can be very enlarged
3. Signs associated with acute blood loss/hypovolemic shock: pallor, poor perfusion, weak pulses

### **Clinical Reasoning**

1. At what age does splenic sequestration occur?
  - a. Patients with Hgb-SS disease tend to get splenic sequestration in the toddler age range.



- b. Patients with Hgb-SC disease can get splenic sequestration when they are in their teens.
2. What are the expected laboratory findings?
    - a. Very low Hgb/Hct.
    - b. Thrombocytopenia is often seen, as well.
    - c. It should be noted that patients with sickle cell disease have elevated platelet counts compared to the general population, so a platelet count in the 140-200 range may represent thrombocytopenia even if the laboratory computer doesn't stamp an "L" next to the result.
  3. What would be your immediate management?
    - a. Upfront immediate management as needed to maintain vascular volume: IVF, NS boluses. Transfusion is necessary to reverse the sickling process, but it is important to realize that although the Hgb may be very low, the blood has not left the body. Instead of a standard PackedRBC transfusion of 15 ml PRBC/kg, transfuse 5 ml PRBC/kg. This will reverse the sickling and avoid cardiac overload as the sequestered blood leaves the spleen.
    - b. Recognize the emergent nature of the situation: Splenic sequestration may have a mortality rate of up to 20%.
  4. What would be the long term management?

Splenic sequestration has a very high rate of recurrence, with up to 50% of patients recurring. Splenectomy may be indicated to prevent recurrences, with the issues of subsequently having to manage a patient status post splenectomy.

**Diagnosis:**

Sickle cell disease, splenic sequestration

**Suggestions for Learning Activities:**

- Discuss the importance of patient education. Parents of children with sickle cell disease are taught how to do an abdominal exam so that they can check for an enlarged spleen at home.
- Review other indications for transfusion in sickle cell patients: stroke, acute chest syndrome, aplastic crisis, priapism (maybe).
- Practice abdominal exam, with emphasis on feeling for abdominal masses
- Review issues related to transfusion, including utility of universal irradiation/leukofiltration of blood products.
- Review aspects of care related to patients without splenic function.

**Other Resources:**

- Kliegman: Nelson Textbook of Pediatrics, 19th ed., Chapter 456.1 - Sickle Cell Disease
- Kliegman: Nelson Textbook of Pediatrics, 19th ed., Chapter 464 – Red Blood Cell Transfusions and Erythropoietin Therapy
- McMillan: Oski's Pediatrics, 4th ed., Chapter 290 - Hemoglobinopathies and Thalassemias

## Common Acute Pediatric Illness: Bleeding, Case #1

Written by Rayne Rouce, M.D.

A previously healthy two year-old female presents with persistent nosebleeds over the past two days and petechiae on her extremities. What is your differential diagnosis? How would you evaluate this patient?

### Definitions for Specific Terms:

**Petechiae**- Pinpoint flat round red spots under the skin surface caused by intradermal hemorrhage. Petechiae are less than 3mm in diameter, and do not blanch when pressed upon.

**Prolonged nosebleed**- Epistaxis that lasts longer than 20 minutes is considered prolonged.

### Review of Important Concepts:

The teaching points for the students are to

- Understand the significance of petechiae as a physical exam finding, especially when other signs of bleeding (epistaxis) are present
- Understand that petechiae and nosebleeds both indicate a disturbance in primary hemostasis ( a quantitative or qualitative platelet problem). In contrast, deep bleeds such as hemarthroses and intramuscular bleeds are indicative of a coagulopathy (Factor 8 or 9 deficiency).
- Understand that the finding of recurrent nosebleeds alone could have a number of benign etiologies, but the combination of epistaxis and petechiae in a child between 2 and 5 years old should raise suspicion for ITP (Immune Thrombocytopenic Purpura).

### Historical Points

- Onset and associated symptoms-What other questions should you ask about the history? Patients with ITP are generally asymptomatic and well-appearing aside from skin findings (petechiae, bruising). They can less commonly present with mild mucosal bleeding (epistaxis, hematuria, hematochezia, menorrhagia). Rarely, patients may develop severe bleeding, such as prolonged epistaxis, gastrointestinal bleeding, hematuria, hemoptysis, and intracranial hemorrhage. The presence of constitutional symptoms (fever, weight loss, pallor, bone pain) make the diagnosis of ITP much less likely and increase suspicion for a malignancy instead.
- Ask about presence/absence of constitutional symptoms, signs/symptoms of infection, or symptoms suggestive of disturbances in other cell lines.
- Preceding illnesses/Recent vaccinations: ITP classically occurs about 1-3 weeks following a viral illness. ITP may also occur after MMR/Varicella vaccines.
- History of bleeding symptoms: A history of a prior episode of bleeding is important for two reasons: 1. History of prolonged epistaxis or petechiae suggests a chronic disorder (chronic ITP or qualitative platelet problem). 2. History of more severe bleeding may suggest an underlying coagulopathy.
- Family History of bleeding disorders (suggests inherited disorder)
- Medications: There are numerous medications that can cause platelet dysfunction (aspirin, antibiotics, anticonvulsants, etc).

## Physical Exam Findings

1. General: is child well-appearing?
  - a. Skin: note petechiae, purpura [palpable versus nonpalpable, the former is seen in Henoch-Schönlein purpura (HSP)], presence or absence of edema(also seen in HSP).
  - b. HEENT: examine mucous membranes for signs of bleeding (epistaxis, gingival bleeding), as well as for signs that suggest other pathology(gum hypertrophy in AML), swollen/boggy nasal turbinates (allergic rhinitis). Look for scleral icterus (suggests a hemolytic process), scleral/retinal hemorrhages
  - c. Evidence for active infection (URI symptoms, etc.)
  - d. Lymphadenopathy (suggests infection or infiltrative bone marrow process)
  - e. Hepatosplenomegaly: absent in ITP. Presence suggests bone marrow process such as leukemia; also can be seen in autoimmune disorders, mononucleosis.
  - f. Joint pain/swelling/tenderness absent in ITP, but can be present in autoimmune disease and leukemia.
  - g. Presence of dysmorphic features, skeletal abnormalities(suggests inherited thrombocytopenia such as Fanconi anemia or Thrombocytopenia Absent Radii)

## Clinical Reasoning

1. How does the history and physical exam help narrow the differential diagnosis?
  - a. Petechiae and mucosal bleeding point towards a platelet problem (quantitative versus qualitative) as opposed to deep joint and muscular bleeding (coagulopathy, factor deficiency).
  - b. The absence of systemic symptoms, hepatosplenomegaly, and signs of infection make a bone marrow process like leukemia less likely.
  - c. The general well appearance of the child makes DIC unlikely, and absence of palpable purpura, hematuria, edema makes HSP unlikely.

\*It should be noted that symptomatic bleeding does not usually occur unless platelets are <10,000/microliter.
2. What testing should be performed at this stage?
  - a. CBC to confirm thrombocytopenia and look for abnormalities of other cell lines (anemia, neutropenia, leukocytosis), reticulocyte count, and peripheral blood smear.
    - Remind students that although ITP is a diagnosis of exclusion, children who present with petechiae, bruising, or mucous membrane bleeding in the ABSENCE of systemic symptoms, hepatosplenomegaly, lymphadenopathy, or bone pain WITH confirmed thrombocytopenia require only a CBC, retic, and peripheral smear. Findings on CBC/peripheral smear suggestive of ITP are: thrombocytopenia with normal or large platelets on smear, normal RBC morphology, and normal WBC count, morphology, and differential. If the history, physical exam, and CBC findings are consistent with ITP, further evaluation is not required. Specifically, the following are unnecessary: bone marrow exam, ANA, direct antibody test, coagulation panel, chemistries, and urinalysis.
    - Anemia may be present in ITP depending on degree of bleeding.
    - Additional testing should be performed on a case by case basis, especially if specific risk factors exist (HIV, Hepatitis, or strong FH of autoimmune disease)
3. What is the most likely diagnosis?
  - a. The following triad makes ITP the most likely diagnosis.

- Thrombocytopenia with an otherwise normal CBC
  - Absence of hepatosplenomegaly, lymphadenopathy, congenital anomalies
  - Platelet recovery without intervention or in response to ITP therapy
- b. If children present with any atypical features (as noted above), further evaluation is necessary (coagulation panel, bone marrow exam, etc). Diagnoses such as hemophilia (Factor 8 or 9 deficiency) are much less likely given this child's presentation. Hemolytic Uremic Syndrome/Thrombotic Thrombocytopenic Purpura unlikely, given presentation.
4. How would you manage this child?
- a. Treatment of ITP ranges from supportive observation to intervention requiring hospitalization and intensive care monitoring. Management is based on the presence of symptoms and the platelet count.
  - b. If the patient is asymptomatic (or with minor symptoms such as petechiae/bruising) AND platelets  $>20,000/\text{microliter}$ , observation alone is appropriate (although some may choose to treat with prednisone or anti-D (Win Rho) in certain clinical scenarios).
  - c. If the patient has minor symptoms AND platelets  $<20,000/\text{microliter}$ , the general consensus is still to observe only, although outpatient prednisone or anti-D is also considered acceptable.
  - d. If the patient has moderate symptoms (extensive cutaneous signs, multiple wet purpura, active bleeding, or prolonged epistaxis) AND platelet  $<30,000/\text{microliter}$ , the consensus is to treat. \*Patients should be hospitalized for treatment if they have active bleeding, anemia, or uncertain follow-up). Treatment options include Anti-D, IVIG, or high-dose steroids.
5. When and with whom should this child follow up with?
- Make sure students recognize that patients should remain hospitalized until not actively bleeding. Access to follow-up is pertinent. Patients should have a CBC drawn one week after discharge (if not clinically indicated sooner), and then again at one month. Patients who require treatment should be followed by a hematologist, and platelets should be monitored monthly until  $>150,000/\text{microliter}$ .
6. What would you tell the parents about the natural history of the disease?
- In most patients, ITP resolves (either spontaneously or with therapy) within 6 months. Up to 25% of patients have platelet counts persistently below  $150,000/\text{microliter}$  after 6 months-these patients meet the definition of chronic ITP.
7. What, if any, precautionary measures should be taken?
- Fall precautions, avoidance of contact sports, supervision, avoid medications known to affect platelet function/number.

### Diagnosis:

Immune Thrombocytopenic Purpura

### Suggestions for Learning Activities:

- Ask the students the questions listed under Clinical Reasoning to probe their thinking.
- Ask the students how their workup would change if the patient had both thrombocytopenia and neutropenia (or significant anemia/leukocytosis)-further evaluation including bone marrow aspirate and biopsy would be necessary, as leukemia or other infiltrative bone marrow processes (aplastic anemia, viral suppression of bone marrow) must be considered.

- Ask students to explain the pathophysiology behind ITP (autoimmune destruction of platelets by antibodies directed against the glycoproteins on the platelet membrane).
- Assign students to clinically appraise literature on a) The role of steroids versus IVIG in the management of acute ITP and/or b) What percentage of patients diagnosed with ITP go on to develop an autoimmune disorder or leukemia.

**Other Resources:**

- Neunert C, Lim W, et al. The American Society of Hematology 2011 evidence-based guidelines for immune thrombocytopenia. *Blood*. 2011; 117 (16): 4190-4207.
- Buchanan GR, et al. *Pediatric Blood and Cancer* 47:681, 2006.
- Lanzkowsky, P. *Manual of Pediatric Hematology and Oncology*, 5th Edition. 12: 321. 2011

## **Common Acute Pediatric Illness: Hematuria and Proteinuria, Case #1**

Written by Adam Weinstein, M.D.

A ten-year-old boy complains of “dark urine” and a headache. Discuss your diagnostic approach to this patient.

### **Definitions for Specific Terms:**

**Microscopic Hematuria** –urine that appears normal to the eye, but with dipstick that tests positive for blood with microscopy of >5 RBC/high power field

**Gross Hematuria** –visible change in urine, be it clots or discoloration (pink, red, brown, cola colored), confirmed as blood on urine dipstick and microscopy

**Glomerular Hematuria** –Blood is coming from the glomerulus, whose basement membrane has become thin or damaged, such that RBCs can pass into the filtrate

**Post-glomerular Hematuria** –Blood is coming from elsewhere in the urinary tract, whether it be from a ruptured renal cyst or kidney trauma (e.g. tubular or interstitial etiology), a ureteral stone, bladder irritation, or urethritis (e.g. urinary tract etiology)

### **Review of Important Concepts:**

#### **Historical Points**

- Time course of presentation
  - How long?
  - Acute or chronic?
  - Has this happened before?
- Quality of “dark urine”
  - All of these questions can give clues as to etiology:
  - What color, what intensity?
  - Is it uniformly dark, or is it alternately normal and dark?
  - Is it just at the beginning or end of the void? Or the entire void?
  - Are there clots?
  - Is it mixed in, or does the blood precipitate out?
- Associated symptoms such as
  - dysuria
  - frequency
  - enuresis
  - abdominal pain
  - flank pain
  - fever
  - polyuria
  - edema
  - constitutional symptoms (appetite, fatigue)

- Particulars of headache
  - Location, severity, alleviators, aggravators, quality, etc.(e.g. use of an acronym—NOPQRST or SOCRATES—or other mnemonic for pain/headache assessment)
- Thorough Past Medical Hx, including
  - Medication history (prescription, over-the-counter, “supplements” and other home or herbal remedies), and
  - Recent exposures—any trauma?
  - Overexertion/excessive exercise?
  - Recent infections, in particular URI’s, sore throats, skin infections, rashes?)
- Family history is essential, both asking about kidney disease in the family—especially childhood onset blood in the urine, kidney failure, kidney stones, but also asking about autoimmune disease, and deafness (the latter, considering Alport Syndrome as an etiology).

### Physical Exam Findings

1. Thorough view of vitals
  - a. hypertension (thinking along lines of a glomerulonephritis),
  - b. signs consistent with dehydration (could dark urine just be concentrated urine?),
  - c. weight gain vs. weight loss?
  - d. signs of poor/slow growth (chronic illness)?
2. Physical exam findings emphasizing fluid status
  - a. Is there edema and/or other signs of fluid retention (suggesting glomerulonephritis)?
  - b. Are there signs of dehydration?
3. Thorough abdominal and GU exam to assist in differential diagnosis

### Clinical Reasoning

1. How to confirm etiology of dark urine? How can you be sure it’s hematuria or is it something else?  
Urinalysis including microscopy
  - a. If Urinalysis is negative for blood, the discoloration is likely due to food dye (beets, blackberries), or medication effect (e.g. rifampin, pyridium, nitrofurantoin)
  - b. If Urinalysis is positive for blood but the microscopy is negative for RBC’s, consider pigment such as myoglobinuria or hemoglobinuria.
2. Once confirmed as hematuria, how to distinguish between etiologies, in particular, Glomerular versus Post-Glomerular hematuria as a first step?  
Clues on history, exam, and urinalysis/microscopy can suggest Glomerular vs. Postglomerular etiology.
  - a. Glomerular cause will reveal:
    - systemic signs and symptoms, such as fatigue, failure to thrive, short stature, edema, rashes, joint and other organ system involvement, hypertension
    - recent or concurrent infection.
    - Urinalysis with proteinuria and/or dysmorphic RBCs suggests glomerular cause, as does hypertension.
    - Urine microscopy with RBC casts is definitive for glomerular etiology.

- b. Postglomerular etiology may be more suggested by:
  - localized signs/symptoms, such as abdominal or flank pain, an abdominal mass (e.g. tumor, hydronephrosis, or enlarged cystic kidney), dysuria, enuresis, constipation +/- dysfunctional voiding
  - history of UTI's or kidney stones.
  - Urinalysis will not have RBC casts and the RBC's are generally eumorphic (normal appearing) rather than dysmorphic.
3. If felt this is glomerular hematuria, what are the next steps in evaluation thinking along the lines of assessing for severity/complications and etiology?
  - a. Severity (is there hypertension, renal insufficiency, fluid and electrolyte abnormalities? quantitate proteinuria; assess other organ systems—such as Skin, Musculoskeletal, GI, Lungs/ENT, Heart, CNS involvement, etc...; check CBC for anemia or thrombocytopenia)
  - b. Etiology (thorough history and physical, of course, as many systemic illnesses, such as Lupus, or HSP, etc... can present with gross hematuria and acute glomerulonephritis; consider screening for Post-Strep GN, SLE, MPGN via Complements—C3, C4 (C3 low in Post-Strep, MPGN, both low in SLE) and serologies as applicable; depending on age, history and exam, may consider screening for other etiologies as well. Certain etiologies, such as IgA Nephropathy, have no reliable screen and can only be diagnosed by biopsy, if necessary)
4. What if Postglomerular cause is still on the differential?  
 Consider renal/bladder ultrasound as this can evaluate for and/or exclude many serious postglomerular etiologies; hypercalciuria is one of the more common etiologies, so can quantify urine calcium, in particular with calcium/creatinine ratio; if signs/symptoms of cystitis or UTI, consider urine culture; clotting profile or hemoglobin electrophoresis as indicated.

### **Suggestions for Learning Activities:**

- Ask the student(s) the questions listed under “clinical reasoning” to probe their thinking about the case
- Consider reviewing slides of urine microscopy, distinguishing between eumorphic vs. dysmorphic RBCs, types of casts, a couple common types of crystals (e.g. calcium oxalate)
- Role play – have the students explain to you as the “parent” what they are most worried about. It may be (and likely will be) something quite alarming and worrisome, whereas many cases of gross hematuria in pediatrics can have relatively reassuring etiologies and a benign clinical course. This distinction is important. The provider will need to know how to evaluate and exclude serious illness, but also explain through the evaluation and be able to reassure when appropriate.
- Discuss the pathophysiologic mechanism(s) by which an acute glomerulonephritis may cause hypertension
- Ask the student(s) questions about treatment considerations.
- What sort of supportive treatments may be helpful? (e.g. control of hypertension—low sodium diet, anti-hypertensive medications)
- When should a referral to a pediatric nephrologist be considered? (concomitant proteinuria, hypertension, renal insufficiency, other signs of chronic illness, and/or significant family history)



**Other Resources:**

- Rudolph's Pediatrics (or other standard pediatrics textbook) Chapter on Clinical Presentation of Renal Disease, section on Evaluating the Child with Hematuria, and Hematuria and Proteinuria.
- Current Opinions in Pediatrics, Vol 20 in 2008, beginning on page 137, is a series all about Pediatric Glomerular Disease. The article on p. 140-144 in particular details the diagnostic approach for hematuria (and proteinuria).
- Pan CG. Evaluation of Gross Hematuria. Pediatric Clinics of North America Vol. 53 (2006), 401-412.

## **Common Acute Pediatric Illness: Hematuria and Proteinuria, Case #2**

Written by Adam Weinstein, M.D.

A three-year-old boy is brought to the pediatrician because of puffy eyes, swollen legs, an enlarged scrotum, and a sudden weight gain. What is your differential diagnosis and how would you evaluate this patient?

### **Definitions for Specific Terms:**

**Proteinuria**- An elevated level of protein in the urine, which is generally screened for in office practice by the urine dipstick. The urine dipstick specifically tests for the presence of albumin. It will detect albuminuria, if present, but will test negative if the urine protein is exclusively another type of protein (the latter are extremely uncommon in pediatrics). The urine dipstick tests for concentration of protein (albumin) in the urine. Urine protein concentration may vary based on the concentration (osmolality) of the urine itself. To control for the urine osmolality, proteinuria is more exactly quantitated either as urine Protein: Creatinine ratio (normal cutoff  $<0.2$  mg/mg) in a spot or random urine sample or a 24 hour urine protein (normal cutoff  $<250$ mg/24 hours) in a 24 hour-timed urine sample.

**Nephrotic Range Proteinuria**- Proteinuria that is quantitatively severe enough that it could result in the nephrotic syndrome. Generally defined as 50mg/kg/24 hours, or alternatively 40mg/m<sup>2</sup>/24hours. In an adult, or older child, greater than 3 to 3.5 grams/24 hours. If assessing by Protein: Creatinine ratio of spot urine, generally a ratio  $>2.0$ .

- Nephrotic Syndrome—Defined as:
  - Nephrotic Range Proteinuria
  - Hypoalbuminemia ( $<3.0$  mg/dL)
  - Edema
  - Hypercholesterolemia

### **Review of Important Concepts:**

#### **Historical Points**

- Time course of presentation
  - How long?
  - Acute or chronic?
  - Has this happened before?
- Thorough history assessing for symptoms of congestive heart failure, allergic disorders (though the latter, generally for milder and more localized cases of “swelling”)
- Quality of urine
  - What color?
  - How frequent/much?
- Other associated symptoms related to genitourinary or GI illness, such as
  - abdominal pain or distension
  - flank pain
  - fever
  - vomiting

- diarrhea
- GI bleeding
- constitutional symptoms (appetite, fatigue)
- Detailed Past Medical Hx including
  - Medication and allergy
  - Recent exposures (Recent infections?)
- Family history

### Physical Exam Findings

1. Thorough view of vitals
  - a. in particular blood pressure
  - b. emphasizing fluid status and location of edema
2. Assessment for signs of allergy, rashes, urticaria
3. Thorough cardiac exam and for findings associated with CHF
4. Abdominal and skin exam, in particular for findings associated with cirrhosis or decreased hepatic synthesis
5. Careful assessment for signs of multi-organ system illness

### Clinical Reasoning

1. How to confirm etiology of edema?
  - a. Evaluate heart on history and exam, if concerns, further cardiology evaluation
  - b. If localized edema or history and exam suggestive, consider allergy, consider lymphatic or venous obstruction
  - c. Assess urinalysis
    - i. If positive for proteinuria, evaluate for nephrotic syndrome
    - ii. If negative or minimal, consider alternative etiologies such as hepatic failure, protein losing enteropathy, malnutrition, hypothyroidism
    - iii. If positive proteinuria, how does one confirm nephrotic syndrome?
      - 1) Serum albumin
      - 2) Quantitate proteinuria (should be nephrotic range)
      - 3) Serum Cholesterol level
2. How to distinguish between etiologies of nephrotic syndrome?

Age in appropriate range:

  - a. Less than 1 year old—congenital nephrotic syndrome (hereditary causes), TORCHeS and other infections
  - b. Between ages 1 and 10-12 years—presumed minimal change and assess based on empiric treatment response
  - c. Older than 10-12 years old—minimal change is possible, but must consider other etiologies such as FSGS, Membranous Nephropathy, SLE, and others. Will often need to biopsy.

3. Assess for signs of concurrent glomerulonephritis
  - a. RBC casts on U/A, elevated creatinine, elevated blood pressure
  - b. If any present, unlikely to be minimal change disease, and more likely other etiology. Will often need to biopsy depending on other circumstances.
4. Assess response to empiric treatment
  - a. Large majority of minimal change disease will go into remission from steroids.
  - b. If partial or no response to steroids, suggests other etiology, and will often need to biopsy.

### Diagnosis:

From the above vignette, proteinuria is not confirmed, but presentation is suggestive of childhood nephrotic syndrome, which is most commonly due to minimal change disease

### Suggestions for Learning Activities:

- Ask the student(s) the questions listed under “clinical reasoning” to probe their thinking about the case.
- Considering reviewing basic science pathophysiology of nephrotic syndrome.
- Discuss how and why edema formation occurs. Through discussion of this mechanism, come up with clinical strategies to prevent and/or treat the edema.
- Review the complications associated with nephrotic syndrome.
  - symptomatic anasarca
  - infections (cellulitis, peritonitis)
  - coagulopathy
- Role play – have the students play the physician and explain to you as the “parent” what the problem is with this child. Have the student assess what the parent is most worried about. In the explanation of the illness, be sure the student discusses the expected course (short-term and long-term) and reasons to bring the child back or call their physician.
- Ask the student(s) questions about treatment considerations.
  - What sort of supportive treatments may be helpful? (e.g. low sodium diet; conversely, empiric anticoagulation and antibiotic prophylaxis has not been shown to be helpful; lastly to vaccinate or not to vaccinate—discuss the controversy: vaccination may pose risk for relapse vs. withholding risk for illness).
  - When can treatment be started empirically? (e.g. if correct age range for minimal change, and no signs of a glomerulonephritis, can plan to start empiric corticosteroids).

### Other Resources:

- Rudolph’s Pediatrics (or other standard pediatrics textbook) Chapter on Clinical Presentation of Renal Disease, section on Evaluating the Child with Edema, section on Nephrotic Syndrome.
- Gipson DS et al. Management of Childhood Onset Nephrotic Syndrome. Pediatrics Vol. 124(2), 2009, pp.747-57.

## FLUID AND ELECTROLYTE MANAGEMENT

### **Fluid and Electrolyte Management, Case #1**

Written by Edward Clark, M.D.

A six-year-old girl admitted for elective surgery and she is made NPO. She weighs 21 kg and is 135 cm. tall. Write the orders for her IV fluids prior to surgery.

#### **Definitions for Specific Terms:**

**Total Body Fluid Requirements**- The sum of maintenance + deficit + ongoing fluid losses

**Maintenance Intravenous Fluids**- The quantities of water and electrolytes that must be consumed to replace the amount of water and electrolytes lost each day that occur as a result of normal daily metabolic activities, without requiring any renal compensation.

**Deficit Fluids**- Pathologic fluid losses in illnesses produce a fluid deficit that may manifest as dehydration.

**Ongoing Fluid Losses**- Sensible and insensible fluid losses

**Sensible Fluid Losses**- Measurable forms of fluid loss such as urinary losses and stool losses in the absence of diarrhea.

**Insensible Fluid Losses**- Less readily measurable forms of fluid loss such as losses from the skin and the respiratory tract.

**Replacement Fluid Losses**- Term used to denote deficit fluids and/or ongoing losses if they are significant or excessive.

“A child awaiting surgery may need only maintenance fluids, whereas a child with diarrheal dehydration needs maintenance and deficit therapy and also may require replacement fluids if significant diarrhea or vomiting continues.”

#### **Review of Important Concepts:**

##### **Historical Points**

Maintenance implies fluid and calorie requirements at rest in a stable patient. In obtaining history, keep in mind that several factors or pathological conditions may increase or decrease fluid needs.

## Clinical Reasoning

1. When is it necessary to begin maintenance fluids?
  - a. It is important to recognize when to start maintenance fluids. Healthy children can tolerate variations in intake due to many homeostatic mechanisms that can adjust absorption and excretion of water and electrolytes.
  - b. The calculated fluid and electrolyte needs that form the basis of maintenance therapy are not absolute requirements.
    - A normal teenager who is given nothing by mouth (NPO) overnight for a morning procedure does not require maintenance fluids because a healthy adolescent can easily tolerate 12-18 hours without oral intake.
    - In contrast, a 6 month old child waiting for surgery should begin receiving fluids within 8 hours of the last feeding.
    - Infants become dehydrated more quickly than older patients due to differences in body surface area and a decreased ability for the kidney to concentrate and compensate.
2. What factors may alter maintenance fluid or electrolyte requirements?
  - a. CNS depression
  - b. Sedation
  - c. Hyperventilation
  - d. Burns
  - e. Sepsis
  - f. Fever
  - g. Environmental heat stress
  - h. Major surgery
  - i. Cardiac and renal disease
  - j. Leakage around a gastric tube
  - k. Excessive drooling from a cerebral palsy patient
  - l. High humidity
  - m. Hypermetabolic states
  - n. Hypothermia
  - o. Chronic conditions
  - p. Normal and abnormal sweat loss as in cystic fibrosis where salt requirements may be increased due to sweat loss
3. What makes up the composition of maintenance fluids?
  - a. A solution of water, glucose, sodium chloride, and potassium chloride. For each 100 cc of maintenance fluids, a child needs 3 mEq of sodium chloride and 2 mEq of potassium chloride, as well as, a carbohydrate source.
  - b. In general for children greater than 10 kg, one-half normal saline with 5% dextrose and 20 mEq/L KCL meets maintenance glucose and electrolyte needs.
  - c. One-fourth normal saline with KCL is often used in children under 10kg due to the high water needs per kilogram. The glucose provides approximately 20% of the normal caloric needs of the patient and prevents protein break down.
  - d. It is important that patients do not remain on maintenance therapy indefinitely since maintenance fluids do not provide adequate calories, protein, fat, minerals, or vitamins on a long-term basis.

## Diagnosis / Calculation Methods

Different methods are used to estimate maintenance fluid and electrolyte requirements in infants and children. The two most common methods are based on either metabolic rate (the caloric or Holliday-Segar method) or on body surface area (or square meter method).

The body surface area method is based on the assumption that caloric expenditure is related to body surface area. This method requires the use of Mosteller's formula or nomogram found in most textbooks and requires a knowledge of the patient's height. Mosteller's formula is  $\text{surface area (m}^2\text{)} = \text{Ht(cm)} \times \text{Wt(kg)} / 3600$ . Apply body surface area to maintenance fluids =  $1500 \text{ ml} / \text{m}^2 / 24\text{hr}$ .

### Calculating maintenance fluid requirements for a 21kg child:

1. Using the **Holliday-Segar** or "caloric" method: the amount of fluid needed is 100mL/kg/day for the first 10 kg, plus 50mL/kg/day for the next 10 kg, plus 20mL/kg/day for each additional kg thereafter.

Daily requirement:  $(100 \text{ mL/kg/day} \times 10 \text{ kg}) + (50 \text{ mL/kg/day} \times 10 \text{ kg}) + (20 \text{ mL/kg/day} \times 1 \text{ kg}) = 1,520 \text{ mL/day}$ .

Hourly rate:  $1,520 \text{ mL/day} \text{ divided by } 24 \text{ hr/day} = 63 \text{ mL/hr}$

2. **Alternative Holliday-Segar** method: This method eliminates one step in the calculations by dividing the above amounts (100, 50, 20) of fluid needed by 24hrs and rounding to equal ( 4, 2, 1); 4mL/kg/hr for the first 10 kg, plus 2mL/kg/hr for the next 10 kg, plus 1mL/kg/hr for each additional kg thereafter.

When using this "short cut" method, the daily requirement is automatically calculated to an hourly rate. As in the example:  $(4 \text{ mL/kg/hr} \times 10 \text{ kg}) + (2 \text{ mL/kg/hr} \times 10 \text{ kg}) + (1 \text{ mL/kg/hr} \times 1 \text{ kg}) = 61 \text{ mL/hr}$ .

\*Notice that there is a slight difference in calculations. Also, this method is not preferred if fluid deficits and losses need to be figured into the total body fluid requirements.

Using the **body surface area** method: Calculate the body surface area using Mosteller's formula:  $135\text{cm} \times 21 \text{ kg} / 3600 = 0.8 \text{ m}^2$  then enter into  $1500 \text{ ml} / 0.8 / 24\text{hr} = 78 \text{ mL/hr}$

\*Note that these are estimates and that we have a 15cc per hour difference between the two methods. Is a tablespoon per hour difference going to cause problems in a 6yo child? A small infant?

### Suggestions for Learning Activities

- Ask the student(s) the questions listed under "clinical reasoning" to probe their thinking about the above case
- Ask the student(s) to calculate the maintenance fluids on one of their patient's that they are following or the last patient that they have seen.
- Ask the student(s) what patients that are currently on the service may have increased or decreased maintenance fluid requirements? electrolyte requirements? and why?
- How may the following conditions alter a child's maintenance fluid and electrolyte needs?
  - Fever (increased insensible losses)

- Diabetes Insipidus (increased urinary losses)
- Diabetes mellitus (increased urinary losses if hyperglycemia; no change if under control)
- Sedation (decreased insensible losses)
- Renal failure (decreased urinary losses if oligo-anuria type)
- SIADH (decreased urinary losses)

### **Other Resources**

- The Harriet Lane Handbook – chapter on Fluids and Electrolytes and BSA nomogram in Formulary Adjunct



## **Fluid and Electrolyte Management, Case #3**

Written by Pat Patterson, M.D.

A 7-month old with fever, vomiting and diarrhea for the past 24 hours. What are the symptoms and physical findings to help decide if the infant is dehydrated?

### **Definitions for Specific Terms:**

**Fever**- A rectal temperature above 37.9 degrees C or 100.4 degrees. An oral temperature above 37.4 degrees C or 99.4 degrees F. An axillary temperature above 37.1 degrees C or 98.9 degrees F

**Diarrhea**- The excessive loss of fluid and electrolytes in stool

**Dehydration**- Body fluid depletion

### **Review of Important Concepts:**

#### **Teaching Points**

- Identify the historical and physical exam findings important in the assessment of the state of hydration/dehydration
- Understand treatment options for patients diagnosed with dehydration

#### **Historical Points**

- Age of Child: Infants dehydrate faster than older children and adults Infants have a greater percentage of total body water per weight than do adults. (about 70-75% compared with ~ 50% for adults.)
- Quantify frequency and volume of stools and emesis, bilious vs. non-bilious, to help assess degree of dehydration and possible pathologies.
- Quantify intake: what is being fed the baby, how much, how often. Is it retained? How soon after feeds does the vomiting occur? Clear liquids, particularly the electrolyte solutions commercially available in the US are rapidly absorbed from the GI tract. Administration of free water can contribute to the risk of hyponatremia and the consumption of sugary drinks can contribute to diarrhea.
- Quantify urine output and tear production
- Question last known weight of infant and when it was taken. You may have access to a recent weight that would allow for a direct measurement of the degree of dehydration.
- PMH: any underlying disease that may contribute to dehydration or electrolyte regulation

#### **Physical Exam Findings**

The chart below summarizes the important signs and symptoms associated with dehydration

Parameter	Degree of Dehydration		
	Mild	Moderate	Severe
Weight loss (%)	3-5	6-9	10-15
Skin color	Pale	Gray	Mottled
Skin turgor	May be normal	Decreased	Tenting
Anterior Fontanelle	Normal	Depressed	Sunken
Mucous membranes	Slightly dry	Dry	Dry, parched, collapse of sublingual veins
Eyes	Normal	Decreased tears	Sunken, absence of tears
Central nervous system	Alert but thirsty	Irritable	Lethargic, grunting, coma
Pulse	Normal and strong	Rapid and slightly weak	Significantly tachycardic, and very weak to not palpable
Capillary refill*	Normal (< 2 sec)	2–4 sec	> 4 sec
Blood pressure	No change	Orthostatic decrease	Shock
Urine	Normal to mildly reduced	Significantly reduced	Anuria

\*Capillary refill: Assessment of capillary refill can be an important tool in determining perfusion. To perform, simply press on the skin with your finger for a couple seconds causing the skin to blanch. Remove your finger and count how many seconds it takes before the capillaries refill and the blanching resolves. The longer the time for capillary refill, the poorer the perfusion.

### Clinical Reasoning

- Does the presence of fever contribute to this infant's dehydration and if so, how?  
Fever contributes to dehydration through increased insensible loss through the skin, sweating, and increases respiratory rates leading to additional fluid loss.
- What labs, if any, would you consider for this infant?  
In general, no labs are needed unless the patient is assessed to be moderately-to-severely dehydrated. Electrolytes, BUN and creatinine and glucose are helpful.
- How does your approach to rehydration of a patient with hypernatremia,  $\text{Na} > 150 \text{ meq/L}$  differ from your approach to the patient with normal sodium?  
If correct serum sodium too rapidly, risk cerebral edema as fluid shifts from the ECF into the CNS in an attempt to equilibrate with the hypernatremic environment of the CNS relative to the ECF provided in the IVF.

4. Why is it ill-advised to use sugary drinks to orally rehydrate patients?  
Juices, soft drinks, and punches usually contain much higher concentrations of sugars and almost no sodium; they are inappropriate for use as an ORS. The higher sugar concentrations in these fluids may exacerbate diarrhea by presenting a large osmotic load to the intestine.
5. If vomiting and diarrhea continue with oral rehydration, should the infant be placed on 'bowel rest' with nothing by mouth in hopes that total rest would stop the vomiting and diarrhea? 'No' Vomiting is not a contraindication to ORT and fluid replacement should continue orally even in the presence of vomiting. Strong evidence suggests that both the volume and duration of diarrhea are reduced when children are fed immediately following rehydration. Key to the successful treatment of dehydration using ORT is the offering of frequent small volumes of liquids; perhaps as little as a tablespoon, 15cc, of solution every 15-20 minutes. A general guideline is to give 50-100 cc/kg of ORS over 2-4 hours.
6. In the moderate to severely dehydrated child, a metabolic acidosis is frequently seen. How would you alter your fluid management if at all?  
In general, there is no need to alter fluid management in the presence of a metabolic acidosis secondary to dehydration. Correcting the underlying dehydration will correct the metabolic acidosis.

## Diagnosis and Treatment

Treatment options depend upon degree of dehydration and presence of any underlying conditions that may exacerbate the illness. Severely dehydrated infants and children will need intravenous fluids.

1. Oral rehydration therapy
  - First choice for the conscious child who has mild or moderate dehydration
  - Fluid absorption can be promoted by enteral administration of properly designed fluids, even in the face of ongoing losses.
  - Choice of solution important: An Oral Rehydration Solution, ORS, is specifically formulated to promote water and electrolyte absorption through the co-transport system in the gut. A physiologically appropriate ORS contains: 70–90 mEq/L sodium,  $\leq 25$  g/L glucose, 20 mEq/L potassium and  $\sim 30$  mEq/L of base in the form of citrate. Appropriate, commercially available solutions are readily available in the US.
2. Parenteral Therapy for Dehydration:
  - For patients who have severe dehydration (shock) fluids are administered intravenously or intraosseously when access difficult.
  - Rapid boluses of 0.9% sodium chloride, (**not** D5 0.9% NaCl), in initial volumes of 20 mL/kg for  $\leq 20$  minutes. Take note that parenteral solutions used for bolusing patients generally do not contain dextrose unless glucose testing has demonstrated that the patient is hypoglycemic.
3. Enteral fluid therapy may begin immediately if
  - the patient is conscious
  - airway protective reflexes are intact
  - fluids are given either by mouth or nasogastric tube.

## **Fluids and Electrolyte Management, Case #4**

Written by Lavjay Butani, M.D.

An infant weighing 8 kg is estimated to be 12% dehydrated. What fluids should you start initially? What laboratory tests should be ordered immediately? What is the calculated fluid deficit and how should it be replaced? What IV solution(s) should be used?

### **Definitions for Specific Terms:**

**Total Body Fluid Requirements**- The sum of maintenance + deficit + ongoing fluid losses.

**Maintenance Intravenous Fluids**- The quantities of water and electrolytes that must be consumed to replace the amount of water and electrolytes lost each day that occur as a result of normal daily metabolic activities, without requiring any renal compensation.

**Deficit Fluids**- Pathologic fluid losses in illnesses produce a fluid deficit that may manifest as dehydration.

**Ongoing Fluid Losses**- Sensible and insensible fluid losses

**Sensible Fluid Losses**- Measurable forms of fluid loss such as urinary losses and stool losses in the absence of diarrhea

**Insensible Fluid Losses**- Less readily measurable forms of fluid loss such as losses from the skin and the respiratory tract

**Replacement Fluid Losses**- Term used to denote deficit fluids and/or ongoing losses if they are significant or excessive.

“A child awaiting surgery may need only maintenance fluids, whereas a child with diarrheal dehydration needs maintenance and deficit therapy and also may require replacement fluids if significant diarrhea or vomiting continues.”

### **Review of Important Concepts:**

#### **Historical Points and Physical Exam Findings**

- Assessing and estimating the degree of dehydration is the first and most important step in fluid management in a dehydrated child since this will determine how much and in what manner (route and rapidity) fluid resuscitation should occur. The degree of dehydration can be estimated if a recent previous weight of the child when well is known. Often this is not available; in such instances, severity of dehydration can be estimated by looking for a constellation of signs and symptoms (see table in Case 3).
- How alert is the child? What are his/her vital signs? Children with moderate to severe dehydration are at risk of evolving into hypovolemic shock and so their vital signs and sensorium need to be evaluated.

- What have the parents been giving the child at home for rehydration? Infants are especially vulnerable to develop severe electrolyte abnormalities such as hypo or hypernatremia if improper oral rehydration solutions are used (such as water or inappropriately mixed homemade oral rehydration solutions)

### Clinical Reasoning

1. What might be some of the common causes of moderate to severe dehydration in a child of this age?
  - a. Gastroenteritis (viral or bacterial)
  - b. Intractable vomiting (from increased intracranial pressure)
  - c. Anatomic GI abnormalities
  - d. Intoxications
  - e. Inborn errors of metabolism)
  - f. Acute blood loss from any source, including head injury (accidental or non-accidental trauma)
  - g. Urinary losses (salt wasting syndromes such as congenital adrenal hyperplasia)
  - h. Excess loss of fluid in sweat (as in children with cystic fibrosis during the summer months)
2. What is the preferred route of rehydration in this child and why?
  - a. Children with mild to moderate dehydration can be safely and effectively managed with oral rehydration if their vital signs remain stable, they tolerate oral fluids and their sensorium is normal.
  - b. Alternatively other routes of rehydration, including nasogastric and intravenous, can be employed, either exclusively or in combination with oral rehydration.
  - c. For children with severe dehydration, rapid repletion of effective circulating volume is desirable and hence this child would benefit from IV rehydration.
3. What laboratory tests should be ordered immediately?
  - a. For infants with moderate to severe dehydration, it is important to obtain a blood glucose (finger stick) and electrolytes to evaluate their renal function and for detection of electrolyte abnormalities such as acidosis and dysnatremias.
  - b. Other tests should be ordered based on the clinical appearance of the child (e.g. blood gas if child looks lethargic or obtunded), and the clinical scenario obtained on history (e.g. imaging studies and cultures based on suspected differential diagnosis).

### Diagnosis / Calculations:

Fluid deficit: Estimated well weight = x kg. Current weight = 8 kg. Weight loss is 12%. Therefore  $x - 12\% x = 8 \text{ kg}$ ; or  $x = 9.1 \text{ kg}$  (or approximately 9 kg). Fluid deficit is  $9 \text{ kg} - 8 \text{ kg} = 1 \text{ kg}$  (or 1000 ml).

Initial fluid management: Replete effective circulating volume with isotonic saline since a sodium containing solution will stay in the Intravascular extracellular compartment in the most effective manner (since sodium is the predominant cation in the extracellular compartment). Therefore the child should get normal saline as a fluid bolus of 20 ml/kg over 20-30 minutes (or as fast as his/her IV will handle the solution). This should be repeated as needed until vital signs stabilize and the child starts voiding. In addition, the child should be allowed to drink oral rehydration solutions if he/she is alert and does not have a suspected surgical condition.

After the fluid boluses have been administered and the child stabilized, the remainder of the deficit (if any), should be given either continuously over 24 hours (unless he/she is hypernatremic) along with his/her maintenance requirements (900 ml) or half of the deficit should be given over the 1<sup>st</sup> 8 hours and the remainder over the next 16 hours (along with his maintenance requirement of 900 ml/day).

The composition of the fluid will depend on his/her serum sodium concentration and his sodium deficit. Assuming a normal serum sodium (140 mEq/L) and assuming that the child has received one fluid bolus of 180 ml (20ml/kg) of isotonic saline, the fluid volume that the child needs over the next day is = 900 ml (maintenance) + 1000 ml (deficit) – 180 ml (bolus volume) = 1720 ml or 72 ml/hour. For the child's sodium requirements, one needs to add his/her maintenance sodium requirement (about 2-3 mEq/kg/day) and his/her sodium deficit.

Sodium (maintenance) = 2-3 mEq/kg/day = 25 mEq/day (approximately)

Sodium deficit = Total body sodium (well state) – Total body sodium (present state)

Total body sodium (well) = Total body water (well) x Serum sodium (well) =  $0.7 \times 9 \text{ (weight)} \times 140$  (assuming child has a normal serum sodium) =  $6.3 \times 140 = 882 \text{ mEq}$

\* Note: unlike in adults, a greater proportion of body weight is water, in children (ranging from a high of 85% in neonates to 60% in adolescents). For most children using 70% of their weight to calculate total body water will work.

Total body sodium (ill) = Total body water (ill) x Serum sodium (ill) = [Total body water (well)-fluid deficit] x Serum sodium (ill) =  $(6.3-1.0) \times 140 = 5.3 \times 140 = 742 \text{ mEq}$

Therefore sodium deficit is  $882 - 742 \text{ mEq} = 140 \text{ mEq}$

And so, the child's total sodium requirement over 24 hours is 140 mEq (sodium deficit) + 25 mEq (maintenance sodium) – sodium already given in isotonic saline bolus ( $154 \text{ mEq/L} \times 0.18 \text{ L} = 28 \text{ mEq}$ ) =  $165-28=140 \text{ mEq/day}$

The commercially available IV Fluid that most closely matches the child's need of 1720 ml of water and 140 mEq of sodium will be a solution that has a sodium concentration of 140/1.72 mEq/L which is 81 mEq/L. The commercially available IV fluid solution closest to this is ½ NS (which has 77 mEq/L sodium). Therefore this child should get ½ NS at 72 ml/hour. If the child is not eating, most would add some dextrose initially to prevent ketosis and hypoglycemia (hence the best fluid choice would be D5 ½ NS at 72 ml/hour for 24 hours). Avoid using 'home made' IV fluid solutions compounded by the pharmacy-the risk of error is too great to take a chance.

This same basic approach is used in setting of hypo and hypernatremia except that in hypernatremia the deficit should be replaced over 48 hours to prevent significant osmotic shifts.

If patients with hyperosmolar states (such as diabetic ketoacidosis and severe hypernatremia) are rapidly brought to a state of normal osmolality, there is high risk of water moving intracellularly, leading to cerebral edema and herniation of the brain.

**Suggestions for Learning Activities:**

- Ask the student(s) the questions listed under “clinical reasoning” to probe their thinking about the case
- Have students review the literature on the effectiveness of nasogastric hydration for children with dehydration

**Other Resources:**

- The Harriet Lane Handbook – chapter on Fluids and Electrolytes and BSA nomogram in Formulary Adjunct
- Alan L. Nager and Vincent J. Wang: Comparison of Nasogastric and Intravenous Methods of Rehydration in Pediatric Patients With Acute Dehydration. *Pediatrics* 2002; 109; 566

## **Fluid and Electrolyte Management, Case #5**

Written by Adam Weinstein, M.D.

A two-month-old infant is brought to the Emergency Department because of seizures. He has had diarrhea for five days and has been fed only water and diluted apple juice. What might be the cause of the seizures and how should they be treated?

### **Definitions for Specific Terms:**

**Total Body Fluid Requirements**- The sum of maintenance + deficit + ongoing fluid losses

**Maintenance Intravenous Fluids**- The quantities of water and electrolytes that must be consumed to replace the amount of water and electrolytes lost each day as a result of normal daily metabolic activities, without requiring any renal compensation.

**Deficit Fluids**- Pathologic fluid losses in illnesses produce a fluid deficit that may manifest as dehydration.

**Ongoing Fluid Losses**- Sensible and insensible fluid losses

**Sensible Fluid Losses**- Measurable forms of fluid loss such as urinary losses and stool losses in the absence of diarrhea

**Insensible Fluid Losses**- Less readily measurable forms of fluid loss such as losses from the skin and the respiratory tract

**Replacement Fluid Losses**-Term used to denote ongoing losses if they are significant or excessive.

“A child awaiting surgery may need only maintenance fluids, whereas a child with dehydration due to diarrhea needs maintenance and deficit therapy and also may require replacement fluids if significant diarrhea continues.”

### **Review of Important Concepts:**

#### **Historical Points**

- Time/course of presentation- How long, acute or chronic. Has this happened before?
- Assess aspects of hydration- Mood, activity, urine output; HR, BP, comparative weights, mental status, skin turgor, mucus membranes, tears, fontanelle, etc...
- Detailed assessment of fluid intake- Volume, content (how much salt, sugar, etc...), and whether any is being kept down vs. how much is being lost.
- Other associated symptoms- e.g. is there a fever? This would influence aspects of hydration status (increased insensible losses), but also have implications on the differential diagnosis, such as meningitis
- Past Medical Hx, Social Hx, Family Hx- Clues with regards to risks of severity and for recurrence, appropriateness of environment, any pertinent co-morbid conditions including those identified on newborn screening.



## Clinical Reasoning

### 1. What might be the cause of the seizures?

In a child with the above history, an acute electrolyte or metabolic derangement is at the top of the differential, and importantly, these represent immediately reversible causes.

- Hyponatremia - high intake of electrolyte free/hypotonic solutions in the setting of dehydration
- Hypoglycemia - not keeping anything down? This should be considered.
- Hypocalcemia - more a consideration if a chronic history of diarrhea and potentially low intake of calcium. This specifically refers to a low ionized calcium (free calcium) level.

### 2. How should they be treated?

Immediate/emergent fluid/electrolyte assessment and concurrent resuscitation.

- Based on history, the child will likely show signs of acute VOLUME depletion.  
Isotonic Normal Saline infusion (bolus) rapidly over 20 minutes and repeat as needed.  
Usually in 20ml/kg increments.
- Stat (I-stat if available) for SODIUM level.  
If critically low (<120-125), would give hypertonic saline with goal to stop seizures and immediately achieve sodium in low-to mid 120s.  
If >125, then hyponatremia unlikely the etiology of the seizures and hypertonic saline not necessary  
In either case once patient is stabilized:
- Subsequently provide both deficit and maintenance fluids +/- replacement fluids (if applicable) to complete treatment of the fluid and electrolyte disorder. (see FLUID AND ELECTROLYTE CASE 4 for an example)...
- D-stick for immediate blood GLUCOSE.  
Dextrose bolus if low (definitely if <40, some do so if 40-60)  
If >40-60, then can include dextrose as component of maintenance fluid regimen as discussed in previous cases.
- Stat (I-stat if available) for CALCIUM level. Replete acutely and with ongoing supplementation if applicable.

### 3. What makes up the composition of hypertonic saline?

- It is an approximately 3% Sodium Chloride solution which specifically, has a sodium concentration of 513 mEq/L.
- In comparison, Normal Saline is 0.9% NaCl and has 154 mEq/L of sodium.

### 4. Once stabilized, henceforward, what is the goal rate of correction of serum sodium and why?

- Rapid correction of hyponatremia may result in central pontine myelinolysis
- Rapid correction (increase) of extracellular osmolality may result in sudden loss of intracellular volume as water moves extracellularly.
- Rapid correction should be reserved for symptomatic patients (e.g. seizures, mental status changes); treatment goal is to stabilize and eliminate the symptoms, then slow down rate of correction.
- In asymptomatic patients, or once stabilized, the desired rate of correction is about 0.5 mEq/L correction per hour (or about 10-12 mEq/L per 24 hours).

**Calculations:**

Volume of Hypertonic (3%) NaCl needed to raise the serum sodium level by “A” mEq/L:  
 $3\% \text{ NaCl (mL)} = \text{“A” mEq/L} \times \text{body weight (kg)} \times 0.6\text{L/kg}$

Example: 5 kg infant with serum sodium 115 mEq/L. Want to raise sodium to 125 mEq/L  
 So raising level by 10 mEq/L  
 $10 \times 5 \times 0.6 = 30 \text{ mL of } 3\% \text{ NaCl}$

Dextrose treatment for symptomatic hypoglycemia

IV Glucose bolus of 0.5 to 1 gram/kg

This would be 2-4 mL/kg of D25 (25% Dextrose) if central access

5-10 mL/kg of D10 (10% Dextrose)

**Suggestions for Learning Activities:**

- Ask the student(s) the questions listed under “clinical reasoning” to probe their thinking about the case.
- Create some sample case scenarios for which the student can practice with hypertonic saline, dextrose, and/or fluid resuscitation calculations.
- Discuss the pathophysiology that places pediatric patients at risk for dehydration with hyponatremia. Emphasize the role of ADH, and distinguish between appropriate stimuli for ADH and the syndrome of inappropriate ADH secretion (SIADH).
- Discuss the pathophysiology that places infants, in particular neonates, at risk for hypoglycemia with acute illness associated with decreased nutritive intake
- Discuss some inborn errors of metabolism that may also present in infancy as hypoglycemia.
- Role play – have the students explain to you (you are the “parent”) what is going on during the above resuscitation. In the emergent setting, explain what the cause of the seizure might be and how the resuscitative team is addressing it and will safely and effectively stop the seizure and prevent neurologic morbidity.

**Other Resources:**

- The Harriet Lane Handbook – chapter on Fluids and Electrolytes
- PALS Provider Guide (American Heart Association)—chapter on Fluid Therapy and Medications in Shock or Arrest (and related “CODE cards”)

## **Fluid and Electrolyte Management, Case #6**

Written by Adam Weinstein, M.D.

A nine-month-old infant has diarrhea and signs of moderate dehydration. His electrolytes are Na<sup>+</sup> 162, K<sup>+</sup> 5.6, Cl<sup>-</sup> 132, and bicarbonate 12. During IV rehydration the patient has a generalized seizure. What is the probable cause of the seizure? How should it be treated? How could this complication have been avoided?

### **Definitions for Specific Terms:**

**Total Body Fluid Requirements**- The sum of maintenance + deficit + ongoing fluid losses

**Maintenance Intravenous Fluids**-The quantities of water and electrolytes that must be consumed to replace the amount of water and electrolytes lost each day as a result of normal daily metabolic activities, without requiring any renal compensation.

**Deficit Fluids**- Pathologic fluid losses in illnesses produce a fluid deficit that may manifest as dehydration.

**Ongoing Fluid Losses**- Sensible and insensible fluid losses

**Sensible Fluid Losses**- Measurable forms of fluid loss such as urinary losses and stool losses in the absence of diarrhea

**Insensible Fluid Losses** - Less readily measurable forms of fluid loss such as losses from the skin and the respiratory tract

**Replacement Fluid Losses**- Term used to denote ongoing losses if they are significant or excessive.

“A child awaiting surgery may need only maintenance fluids, whereas a child with dehydration due to diarrhea needs maintenance and deficit therapy and also may require replacement fluids if significant diarrhea continues.”

### **Review of Important Concepts:**

#### **Historical and Physical Exam Points**

- Time/course of presentation –how long, acute or chronic.
- Assess aspects of hydration and degree of dehydration—mood, activity, urine output; HR, BP, comparative weights, mental status, skin turgor, mucus membranes, tears, fontanelle, etc...
- Detailed assessment of fluid intake—volume, content (how much salt, sugar, etc...), and at what rate was it administered? Also how much fluid is still being lost (e.g. diarrhea).
- Past Medical Hx, Social Hx, Family Hx—clues with regards to risks of severity and for recurrence, appropriateness of environment, any pertinent co-morbid conditions

## Clinical Reasoning

1. What might be the cause of the seizures?
  - a. In a child with the above presentation, an acute electrolyte derangement is at the top of the differential.
  - b. Overly rapid correction of hypernatremia- This is the most likely etiology. Rapid correction of fluid deficit, in particular with hypotonic fluids, may result in brisk decrease in serum sodium, leading to cerebral edema and CNS disturbance.
  - c. Hypoglycemia- This should be considered if there has been no oral intake for awhile and if IV fluids did not contain any dextrose.
2. How should it be treated?
 

Immediate/emergent fluid/electrolyte assessment and concurrent resuscitation.

  - a. If due to overly rapid correction of hypernatremia, should reverse it and acutely elevate serum osmolality with hypertonic saline.
  - b. Hypertonic saline is an approximately 3% Sodium Chloride solution which specifically, has a sodium concentration of 513 mEq/L. In comparison, Normal Saline is 0.9% NaCl and has 154 mEq/L of sodium.
  - c. Administration will acutely increase serum sodium, and reverse cerebral edema and the CNS disturbance.
  - d. Sometimes administered empirically at a rate of 0.5 to 2mL/kg/hr until seizures stopped/target sodium level reached, though protocols vary widely from institution to institution.
  - e. Could also calculate rate of correction by administering a specified volume for a desired sodium level (see Calculation below)
3. Essential components of management would then include
  - a. Continuing hypertonic saline until seizures and CNS concerns resolve
  - b. Close and frequent monitoring of serum sodium and electrolytes, osmolality to achieve target level
  - c. Maintain at this level and once patient is stabilized:
    - Subsequently provide both deficit and maintenance fluids +/- replacement fluids (if applicable) to complete treatment of the fluid and electrolyte disorder.
    - This should be provided cautiously with goal to complete treatment in 48-72hours or such that rate of correction of hypernatremia does not exceed 0.5 mEq/L/hr (or 10-12 mEq/L/day).
4. How could this complication have been avoided?
  - a. Avoiding a rapid correction of hypernatremia as noted above
  - b. Rapid correction should be reserved for symptomatic patients (e.g. seizures, mental status changes); treatment goal is to stabilize and eliminate the symptoms, then slow down rate of correction.
  - c. In asymptomatic patients, or once stabilized, the desired rate of correction is about 0.5 mEq/L correction per hour (or about 10-12 mEq/L per 24 hours).

**Calculations:**

Volume of Hypertonic (3%) NaCl needed to raise the serum sodium level by “A” mEq/L:

$$3\% \text{ NaCl (mL)} = \text{“A” mEq/L} \times \text{body weight (kg)} \times 0.6\text{L/kg}$$

Example: 10 kg infant with serum sodium that fell from 162 mEq/L to 147 mEq/L. Want to raise sodium to 152 mEq/L.

So raising level by 5 mEq/L

$$5 \times 10 \times 0.6 = 30 \text{ mL of } 3\% \text{ NaCl}$$

**Suggestions for Learning Activities:**

- Ask the student(s) the questions listed under “clinical reasoning” to probe their thinking about the case.
- Create some sample case scenarios for which the student can practice with hypertonic saline and fluid resuscitation calculations.
- Discuss the pathophysiology that places pediatric patients at risk for overly rapid correction of hyperosmolality. Emphasize the role of ADH. Consider, alternative hyperosmolar states such as DKA, uremia, and toxic ingestions (e.g. ethylene glycol).
- Role play – have the students explain to you (you are the “parent”) what is going on during the above resuscitation. In the emergent setting, explain what the cause of the seizure might be and how the resuscitative team is addressing it and will safely and effectively stop the seizure and prevent neurologic morbidity.

**Other Resources:**

- The Harriet Lane Handbook – chapter on Fluids and Electrolytes
- PALS Provider Guide (American Heart Association)—chapter on Fluid Therapy and Medications in Shock or Arrest (and related “CODE cards”)

**Fluid and Electrolyte Management, Case #7**

Written by Adam Weinstein, M.D.

An 8kg nine-month-old infant has vomiting and diarrhea. He has dry mucous membranes and decreased tearing and urination. After your assessment, you would like to try oral rehydration. What liquids, what quantity, and how often should the mother give the fluids to the infant?

**Definitions for Specific Terms:**

**Total Body Fluid Requirements** - The sum of maintenance + deficit + ongoing fluid losses

**Maintenance Intravenous Fluids** -The quantities of water and electrolytes that must be consumed to replace the amount of water and electrolytes lost each day as a result of normal daily metabolic activities, without requiring any renal compensation.

**Deficit Fluids** - Pathologic fluid losses in illnesses produce a fluid deficit that may manifest as dehydration.

**Ongoing Fluid Losses** - Sensible and insensible fluid losses

**Sensible Fluid Losses** - Measurable forms of fluid loss such as urinary losses and stool losses in the absence of diarrhea

**Insensible Fluid Losses** -Less readily measurable forms of fluid loss such as losses from the skin and the respiratory tract

**Replacement Fluid Losses** -Term used to denote ongoing losses if they are significant or excessive.

“A child awaiting surgery may need only maintenance fluids, whereas a child with dehydration due to diarrhea needs maintenance and deficit therapy and also may require replacement fluids if significant diarrhea continues.”

**Review of Important Concepts:****Historical and Physical Exam Points**

- Time/course of presentation
  - How long?
  - Acute or chronic?
- Assess aspects of hydration
  - Mood
  - Activity
  - Urine output
  - HR, BP
  - Comparative weights
  - Mental status
  - Skin turgor

- Mucus membranes
- Tears
- Fontanelle, etc...
- How severe is the dehydration?
- Detailed assessment of fluid intake
  - Volume
  - Content (how much salt, sugar, etc...)
  - Determine whether any is being kept down vs. how much is being lost.
  - Any risks for hypo- or hyperosmolar abnormality?
- Past Medical Hx, Social Hx, Family Hx
  - Clues with regards to risks of severity and osmolar abnormalities, appropriateness of environment, any pertinent co-morbid conditions?

### Clinical Reasoning

1. What liquids should the mother give the infant?
  - a. In a child with dehydration from GI losses, the infant will need to have both fluid and electrolyte replacements. The ideal solution will be an electrolyte containing solution.
  - b. Oral solutions in this regard include solutions like WHO formula or Rehydralyte (which have ~75 mEq/L Na) or Pedialyte (which has ~45 mEq/L Na)
  - c. These solutions should also contain some sugar (glucose), ideally in 1:1 molar ratio with sodium, to enhance GI absorption of the fluid via the Na-Glucose co-transporter. Pedialyte adjusts this to a 3:1 ratio to make it more palatable. This is still much closer to 1:1 than sports drinks. These fluids also contain potassium 20 mEq/L and citrate (as a base equivalent) 10 mEq/L.
  - d. Solutions that contain excess free water without electrolytes will create risk for development of hyponatremia or other electrolyte disorders. For severely dehydrated patients, even Pedialyte may be too hypotonic in this regard, and a fluid with 75 mEq/L of sodium or more is preferred.
2. What quantity of fluids should the mother give to the infant and how often?
  - a. Given the ongoing vomiting, small volumes more frequently may be more easily tolerated.
  - b. Ideally, the provider will assess the degree of dehydration (if any).
    - If infant is well-hydrated, then mother should provide the infant the fluid to achieve a daily maintenance volume plus replacement of any diarrheal losses
    - If infant is dehydrated, then mother should provide both deficit and maintenance fluids +/- replacement fluids to rehydrate the infant and maintain euvolemia.
  - c. With oral fluids and for home intake, estimates may be adequate, provided infant is:
    - Tolerating fluids, not vomiting them. Giving small volumes hourly, or sips every 15 to 30 minutes may be needed in this regard
    - Showing signs of maintaining or improving hydration based on mood, activity, and urine output

### Calculations:

The infant in this case weighs 8 kg, and based on the above description has mild to moderate dehydration. Calculate and prescribe a fluid replacement regimen using oral rehydration.

**Theoretical example:**

- Daily Maintenance needs are 800 mL/day ( $8 \times 100\text{mL/kg/day}$ )
- Diarrheal losses need to be replaced—could consider 1.5 X maintenance rate with aim of estimating this target = 1200mL/day for this infant
- Deficit needs to be replaced as well.
  - Mild dehydration is 5% volume deficit = 400 mL
    - ( $5\% \times 8\text{kg} = 8\text{L} = 8000 \text{ mL} \times 0.05$ )
  - Moderate dehydration is 10% deficit = 800 mL
    - ( $10\% \times 8\text{kg} = 8\text{L} = 8000\text{mL} \times 0.10$ )
- So could replace 600mL in addition to 1.5X maintenance rate =  $1200\text{mL} + 600\text{mL} = 1800\text{mL/day}$  or  $(1800\text{mL/day} \div 24\text{hr/day} = 75\text{ml/hr})$
- If replacing orally with Pedialyte or Rehydralyte, could encourage parents to achieve this by giving:
  - 75 mL/hr (2.5 ounces each hour, on average)

Instruct parent(s) to call M.D. if not tolerating (ongoing emesis) or hydration status not improving due to higher volume diarrhea, and worsening mood, activity, urine output

**Suggestions for Learning Activities:**

- Ask the student(s) the questions listed under “clinical reasoning” to probe their thinking about the case.
- Create some sample case scenarios for which the student can practice with fluid calculations. Can use the above theoretical calculation in this regard.
- Discuss the pathophysiology that would preclude the use of an oral rehydration regimen.
- Role play – have the students explain to you (you are the “parent”) how to rehydrate and maintain hydration of your infant with gastroenteritis and dehydration using oral fluids, noting the above (which fluids to use, how much, how often, and how to know it is not working and therefore, to seek care).

**Other Resources:**

- The Harriet Lane Handbook – chapter on Fluids and Electrolytes
- Rudolph’s Pediatrics (or other standard pediatrics textbook) Chapter on Fluid, Electrolytes, and Acid Base, subsection on Oral Hydration.



## **Fluid and Electrolyte Management, Case #8**

Written by Adam Weinstein, M.D.

A nine-year-old child with diabetic ketoacidosis has the following electrolytes: Na<sup>+</sup> 132, K<sup>+</sup> 5.4, Cl<sup>-</sup> 103 and Bicarb 9. What is the anion gap? As the fluid deficit is corrected what is likely to happen to the serum K? How should this be managed?

### **Definitions for Specific Terms:**

**Total Body Fluid Requirements**- The sum of maintenance + deficit + ongoing fluid losses

**Maintenance Intravenous Fluids**-The quantities of water and electrolytes that must be consumed to replace the amount of water and electrolytes lost each day as a result of normal daily metabolic activities, without requiring any renal compensation.

**Deficit Fluids**-Pathologic fluid losses in illnesses produce a fluid deficit that may manifest as dehydration.

**Ongoing Fluid Losses**- Sensible and insensible fluid losses

**Sensible Fluid Losses**-Measurable forms of fluid loss such as urinary losses and stool losses in the absence of diarrhea

**Insensible Fluid Losses**-Less readily measurable forms of fluid loss such as losses from the skin and the respiratory tract

**Replacement Fluid Losses**-Term used to denote ongoing losses if they are significant or excessive.

**Anion Gap**- The difference between the measured cations (Sodium) and measured anions (Chloride, Bicarbonate) in the serum. Potassium is not included as it is “negligible” in quantity. When there is an “elevated” anion gap, it suggests there are unmeasured anions in the serum (such as lactic acid or ketoacids, for example)

“A child awaiting surgery may need only maintenance fluids, whereas a child with dehydration due to diarrhea needs maintenance and deficit therapy and also may require replacement fluids if significant diarrhea continues.”

### **Clinical Reasoning:**

1. What is the anion gap?  
Sodium – (Chloride + Bicarbonate) concentrations.  $132 \text{ mEq/L} - 112 \text{ mEq/L} = 20 \text{ mEq/L}$
2. As the fluid deficit is corrected what is likely to happen to the serum K?
  - a. The serum potassium concentration will decrease
  - b. Based on history and experience with DKA, these patients are moderately to severely dehydrated
  - c. Therefore renin-angiotensin-aldosterone system is active

- d. Once renal perfusion is improved, then aldosterone activity will facilitate renal tubular K excretion
  - e. Incidentally, the patient in DKA may have some K losses via vomiting as well
  - f. As patients with DKA are rehydrated, the kidney is better able to excrete ketoacids and start to correct the acidosis
  - g. As acidosis corrects, hydrogen ions will shift out of cells and extracellular potassium will shift back intracellularly, lowering serum K
  - h. A similar effect will be observed as hyperosmolality corrects as well
  - i. Presumably, the patient with DKA will also be treated with insulin
  - j. Insulin will also directly shift potassium intracellularly, lowering serum K.
3. How should this be managed?
    - a. As soon as rehydration is begun, there should be a low threshold to add potassium to the IVF
    - b. Since the decrease in serum potassium will be anticipated, once renal function is established and serum K reaches or approaches 5 mEq/L, potassium should be added
    - c. Can be adjusted with concentrations of 20 to 40 mEq/L in the fluids, often as potassium phosphate or combination of potassium chloride plus potassium phosphate.

### Calculations:

1. Practice calculating anion gap in a number of settings  
Practice assessing whether a given metabolic acid-base disturbance is an isolated single abnormality versus a combined metabolic disturbance using delta-delta formula
2. The change in Anion Gap should equal the change in serum bicarbonate.
  - a. If change (delta) in Anion gap equals the change (delta) in serum bicarbonate, then there is a pure Anion Gap metabolic acidosis
  - b. If change in Anion gap is less than change in serum bicarbonate: Then this suggests there is a combined metabolic acidosis with both an anion gap and non-anion gap component
  - c. This is because there is something “worsening” the acidosis in addition to the acid that is causing the gap
  - d. If change in Anion gap is greater than the change in serum bicarbonate:
    - then this suggests there is a metabolic alkalosis in addition to an anion gap metabolic acidosis
    - this is because there is something “normalizing” the serum bicarbonate—the serum bicarbonate is “better” than it would be if it were just a “pure” anion gap metabolic acidosis.
3. In the question above:  
 Anion Gap = 20. Delta gap =  $20 - 12 = 8$   
 Bicarbonate = 9. Delta bicarb =  $24 - 9 = 15$   
 Anion gap delta is less than bicarbonate delta  
 Therefore there is a combined anion gap acidosis with a non-anion gap component  
 potentially diarrhea and/or renal tubular loss

**Suggestions for Learning Activities:**

- Ask the student(s) the questions listed under “clinical reasoning” to probe their thinking about the case.
- Create some sample case scenarios for which the student can practice understanding the concept of anion gap and mixed metabolic disturbances using the delta delta formula.
- Discuss the physiology of potassium ions and what environments will cause it to move intracellularly versus extracellularly
- Discuss in the context of the differential diagnosis for hyperkalemia
- Discuss in the context of the emergent management of symptomatic or life-threatening hyperkalemia
- Discuss the pathophysiology of diabetic ketoacidosis and its resulting fluid and electrolyte disturbances, including those of osmolarity, hypo- vs. iso- vs. hypernatremia, potassium, and phosphate.

**Other Resources:**

- The Harriet Lane Handbook – chapter on Fluids and Electrolytes
- Rudolph’s Pediatrics (or other standard pediatrics textbook) Chapter on Fluids, Electrolytes, and Acid-Base and Chapter on Diabetic Ketoacidosis.

## **Fluids and Electrolyte Management, Case #9**

Written by Lavjay Butani, M.D.

A nine-month-old girl presents with two days of vomiting and diarrhea. She is listless and her heart rate is 210. What is the most appropriate initial management of this child?

### **Review of Important Concepts:**

#### **Historical Points**

Assessing and estimating the degree of dehydration is the first and most important step in fluid management in a dehydrated child since this will determine how much and in what manner (route and rapidity) fluid resuscitation should occur. The degree of dehydration can be estimated if a recent previous weight when the child was well is known. Often this is not available; in such instances, severity of dehydration can be estimated by looking for a constellation of signs and symptoms (see table in Case 3).

#### **Physical Exam Findings**

1. Can the degree of dehydration explain her clinical picture?
  - a. If this child appears mild or moderately dehydrated based on her previous weight or physical signs, one has to evaluate her for other causes for her listlessness and high heart rate, such as septic shock or cardiogenic shock.
  - b. One also needs to keep in mind that this child could have more than one process going on at the same time (such as sepsis and hypovolemia).
2. What have the parents been giving the child at home for rehydration?
  - a. Infants are especially vulnerable to develop severe electrolyte abnormalities such as hypo or hypernatremia if improper oral rehydration solutions are used (such as water or inappropriately mixed homemade oral rehydration solutions)
3. Are there sick contacts?

A family history of similar illness may indicate an infectious etiology such as viral gastroenteritis.
4. Dietary history and exposures?

A history of exposure to cattle, pets (such as turtles), well water or unpasteurized milk may indicate specific bacterial or parasitic pathogens (Salmonella for turtles, Giardia or E. coli for well water use), enterohemorrhagic E. coli with unpasteurized milk and cattle exposure.
5. Has she been immunized? Parental refusal to immunize or other barriers to immunization increase likelihood of infectious causes for her symptoms and concerning vital signs.
6. What are the rest of her vital signs and her examination?
  - a. Fever may indicate sepsis.
  - b. If she has meningeal signs (which are often not present in young infants and children), meningitis would be high on the list.

## Clinical Reasoning

1. What might be some possibilities that would explain this child's clinical appearance? Severe gastroenteritis (viral or bacterial)
  - a. Inborn errors of metabolism
  - b. Bacteremia
  - c. Meningitis
  - d. Pneumonia
  - e. Urosepsis.
2. How would you manage this child acutely?
  - a. Stabilize the airway, breathing and circulation.
  - b. Check blood glucose. For circulation, administer an IVF bolus of 20 ml/kg with normal saline (to expand her intravascular volume) over 20-30 minutes. Repeat as needed until clinical signs of dehydration have improved and vital signs have stabilized.
  - c. Further management and investigations will depend on the clinical history and examination.
  - d. For serious bacterial infections, a 'sepsis work up' including an LP should be seriously considered and IV antibiotics presumptively started.
  - e. Frequent monitoring of her vital signs is important as is watching her neurologic status.
  - f. Further enteral and/or parental rehydration and its rate and content would likely be incorporated based on the child's evaluation, including the estimated degree of dehydration and lab results (e.g. any dysnatremia).
  - g. If vomiting and diarrhea persists, replacement fluids may be needed to prevent the child from going into hypovolemic shock.

## Suggestions for Learning Activities:

- Ask the student(s) the questions listed under "clinical reasoning" to probe their thinking about the case
- Have students think about options for hydration if IV access cannot be obtained easily.
- EBM project- have students review risks and benefits of the new rotavirus vaccine in preventing morbidity and mortality in children from gastroenteritis.

## Other Resources:

- The Harriet Lane Handbook – chapter on Fluids and Electrolytes and BSA nomogram in Formulary Adjunct

## GROWTH AND DEVELOPMENT

### Growth and Development, Case #1

Written by Linda O. Lewin, M.D.

A three-month-old full-term infant, who was 3000 g. at birth, now weighs 3420 g. Her height velocity has been normal. Her parents want to know if this is an adequate weight gain. What would you tell them? What are the common causes of poor weight gain at this age? How would you evaluate the infant?

#### Definitions for Specific Terms:

**Height velocity**- refers to the number of centimeters/year the patient has grown. In the first year of life the average growth velocity is 25 cm/yr but that varies from 38 cm/yr in the first 2 months to 12 cm/yr at 1 yr. At age 2 growth velocity is 10 cm/yr, from 2-4 yrs it is 7 cm/yr, from 4-5 yrs it is 6 cm/yr, and growth velocity is 5cm/yr from age 5 until the pubertal growth spurt.

#### Review of Important Concepts:

- Know the normal pattern of weight gain in the first three months of life
- List the common causes of poor weight gain in the first three months of life
- Describe the evaluation of a patient with poor weight gain at three months

#### Historical Points

This is an example of a situation in which a very detailed history is critical. These are some key points that can help rule in or rule out possible diagnoses:

- Other complaints about the baby, including sleeping too much, displaying unusual movements, spitting up, bowel problems, rashes, tiring easily, breathing hard, and other complaints that might point to a GI, cardiac, pulmonary, endocrine, neurologic, or infectious cause.
- Birth history looking for maternal illness, infection, medications, other exposures
- Family history of poor growth, feeding intolerance, inborn errors of metabolism, genetic syndromes
- Social history, including who lives with the baby, who feeds her, maternal depression or other illness
- Diet history, especially what the baby is eating. If breastfed then specific questions about how successful that has been and if formula fed then details about what formula, how it is mixed, and how much is being eaten.

#### Physical Examination Findings

The physical exam should also be detailed, looking for evidence of congenital anomalies, neurologic abnormalities, cardiac and respiratory problems, GI function, and general development.

1. General appearance:  
Is the baby vigorous?

2. Vitals:
  - a. Tachycardia or tachypnea?
  - b. Fever?
  - c. Blood pressure abnormalities?
  - d. Low O<sub>2</sub> saturation?
3. HEENT:  
Evidence of malformations of mouth, tongue, etc.
4. Lungs:
  - a. Respiratory distress?
  - b. Abnormal lung sounds?
5. Cardiac:  
Murmurs, tachycardia?
6. Abdomen:
  - a. Large liver?
  - b. Other masses?
7. Neurologic:
  - a. Normal tone?
  - b. Reflexes?
  - c. Gag, suck, swallow?
8. Skin:
  - a. Rash?
  - b. Cyanosis?
  - c. Jaundice?
9. Lab work should be directed to the most likely causes based on the history and physical exam.

### **Clinical Reasoning**

1. Is this adequate weight gain?  
The average newborn loses up to 10% of his/her birth weight in the first few days of life, then is expected to be back at birth weight by 2 weeks of age. In the first 4 months, babies gain an average of 20-30gm (1oz) per day, from 4-6 months approximately 15-20gm/day, and from 6-12 months it is approximately 10-12gm/day. Most babies double their birth weights by 6 months.

Teaching suggestion: ask the learner(s) to calculate this babies' weight gain per day and determine if it falls within the expected guidelines. Can go to online growth chart and practice plotting this baby's growth at [www.cdc.gov/growthcharts/](http://www.cdc.gov/growthcharts/).

The baby in the case has gained 420g since birth, or 14oz. We would expect in 90 days that the baby would have gained close to 2000g, so this is clearly not adequate.

2. What are the common causes of poor weight gain at this age?

Assuming that this is not a baby that was growing fine but then developed an acute illness that has caused her to lose weight, there is a long list of possible causes. They include:

a. Problems of intake:

- Too few calories with normal metabolic demands:
- Not enough given
- Improperly mixed formula
- Poor maternal milk supply due to poor diet, stress, medications (mother should continue prenatal vitamins while nursing)
- Improper use of other foods: most commonly water, juice
- Neurologic disease: if the baby has a poor suck reflex or uncoordinated swallow he/she might not get in enough. Those babies might choke/cough while feeding.
- Anatomic abnormality of the mouth (palate), pharynx, or esophagus
- Poor signaling of hunger: the baby doesn't cry when hungry or the parent doesn't recognize the baby's signal for wanting to eat

b. Enough calories but increased metabolic demands:

- Cardio-pulmonary disease: feeding is like exercise to babies and if they tire due to CHF or respiratory distress they may not take enough calories
- Chronic inflammation/infection
- Problems of usage of nutrients:
- Cow's milk and/or soy protein intolerance
- Significant GE reflux leading to excessive vomiting
- GI malformation leading to excessive vomiting
- Malabsorption of fats, carbohydrates, or proteins
- Metabolic disorder in which nutrients aren't used or leading to neurologic difficulties that cause poor feeding

**Suggestions for Learning Activities:**

- Present a number of scenarios in which the same patient presentation represents different underlying causes. Good examples are improper formula preparation, cow's milk intolerance (contrast it with lactose intolerance, which is extremely rare in newborns), congestive heart failure, and developmental delay, as they are more common than many of the other diagnoses. This could be presented in the opposite way as well and ask, for a given diagnosis, what would the learner expect to hear in the history and see in the physical exam and/or diagnostic studies?

**Other Resources:**

- <http://www.cdc.gov/growthcharts/>



## **Growth and Development, Case #2**

Written by Linda O. Lewin, M.D.

A fifteen-month-old boy says no recognizable words. His parents are concerned and wonder if he needs speech therapy. How would you respond to their concerns? How would you evaluate this child?

### **Review of Important Concepts:**

- Know the expected pattern of speech development in the first two years of life
- List at least one developmental screening tool that can help the clinician identify speech delay in young children
- List the common causes of speech delay in the first two years of life
- Describe the evaluation of a patient with speech delay at 15 months of age

### **Historical Points**

- It is important to assess this child's development to date in all areas to determine if this is an isolated delay or if it represents part of a global developmental problem.
- It is also important to know if the child had some speech at one time but has regressed.
- Questions about hearing are also very relevant to a child without speech.
- Think of development in terms of gross motor (rolling, sitting, crawling, walking, running), fine motor (batting at objects, grabbing with whole hand, pincer grasp, scribbling, piling two objects), social (smiling, feeding self, pat-a-cake, waving, imitating adults), and speech (expressive language skills: cooing, babbling, one word, several words by 15 months and receptive language skills: following directions such as stop, come here, etc.).
- Ask if there is a family history of speech or other developmental delay, if the child has other medical problems or takes any medications, and what the social situation is like.

### **Physical Exam**

The physical exam will be focused on the child's development in the four areas mentioned above, as well as looking for evidence of any systemic illnesses that might be related to developmental delay.

### **Clinical Reasoning**

1. Is this a speech delay?
  - a. A 15 month old child should be able to say several words (in the 5-10 range) that are specific and recognizable to his close family members.
  - b. He should be able to point to common objects that others name, like his favorite toy, a person he lives with, a picture in a book, etc, and follow simple directions like "go get your cup."
  - c. A 15 month old that has no recognizable words is definitely delayed.
2. What is the expected pattern of speech development in the first 2 years?
  - a. By 3 months: turn to sounds, make cooing noises, cry differently for different needs, calm when spoken to
  - b. By 6 months: make gurgling sounds, "blow bubbles," make loud vowel sounds, respond differently to different tones in your voice, notice that some toys make sounds

- c. By 9 months: make repetitive consonant sounds like “ba ba ba” and “da da da” non-specifically, look in the direction of sounds, listen when someone talks to him/her
  - d. By 12 months: say one or two words that are specific, follow some very simple commands like “drink your milk,” point to something he/she wants, try to imitate words
  - e. By 18 months: Say 8-10 words that are specific, follow several simple instructions, point to objects, pictures, and people who are familiar when named, possibly point to body parts (must have been taught these)
  - f. By 24 months: say approximately 50 words, be at least 50% understandable to a stranger, put two words together in novel combinations, start to use pronouns like “mine,” follow simple commands without gestures
3. How do you respond to the child’s parents?
    - a. The clinician must tell the parents that the child is delayed, and that he/she is going to try to find out if there is a recognizable cause in order to decide how to proceed. This can be either easy or challenging, depending on the parents’ level of anxiety and the level of concern of the physician.
    - b. If the child seems to be globally delayed the discussion is much different than if there seems to be a simple expressive speech delay.
  4. What are some common screening tools to identify speech delay?

Commonly used tools are the Denver Developmental Screening Test, the Ages and Stages Questionnaire, the Child Development Inventory, and many others.
  5. What are the common causes of speech delay in a 15 month old?
    - a. Hearing impairment is the first thing to try to rule out when a child is speech delayed. Hopefully, this would have been found earlier than at 15 months either through screening in the newborn nursery or during well child visits. A hearing impaired child coos and makes normal noises early on, but does not develop babbling in the second half of the first year, and shows decreased or no response to sounds or music. Some causes to consider are chronic otitis media with effusion and exposure to ototoxic drugs. Children can be sent to the audiologist for formal testing if hearing impairment is suspected or if speech delay appears to be receptive as well as expressive.
    - b. Delayed speech can be associated with a global developmental delay, meaning that the child also shows delayed development in gross motor, fine motor, and social-adaptive development. There are a large number of causes of global delays, including prematurity (where the child might have to be corrected to gestational age), congenital infection, structural brain abnormalities, genetic syndromes, endocrine disorders, and others. Newborn screening with catch some of those problems, other testing should be done based on the information from a detailed birth history, family history, and past medical history.
    - c. Isolated expressive speech delay has a generally good prognosis. These are children who understand speech normally, but have trouble expressing themselves with speech. This is manifest as difficulty creating proper sentences, finding the right words, using grammar, and other processes of creating effective spoken communication. Poor pronunciation (phonological disorder) is a separate problem in which the child can put the words together correctly but can’t say them in an understandable manner. This is sometimes related to hearing impairment, with a potential history of exposure to ototoxic drugs or repeated bouts of otitis media in infancy.

6. How would you evaluate this patient?
  - a. As noted above, the clinician first needs a detailed history, including prenatal and birth histories, family history, past medical history, exposure to ototoxic drugs, and developmental history to date.
  - b. Results of any previous testing, such as newborn hearing screening and serum newborn screening tests, should be reviewed.
  - c. The first decision point is whether this patient has a global developmental delay or an isolated speech delay.
    - If the problem is global, then work-up should follow from the clues gained from the history and physical exam.
    - If the speech delay is isolated, then hearing testing is appropriate, as well as a very good ear exam looking for fluid in the middle ear or scarring from repeated otitis media.
    - Referral to the state's Infants and Toddler's program, or its equivalent, is appropriate for evaluation and ongoing therapy as necessary.

**Other Resources:**

- US Preventive Services Task Force: Screening for Speech and Language Delay in Preschool Children. At: <http://www.uspreventiveservicestaskforce.org/uspstf/uspshdv.htm>.
- Agency for Healthcare Research and Quality: Screening for speech and language delay in preschool children: recommendation statement. At: <http://www.ngc.gov/content.aspx?id=8396>.
- Leung A, Kao CP. Evaluation and Treatment of the Child with Speech Delay. 1999. <http://www.aafp.org/afp/990600ap/3121.html>

## **Growth and Development, Case # 9**

Written by Kirsten Hawkins, M.D.

A 14 year-old female has not started her periods. What important information should you gather from the history and physical examination?

### **Definitions for Specific Terms:**

**Primary Amenorrhea**- Is defined as the lack of menses by age 14 in the absence of normal development of breasts and pubic hair or by the absence of menstruation by age 16 in the presence of normal development of breasts and pubic hair.

**Sexual Maturity Rating. (a.k.a.: Tanner Staging)**- There are five distinct pubertal stages as developed by Marshall and Tanner.

**Thelarche**- Onset of breast development or breast budding

### **Review of Important Concepts:**

#### **Historical Points**

- Medical History: Menarche usually occurs in Breast Stage 3 or 4 and approximately 3.3 years after their growth spurt and 2.3 years after breast development. The normal range for menarche is 9-15 years with an average age of approximately 12.5 years. 95-97% of females reach menarche by age 16 and 98% by 18 years.
- Past Medical History: Patients with a history of cancer, autoimmune disease, solid organ transplantation, and chronic disease are at risk for primary amenorrhea. A history of any CNS, ocular, olfactory, pelvic, gonadal, and genital abnormalities should be obtained. Growth parameters should be graphed. Family history including parental age of pubertal development is needed.
- Confidentiality: Adolescent patients may be unwilling to share certain information when their parents are present. It's important to not only take a history with the patient's parent/guardian in the room, but also to discuss certain topics privately with the patient. Typically, after the initial history is taken, parents should be asked to step out for a confidential discussion. In addition, the patient should be assured of confidentiality, with the exception of cases where immediate harm may come to the patient or to another person.
- Sexual History: A detailed sexual history is also very important in this case.

#### **Physical Exam Findings**

1. A careful physical examination is important, including height and weight, blood pressure, palpation of the thyroid gland, and Tanner staging of the breast and pubic hair. Facial defects may be associated with hypothalamic-pituitary dysfunction. Renal and vertebral anomalies and hernias are associated with mullerian malformations.
2. A careful gynecologic examination is important in identifying the cause of primary amenorrhea.
  - a. The breast examination may reveal small, pale areolae as a sign of chronic low estrogen.

- b. If amenorrhea is present with galactorrhea, consider a prolactin-producing pituitary adenoma.
  - c. The external genitalia should be examined, looking for an enlarged clitoris, an abnormal hymen, or evidence of estrogen deficiency (thin, pink, vulvar mucosa).
3. Vaginal patency should be established with moistened cotton or Dacron tipped applicator or a moistened gloved finger. If a bimanual exam is possible, look for a mass or ovarian enlargement. A rectal exam may be necessary to help establish the presence of a cervix or to find a mass proximal to an obstructed vaginal canal.
4. The presence of sparse or absent pubic hair with full breast development suggests androgen insensitivity syndrome.
5. Identify hirsutism, severe acne, clitoromegaly, and scalp hair thinning as signs of hyperandrogenism.
6. Evaluate the patient's nutritional status and plot the growth parameters.

### Clinical Reasoning

1. Generate a differential diagnosis for this patient.
  - a. Turner's Syndrome
  - b. Kallman's Syndrome
  - c. Constitutional delay of growth
  - d. Celiac Disease
  - e. IBD
  - f. Cystic Fibrosis
  - g. Pituitary failure
  - h. Gonadal failure
  - i. Eating disorders
  - j. Pituitary adenoma
  - k. Craniopharyngioma
  - l. PCOS
  - m. Mayer-Rokitiansky-Kuster-Hauser Syndrome
  - n. Androgen Insensitivity
  - o. Pregnancy
  - p. Thyroid disorders
2. What lab tests might you order as an adjunct to your history and physical exam? Depending on your history and exam you might need:
  - a. Karyotype
  - b. complete blood count
  - c. erythrocyte sedimentation rate
  - d. Celiac evaluation
  - e. electrolytes
  - f. blood urea nitrogen
  - g. creatinine
  - h. glucose
  - i. calcium

- j. phosphorus
  - k. albumin
  - l. liver enzymes
  - m. urine analysis
  - n. FSH
  - o. TSH
  - p. Free T4
  - q. Prolactin
  - r. testosterone
  - s. DHEAS
  - t. Regardless of reported sexual activity, the patient should have a urine or serum human chorionic gonadotropin (HCG) test
3. What radiology study might you obtain as an adjunct to your physical exam?
- a. A pelvic ultrasound or pelvic MRI may be helpful to identify structural lesions, intrabdominal testes, or congenital malformations.
  - b. A head MRI may identify a pituitary adenoma or craniopharngioma.

**Suggestions for Learning Activities:**

Ask the students to perform a role play for this scenario. Students should practice asking the “parent/guardian” to leave the room, taking a detailed social history from the adolescent “patient.”

**Other Resources:**

- Nelson. L, Primary Ovarian Insufficiency N Engl J Med 2009; 360:606-14.
- Neinstein, et al. Adolescent Health Care- A Practical Guide. 5th Ed. 2008
- Sanfillipo, et al. Pediatric and Adolescent Gynecology, 2nd Edition, 2001
- Emans SJ, Laufer MR, Goldstein DP. Pediatric and Adolescent Gynecology, 5th Edition, 2005

## HEALTH SUPERVISION

### **Health Supervision, Case #1**

Written by Sandy Sanguino

What topics are important to cover in a prenatal visit?

#### **Definitions for Specific Terms:**

**Prenatal Visit**- A visit with the pediatrician that occurs before the birth of the child.

#### **Review of Important Concepts:**

##### **Clinical Reasoning**

The purpose of this visit is multi-faceted. It is about establishing a relationship with the family. It also provides an opportunity to introduce the family to the practice, provide guidance and identify risk-factors. It is important to address any concerns the family might have. Additional priorities for this visit should include:

1. Family resources (family support systems, transition home [assistance after discharge], family resources, use of community resources)
2. Parental (maternal) well-being (physical, mental, and oral health; nutritional status; medication use; pregnancy risks)
3. Family history (specifically inherited diseases)
4. Breastfeeding decision (breastfeeding plans, breastfeeding concerns [past experiences, prescription or nonprescription medications/drugs, family support of breastfeeding], breastfeeding support systems, financial resources for infant feeding)
5. Safety (car safety seats, pets, alcohol/substance use [fetal effects, driving], environmental health risks [smoking, lead, mold], guns, fire/burns [water heater setting, smoke detectors], carbon monoxide detectors/alarms)
6. Newborn care (introduction to the practice, illness prevention, sleep [back to sleep crib safety, sleep location], newborn health risks [hand washing, outings]), discuss circumcision

#### **Suggested Learning Activities:**

- Have the students role play a prenatal visit.

#### **Other Resources:**

- [http://brightfutures.aap.org/3rd\\_Edition\\_Guidelines\\_and\\_Pocket\\_Guide.html](http://brightfutures.aap.org/3rd_Edition_Guidelines_and_Pocket_Guide.html)

### **Health Supervision, Case #3**

Written by Penny Murata, M.D.

A twelve month-old child is seen for a health maintenance visit. He is due to receive his vaccines. On exam he has a temperature of 100.4°F and a runny nose. Should he still be immunized? What are the absolute contraindications to immunizations?

#### **Definitions for Specific Terms:**

**Fever**- What is a fever? Fever is defined as temperature  $\geq 100.4^{\circ}\text{F}$

**Health maintenance visit**- What are the usual ages for health maintenance visits? (newborn follow-up; 2, 4, 6, 9, 12, 15, 18 months; 2 years and annually thereafter); What are the components of a health maintenance visit? (interval history of illness or injury since previous visit; parental concerns; nutrition; behavior; sleep habits; elimination habits; developmental milestones; growth; safety; anticipatory guidance; screening for lead and anemia; review of immunizations needed; recommendations for timing of next visit)

**Absolute contraindications**- Absolute contraindication refers to definite reasons for not administering the immunizations as opposed to “precautions”, which indicate vaccines would most likely be deferred, but might be administered if the benefit outweighs the risk.

#### **Review of Important Concepts:**

##### **Historical Points**

1. Severity of current illness: Does the patient have additional symptoms of moderate or severe illness that are indications to delay vaccine administration? If a child has a severe illness (e.g. influenza, bronchiolitis, pneumonia etc) the vaccines should be delayed to avoid confusing a vaccine reaction with the illness. Mild illnesses, including upper respiratory infection, otitis media, diarrhea, and need for antibiotic use, are not contraindications to vaccination. There is no evidence that administering vaccine during mild illnesses decreases the effectiveness of the vaccine or increases the risk of adverse reactions to the vaccine.
2. History of adverse reaction to vaccine(s): Patients should be screened for previous serious reactions to vaccines (e.g. anaphylactic reaction to vaccine or vaccine component; Guillain-Barre Syndrome). Children with egg allergies can be given MMR without prior skin testing. Anaphylactic symptoms include hives, wheezing or difficulty breathing, circulatory collapse, and shock.
3. History of immunodeficiency: Leukemia, cancer, AIDS, and other immunocompromised conditions are usually contraindications for live virus vaccines. Which vaccines are live? (MMR, MMRV, varicella, rotavirus, and intranasal live attenuated influenza vaccine [LAIV]) MMR and varicella vaccines should be considered for HIV-infected children, depending on age-specific CD4+T-lymphocyte counts ( $\geq 15\%$ ).



4. History of chemotherapy or steroid therapy in the past 3 months: Chemotherapy or long-term high-dose steroid treatment is an indication to postpone live virus vaccines. Ask about the timing, duration, and dose of treatment.
5. History of blood product transfusion, immune globulin or antiviral drug use: Live virus vaccines might need to be postponed.
6. History of vaccinations in the past 4 weeks: The interval between LAIV or injectable live virus vaccine (MMR, MMRV, varicella, yellow fever) and similar vaccine is 28 days.

### Physical Exam Findings

Moderate or severe illness: Examples include respiratory distress or dehydration.

### Clinical Reasoning

1. Which immunizations are indicated for a 12 month-old child? MMR, varicella, hepatitis A (HAV), Pneumococcal, Haemophilus influenza type B (Hib), DTaP (if at least 6 month interval between DTaP#3 and today's DTaP#4), polio#3 if not yet received, hepatitis B (HBV)#3 if not yet received, and possibly influenza depending on the season.
2. What are absolute contraindications to immunizations? Anaphylactic reaction to vaccine or vaccine components (neomycin, streptomycin or polymyxin B-polio; alum and possibly 2-phenoxyethanol-HBV; neomycin or gelatin – MMR, varicella; egg-influenza); encephalopathy within 7 days of DTaP dose; moderate or severe acute illness.
3. What are precautions to vaccines? For DTaP, precautions include previous reaction to DTaP dose: seizure within 3 days, pale or limp episode or collapse within 48 hours, continuous crying for  $\geq 3$  hours within 48 hours, fever of  $105^{\circ}\text{F}$  within 48 hours.
4. What are common reactions to the vaccines that are indicated? DTaP – fever, local inflammation, fussiness, tiredness, poor appetite, vomiting; Polio – local pain; Pneumococcal – fever, drowsiness, loss of appetite, local inflammation; Hib – fever, local inflammation; HAV – headache, loss of appetite, tiredness, local soreness; HBV – fever, local soreness; MMR – fever, mild rash usually within 7-12 days; varicella – local inflammation, fever, or mild rash up to a month after dose; influenza – local inflammation, hoarseness, sore/red/itchy eyes, cough, fever, aches

### Diagnosis:

1. If the patient has no additional symptoms, how would you characterize the current acute illness?  
Mild (not moderate or severe)
2. Are there any vaccines that you would withhold or postpone?  
No, if the patient has no prior reactions to vaccines and given today's mild illness, the patient can receive all indicated vaccines.

**Suggestions for Learning Activities:**

- Have the students discuss the case in small groups of 2-3 students and refer to the Vaccine Information Statements (VIS) for contraindications and common reactions to the indicated vaccines.
- Ask the students to role play the scenario (in small groups or a select few students in front of the large group): the “parent” can express concerns about giving the vaccines when the child is ill and about the possible reactions; the “health care provider” can address the concerns.

**Other Resources:**

- AAP Red Book: Report of the Committee on Infectious Diseases
- American Academy of Pediatrics [www.cispimmunize.org](http://www.cispimmunize.org)
- Centers for Disease Control [www.cdc.gov](http://www.cdc.gov)
- National Network for Immunization [www.immunizationinfo.org](http://www.immunizationinfo.org)
- Parents of Kids with Infectious Diseases [www.pkids.org](http://www.pkids.org)

## **Health Supervision, Case #4**

Written by Penny Murata, M.D.

A twelve month-old child has been taking 2 mg/kg/day of oral prednisone for the past three days for asthma. He is due for his routine immunizations. Would you modify his immunization schedule? What if he had been taking 2 mg/kg/day for the past three weeks?

### **Definitions for Specific Terms:**

**Prednisone**- Prednisone is a synthetic corticosteroid with immunosuppressive and anti-inflammatory properties. What forms of steroids are available, in addition to the oral form? Intravenous, inhaled, intramuscular

**Asthma**- How is asthma diagnosed in young children? It might be difficult to make a definitive diagnosis of asthma in a twelve month-old child; the diagnosis could be supported by personal or family history of atopy and, over time, recurrent episodes of wheezing responsive to bronchodilator use and pulmonary function tests.

### **Review of Important Concepts:**

#### **Historical Points**

1. What is the usual duration of prednisone treatment for acute asthma exacerbation?  
3-5 days, but sometimes up to 7 days or longer depending on patient's response
2. Is the current dose at the usual recommended dose?  
Yes, the usual dose of oral prednisone for asthma exacerbation in the outpatient setting is 1-2 mg/kg/day divided once a day or twice a day.
3. How severe is the patient's current illness?  
The patient has been on oral prednisone for the past 3 days, but might need a longer course depending on the response.

#### **Physical Exam Findings**

Respiratory symptoms: Moderate or severe illness, including respiratory distress, is a contraindication to vaccination. Assess for respiratory rate, shortness of breath, cyanosis, nasal flaring, retractions, and breath sounds.

#### **Clinical Reasoning**

1. Which immunizations are indicated for a 12 month-old child [see also Health Supervision #3]?  
MMR, varicella, hepatitis A (HAV), Pneumococcal, Haemophilus influenza type B (Hib), DTaP (if at least 6 month interval between DTaP#3 and today's DTaP#4), polio#3 if not yet received, hepatitis B (HBV)#3 if not yet received, and possibly influenza depending on the season.
2. How could prednisone use affect the immunizations administered to this patient?  
Prednisone use could result in immunosuppression.

3. Which of the above indicated immunizations are generally contraindicated in an immunosuppressed patient?  
Live vaccines (MMR, varicella, live attenuated influenza vaccine)
4. What amount and duration of systemic steroids are considered unlikely to induce immunosuppression?  
Short term (<14 days); low to moderate dose (<20 mg prednisone/day); long-term, alternate day treatment with short-acting steroids; maintenance physiologic doses for replacement therapy; or topical, inhaled, or intraarticular, bursal, or tendon injection.
5. What amount and duration of systemic steroids might induce immunosuppression?  
 $\geq 2$  mg/kg of body weight or  $\geq 20$  mg./day of prednisone or equivalent for persons who weigh >10 kg for  $\geq 14$  days

**Diagnosis:**

1. For the patient taking 2 mg/kg/day of oral prednisone for the past three days, would you consider the patient to be immunosuppressed, and if so, how would you alter the immunization administration?  
No.
2. For the patient taking 2 mg/kg/day of oral prednisone for the past three weeks, would you consider the patient to be immunosuppressed, and if so, how would you alter the immunization administration?  
Yes. It is recommended to postpone live virus vaccinations for at least one month after discontinuing the corticosteroid therapy.

**Suggestions for Learning Activities:**

- Have the students refer to the Advisory Committee on Immunization Practices (ACIP) General Recommendations on Immunization and drug reference information (e.g. Epocrates or PDR online)
- Modify the case to allow the students to calculate the patient's steroid dose based on the patient's weight and dose of steroid (rather than stating the dose as "2 mg/kg/day")

**Other Resources:**

- AAP Red Book: Report of the Committee on Infectious Diseases
- American Academy of Pediatrics [www.cisimmunize.org](http://www.cisimmunize.org)
- Centers for Disease Control [www.cdc.gov](http://www.cdc.gov)
- Advisory Committee on Immunization Practices (ACIP) General Recommendations on Immunization
- Epocrates [www.epocrates.com](http://www.epocrates.com)

## **Health Supervision, Case #5**

Written by Julia Belkowitz, M.D. and Leticia Oliveros, M.D.

In the nursery, parents are informed that blood needs to be drawn from their newborn for "screening tests". Describe to the parents what these are and why they are performed. What tests are routinely performed in your state? How are the results transmitted to the parents?

### **Definitions for Specific Terms:**

**Screening tests**- A diagnostic test used to identify disease in patient not yet showing symptoms.

**Newborn screening test**- A set of tests administered to all newborns in order to identify serious health conditions prior to the onset of symptoms. All states require universal testing; however the individual tests performed vary state by state.

### **Review of Important Concepts:**

#### **Historical Points**

The test is performed on all newborns regardless of the patient's history. However, some important components of the history to include when interpreting the results include the following:

1. Timing of when the specimen was drawn
2. Birth/ neonatal history: Important factors that could affect the newborn screen results include preterm birth, feeding history, previous medical treatments including blood transfusions or parenteral nutrition
3. Family history can be used to try to identify other family members affected.
4. Feeding history: When feeds were initiated (has it been 24 hours), type of milk/ formula, any feeding difficulties/ interruptions

#### **Physical Exam Findings**

Most cases do not show any physical signs at the time of testing

#### **Clinical Reasoning**

1. Why is newborn screening done?  
Newborn screening tests are done to identify serious, disabling or life threatening conditions that present after birth. Most conditions identified have a very low prevalence. Most states also include a hearing test as a part of the newborn screening program.
2. How many tests are included in the screen?  
The American College of Medical Genetics recommends that each state test for a core panel of 29 disorders and an additional 25 secondary conditions to be included in the testing. Each state varies in its panel, however. Students can refer to the state health department to identify the panel used in individual states.

3. What types of conditions are tested for in newborn screening?
  - a. Amino acid metabolism disorders (e.g. Phenylketonuria, maple syrup urine disease, homocystinuria)
  - b. Organic acid metabolism disorders (problems breaking down chemicals like amino acids, lipids, sugars, and steroids, e.g. isovaleric acidemia, multiple carboxylase deficiency)
  - c. Fatty acid oxidation disorders (e.g. carnitine uptake defect)
  - d. Hemoglobinopathies (e.g. sickle cell anemia, Hb S/beta-thalassemia, Hb S/C disease)
  - e. Others (e.g. hypothyroidism, cystic fibrosis, congenital adrenal hyperplasia, galactosemia, biotinidase deficiency)
4. What are the benefits of universal screening?
  - a. Benefits of testing include that clinical manifestations can be reduced or eliminated because of early identification and intervention.
  - b. It can also potentially identify other family members at risk.
5. What are the risks of the test?
  - a. Risks and limitations of the test include the false negative and false positive associated with the testing.
  - b. A screen does not rule in or rule out disease. This can lead to additional testing and the associated financial and social costs (including stress to families).
  - c. There also may be affected children not identified.
6. How is the testing done?  
 The process by which newborn screening is done varies state by state. Typically the lab is drawn after 24 hours of age/ protein feedings via a heel stick. A drop of blood is placed into each of the specimen areas on special filter paper and sent to the lab for analysis via tandem mass spectrometry and other techniques.
7. How are the results transmitted to patients?  
 The testing laboratory has the responsibility of communicating test results to the hospital of birth and/ or physician of record for the newborn. For abnormal results, most states have systems in place to notify the family in need of immediate medical care and/ or follow up by a specialist. In some states, the primary care provider for the newborn is responsible for communicating the results to the parents.

### **Suggestions for Learning Activities:**

- Students can role play the interaction with the parents.
- Students can look up what screening tests are done in their state and learn about the processes in place for an abnormal result. The ACT sheets from the American College of Medical Genetics are a helpful resource.
- Students can discuss the complexities of a system required for management of one individual child with an abnormal test, including the coordination required at all levels of the system from the state laws, lab draw and testing, notification system to medical provider, challenges with contacting the individual family, and having them access the confirmatory testing, including potential therapy.
- Students can discuss the benefits and costs (psychological and financial) of newborn screening to the individual and society.

- Students can discuss the ethical implication of screening programs and/ or the concept of screening for late onset diseases.

**Other Resources:**

- ACMG ACT Sheets and Confirmatory Algorithms. American College of Medical Genetics; [http://www.acmg.net/AM/Template.cfm?Section=ACT\\_Sheets\\_and\\_Confirmatory\\_Algorithms&Template=/CM/HTMLDisplay.cfm&ContentID=5127](http://www.acmg.net/AM/Template.cfm?Section=ACT_Sheets_and_Confirmatory_Algorithms&Template=/CM/HTMLDisplay.cfm&ContentID=5127). Accessed July 28, 2011.
- Kaye CI M.D. and Committee on Genetics. Technical Report: Introduction to the Newborn Screening Fact Sheets. Pediatrics. 2006; 118(3):1304-1312.
- March of Dimes. [www.marchofdimes.com](http://www.marchofdimes.com)
- National Newborn Screening and Genetics Resource Center. [www.genes-r-us.uthscsa.edu](http://www.genes-r-us.uthscsa.edu)
- Newborn Screening Overview. National Center for Medical Home Resources. [http://www.medicalhomeinfo.org/how/clinical\\_care/newborn\\_screening.aspx](http://www.medicalhomeinfo.org/how/clinical_care/newborn_screening.aspx). Accessed July 28, 2011.

## **Health Supervision, Case #7**

Written by Julia Belkowitz, M.D.

A four-month old boy is seen for a well child examination. Following his first set of immunizations he had a temperature of 103° for 12 hours and was extremely irritable. The parents are concerned about giving the next set of immunizations. How would you address their concerns?

### **Definitions for Specific Terms:**

**Vaccine contraindication**- A condition that increases the risk for a serious adverse reaction.

**Vaccine Precaution**- A condition that might increase the risk for a serious adverse reaction or that might compromise the ability of the vaccine to produce immunity. In general a vaccine should be held in a patient with a precaution unless the benefits outweigh the risks (i.e. community outbreak of infectious disease).

### **Review of Important Concepts:**

#### **Historical Points**

- Associated symptoms with episode above- seizure, inconsolable crying, neurologic changes or altered consciousness
- Past medical history- progressive neurological illness
- Return to baseline after 12 hour period

#### **Physical Exam Findings**

Complete physical exam

#### **Clinical Reasoning**

1. Physician must differentiate a common, expected vaccine reaction from an event that would indicate a precaution or contraindication from administering the next vaccinations.  
What are the expected reactions to vaccines? Common vaccine reactions can be
  - a. Local (such as pain or redness at the site)
  - b. Systemic (such as fever)
2. What are the contraindications for vaccination?  
Absolute contraindications are few and include an anaphylactic reaction to a previous vaccine or encephalopathy (e.g., coma, decreased level of consciousness, or prolonged seizures) within 7 days of previous administration of DTP/ DTaP. Vaccines using the whole cell pertussis (DTP) vaccines are no longer used in the US as they have been replaced with the acellular form (DTaP), associated with fewer adverse effects, since licensed in 1991.
3. What are the vaccination precautions?  
Precautions include moderate or severe acute illness with or without fever, progressive neurologic disorder, including infantile spasms, uncontrolled epilepsy, progressive encephalopathy or reactions



to previous vaccines including temperature of  $\geq 105^{\circ}\text{F}$  ( $\geq 40.5^{\circ}\text{C}$ ), collapse or shock-like state (i.e., hypotonic hyporesponsive episode), persistent, inconsolable crying lasting  $\geq 3$  hours, [Guillain-Barre syndrome](#) <6 weeks after previous dose of tetanus toxoid--containing vaccine.

4. Can a child receive vaccinations if they have a fever after vaccinations?  
Conditions commonly misperceived as contraindications can lead to missed opportunities for vaccinations. Vaccines may be given during mild acute illness with or without fever or current antimicrobial therapy; after mild to moderate local reaction or low-grade or moderate fever after previous vaccine (less than 105 degrees); recent exposure to an infectious disease; family history of seizures, SIDS, or adverse vaccine event.
5. Can this child receive vaccinations again?  
The child in this case appears to have an expected vaccine reaction and the parents should be counseled to continue with vaccinations according to the recommended schedule.
6. How should a physician communicate with a parent concerned about or reluctant to vaccinate their child?  
Open, effective communication is vital during discussions of concerns related to immunizations. The provider should ask directly what the parent's specific concerns are (as well as the source of the information) in order to adequately address the concern.
7. What are cooling measures that can be used in case of fever following future vaccinations?
  - a. Infant acetaminophen at appropriate weight-based dose
  - b. Remove child's clothing
  - c. Tepid bath
8. What information should be given to parents about vaccination?  
In order to reduce concerns with parents about vaccination reactions, parents should be educated about the possible vaccine reactions prior to immunization through discussions with the provider and provision of Vaccine Information Sheets (VIS).
9. Is it ok to delay vaccination of a child?  
Delay of vaccinations constitutes a missed opportunity and leads to incomplete vaccination and subsequent increased risk for preventable illnesses in the child and the community.
10. What should a physician do if there is an adverse event after vaccination?  
In the case of a clinically significant adverse reaction, it should be reported to the Vaccine Adverse Event Reporting System (VAERS). This system helps monitor such outcomes and maintain the safety of vaccines.

### **Suggestions for Learning Activities:**

- Role play the counseling session with the family
- Students can search for individual vaccine contraindications and precautions.
- Students can practice searching for VIS for specific vaccines in specific languages.
- Students can discuss other common concerns they have heard from friends/ family and the media about vaccinations and discuss how to address these misperceptions (i.e. mercury in vaccines, link with autism, etc.) on a community level.

**Other Resources:**

- American Academy of Pediatrics. Active and Passive Vaccination. In: Pickering LK, Baker CJ, Kimberlin DW, Long SS, eds. Report of the Committee on Infectious Diseases. 28th ed. Elk Grove, IL: American Academy of Pediatrics; 2009: 1-9, 40-43.
- American Academy of Pediatrics. Immunizations: Communicating with Families. <http://www.aap.org/immunization/pediatricians/communicating.html>. Accessed July 28, 2011.
- Centers for Disease Control [www.cdc.gov](http://www.cdc.gov) (vaccine information statements)
- Kroger AT, Sumaya CV, Pickering LK, Atkinson WL. General Recommendations on Immunization: Recommendations of the Advisory Committee on Immunization Practices (ACIP). (January 28, 2011) MMWR: Morbidity and Mortality Weekly Report. 60; 1-60. Retrieved from <http://www.cdc.gov/mmwr>.

## **Health Supervision, Case #8**

Written by Julia Belkowitz, M.D. and Fred Malkin, M.D.

The parents of a previously healthy nine-month-old girl want to know why a hemoglobin was checked. How would you answer their concern? What are the common etiologies of anemia at this age? How would you evaluate an abnormal hemoglobin level?

### **Definitions for Specific Terms:**

**Hemoglobin (Hgb or Hb)**- Is the concentration of red blood cell (RBC) pigment in whole blood. Anemia is defined as a low Hgb concentration or red blood cell (RBC) mass compared with age-specific norms.

Normal Hgb levels vary by age:

Age	Hgb	MCV
Birth	13.5-24	95-121
<1 mo	10.0-20	
1-2 months	10-18	
2-6 months	9.5-14	
6 months-2 yrs	10.5-13.5	70-86
2-6 yrs	11.5-13.5	
6-12 yrs	11.5-15.5	

Iron deficiency anemia is the final stage of iron depletion [iron depletion → iron deficiency → iron deficiency anemia].

### **Review of Important Concepts:**

#### **Historical Points**

- Birth history – jaundice/phototherapy
- Nutritional history- type and quantity of milk/ formula, cow's milk, heme rich foods
- Family history of anemia, elevated lead levels
- Developmental history
- Symptoms of anemia such as pica, irritability, fatigue, exercise intolerance, dark colored urine due to hemolysis, dark stools or hematuria due to blood loss
- Exposure to drugs or toxins (e.g. lead)
- Children with iron deficiency anemia are often asymptomatic)

## Physical Exam Findings

Often none but look for pallor, tachycardia, icteric sclera, jaundice, cardiac dilatation, systolic murmurs, splenomegaly, koilonychia, angular stomatitis

## Clinical Reasoning

1. Why screen for anemia?
  - a. Iron deficiency anemia is the most common cause of anemia worldwide and in U.S. Fourteen percent of 1-2 year olds are iron deficient (<http://www.cdc.gov/nchs/fastats/anemia.htm>).
  - b. Anemia can have potential effects on development and behavior.
  - c. Screening is recommended for all infants between ages 9- 12 months (and again 6 months later in high risk communities) to diagnose and treat early.
  - d. Primary prevention, through dietary education, is crucial to prevent iron deficiency.
2. Who is especially at risk?

High risk factors include:

  - a. WIC eligibility
  - b. Children of migrant workers
  - c. Recently arrived refugees
  - d. Early introduction of whole cow's milk (before 1 year of age)
  - e. Consumption of greater than 24 oz of whole cow milk per day (after the first year of life)
  - f. Preterm birth or low-birth weight
  - g. Intake of noniron-fortified infant formula
  - h. Breastfeeding but receiving inadequate dietary iron after age 6 months
3. Why are children this age at risk?
  - a. Babies are born with sufficient iron stores, but rapid growth decreases iron stores by 6 months of age.
  - b. Adequate dietary intake is required to meet high demands of growth.

## Diagnosis:

1. What screening test should be used?
  - a. Typically only a hemoglobin or hematocrit is ordered as the initial test.
  - b. If the screen shows low hemoglobin or hematocrit and dietary history is consistent, empiric treatment for iron deficiency anemia is begun with education on proper diet and supplementation with 3- 6 mg/kg elemental iron per day. Parents should be instructed that iron is absorbed better with an empty stomach/ juice and inhibited by calcium.
2. How do you confirm the diagnosis?

Hemoglobin should be rechecked in 1 month. If the hemoglobin has increased by at least 1 g/dL, a diagnosis of iron-deficiency anemia can be made. Treatment is continued for 2- 3 months (at least one month after hemoglobin returns to normal levels) to replace iron stores.

3. What if it is not iron deficiency anemia?

If the initial screen shows a low hemoglobin in the setting of an iron rich diet or if the patient does not respond as above to iron therapy, other sources for anemia, including occult blood loss, should be investigated.

4. Which tests should be used for further evaluation?

- a. Additional laboratory analysis includes a complete blood count and peripheral smear, serum ferritin, serum iron, total iron binding capacity, and reticulocyte count.
- b. Findings consistent with iron-deficiency anemia are decreased mean corpuscular volume (MCV), decreased mean corpuscular hemoglobin concentration (MCHC), low serum ferritin, increased red cell distribution width (RDW), low serum iron, and high total iron binding capacity (TIBC).
- c. The reticulocyte is expected to increase in response to oral iron supplementation within 7 days.

5. What are other causes for anemia in a child this age?

- a. Other causes of microcytic anemia include thalassemia, lead poisoning, chronic disease, sideroblastic anemia, aluminum toxicity, copper deficiency, and Hb C disorders.
- b. Normocytic anemias include acute blood loss, chronic disease, malignancy, hemolysis, hemoglobinopathies, membrane defects and enzymopathies.
- c. Macrocytic anemias include folate deficiency, vitamin B12 deficiency, hypothyroidism, liver disease, aplastic anemia, Diamond-Blackfan or Fanconi's anemia, and drug effects.
- d. The reticulocyte count is a useful tool to help differentiate.

**Suggestions for Learning Activities:**

- Students can review the Bright Futures guidelines for other recommended screening in children.
- Given a set of lab results, students may discuss the potential etiology of anemia for an individual child (for example: anemia, low MCV, normal RDW → thalassemia trait); different sets of results can be given to small groups of students.
- Students can look up the dietary recommendations for infants and children including those that are breastfeeding, formula feeding and taking solid foods.
- Students can calculate the dose of iron supplementation and possible side effects of iron supplementation (e.g. dark stools, staining of teeth, constipation).
- Incorporate images of red blood cell morphology

**Other Resources:**

- American Academy of Pediatrics. Bright Futures 3rd Edition Guidelines, Pocket Guide, Tool and Resource Kit. [http://brightfutures.aap.org/3rd\\_Edition\\_Guidelines\\_and\\_Pocket\\_Guide.html](http://brightfutures.aap.org/3rd_Edition_Guidelines_and_Pocket_Guide.html). Accessed July 28, 2011.
- American Academy of Pediatrics Committee on Nutrition. Diagnosis and Prevention of Iron Deficiency and Iron-deficiency Anemia in Infants and Young Children (0-3 years of age). Pediatrics. Nov 2010;126(5):1040-1050.
- Kleinman RE. Pediatric Nutrition Handbook. 6th Edition. Elk Grove, IL, American Academy of Pediatrics; 2009:410-419.
- Oski, F. Iron deficiency in infancy and childhood. N England J Med. 1993; 329:190-193.
- Wu AC, Lesperance L, Bernstein H. Screening for Iron Deficiency. Pediatrics in Review. 2002;23:171-178.

## **Health Supervision, Case #9**

Written by Mary E. Brown, M.D., M.S.

The parents of a previously healthy three-year-old boy would like their son tested for tuberculosis. What are the indications for tuberculosis testing? What are the measurements of a positive PPD? How do you interpret a positive PPD in children who had a BCG vaccine?

### **Definitions for Specific Terms:**

**Tuberculin skin test (TST)**- Skin test containing purified protein derivative (PPD) which causes a delayed hypersensitivity reaction in people who have had exposure to or infection with TB.

**Latent tuberculosis infection (LTBI)**- An infection with M. tuberculosis without symptoms of TB disease and without evidence of TB disease on chest x-ray.

**TB Exposure**- A person who has a history of contact with a person with confirmed or suspected TB, but who has a negative TST and no evidence of TB disease on physical exam or chest x-ray themselves.

**BCG vaccine**- Attenuated M. bovis vaccine given to people in areas in which TB is more prevalent or endemic.

**High-risk countries**- Countries other than the United States, Australia, New Zealand, or Western European countries.

### **Review of Important Concepts:**

#### **Historical Points**

- What are the risk factors for exposure to or infection with TB?
  - Family history – family member or close contact with TB disease? Family member with a positive PPD?
  - Travel history – travel for >1 week to a high-risk country?
  - Birth history – born in a high risk country?
  - Immunization history – received BCG vaccine?
- What are the symptoms of TB disease?
  - Fever, night sweats, cough, hemoptysis, shortness of breath.
  - Children with LTBI will not present with any symptoms of active TB disease

#### **Physical Exam Findings**

1. LTBI: Children will have no signs of TB disease on exam.
2. Pulmonary TB disease: Lung exam may demonstrate rales, wheezing, and/or decreased breath sounds.

## Clinical Reasoning

1. What are the indications for TST in children?
  - a. Children who have risk factors for exposure to or infection with TB as noted in Historical points above.
  - b. Annual TST is also indicated for children with HIV infection and incarcerated adolescents.
  - c. Before starting immunosuppressive therapies
  
2. What is a positive PPD?
 

Measured by diameter of induration, not erythema, between 48-72 hours after placement.  
A positive PPD varies depending on the child's risk factors for having LTBI and progressing to active TB disease.

  - a.  $\geq 5$ mm induration –
    - close contact with person with known or suspected TB disease
    - children on immunosuppressive therapies or with immunodeficiency
  - b.  $\geq 10$  mm induration –
    - Increased risk of progression from LTBI to active TB disease
      - children  $< 4$  years old
      - children with chronic diseases
    - Increased risk of exposure to TB disease
      - Children born in areas with a high prevalence of TB
      - Children with exposure to adults who have HIV, are homeless, drug users, incarcerated
  - c.  $\geq 15$  mm induration –
    - Children  $\geq 4$  years old with no risk factors
  
3. How do you interpret a positive PPD in children who received BCG vaccine?
 

A PPD is interpreted with the above criteria, regardless of whether a child has received BCG vaccine.  
Children who receive BCG vaccine are generally at increased risk for infection with TB (i.e. children living in areas where TB is more prevalent).

## Suggestions for Learning Activities:

- Discuss the management of a child with a positive PPD.
- Review a chest x-ray of a child with pulmonary tuberculosis.

## Other Resources:

- Cruz AT, Starke JR. Pediatric Tuberculosis. *Pediatrics in Review*. 2010;31(1):13-26.
- Tuberculosis. In: Pickering LK, Baker CJ, Kimberlin DW, Long SS, eds. *Red Book: 2009 Report of the Committee on Infectious Diseases*. 28th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2009: 680-701.

## **Health Supervision, Case #11**

Written by Penny Murata, M.D.

The mother of a twelve month-old girl, living in a house built four years ago, wants to know why her daughter should undergo lead testing. How would you respond to her concerns? What are the risk factors for lead poisoning? How do you treat an elevated lead level?

### **Definitions for Specific Terms:**

**Elevated blood lead level (EBLL)**- EBLL is defined as 5 µg/dL or higher.

### **Review of Important Concepts:**

### **Historical Points**

1. Risk factors for EBLL: What are risk factors for lead exposure?
  - a. Lead-based paint (banned in 1978) or lead-contaminated dust (created through deterioration of lead-based paint)
  - b. Folk medication (greta, azarcon, ghasard, Ba-baw-san, Daw Tway, Pay-loo-ah, litargirio, surma, ayurvedic medicine)
  - c. Artificial turf
  - d. Candy imported from Mexico
  - e. Certain cosmetics (kohl)
  - f. Toy jewelry
  - g. Toys
  - h. Tap water
  - i. Cookware
  - j. Ceramics
  - k. Lozeena spice
  - l. Caregivers who work with lead-based products
  - m. Sibling or playmate with EBLL
  - n. Recent immigrant, refugee, or foreign adoptee;
  - o. Low socioeconomic status
2. Symptoms of EBLL: What are possible symptoms of EBLL?
  - a. Cognitive development is adversely affected by blood lead levels <10 µg/dL
  - b. Most children with EBLL <40 µg/dL are asymptomatic, however at higher levels of blood lead, symptoms include headache, abdominal pain, vomiting, constipation, loss of appetite, constipation, clumsiness, somnolence, and irritability.
3. Age-associated risk: What ages are most at risk of lead poisoning and why?
 

Children less than age 72 months (peak at about 24 months old) are at higher risk for EBLL due to the period of rapid growth and greater likelihood of putting their hands and other objects in their mouths. (Frequent hand washing might be useful in lowering EBLL, but there is no supporting data.)



**Physical Exam Findings**

1. Encephalopathy: lead level threshold is 70  $\mu\text{g/dL}$ , but usually linked with higher lead levels
2. At-risk behaviors: pica, hand-to-mouth activity
3. Neurodevelopmental or behavioral disorders: distractibility, aggression, speech delay, or cognitive delay

**Clinical Reasoning**

1. Universal vs targeted screening: What are the advantages and disadvantages of universal screening vs targeted screening? (consider cost of testing, decreasing prevalence of EBL, population at risk of EBL, clinical manifestations and cost of EBL)
2. What are the recommendations for lead screening? For children enrolled in Medicaid or an assistance program, lead screening is recommended at ages 12 and 24 months and if not previously screened, at age 36 to 72 months. For children not eligible for Medicaid or assistance program, the guidelines are not clear.

**Diagnosis:**

1. Method of testing:  
Venous blood lead level is the only reliable test.  
Lead toxicity: The degree of lead toxicity is indicated by the blood lead level category ( $\mu\text{g/dL}$ ): 5-44; 45-69; >70.
2. What laboratory tests in addition to lead level would be helpful?  
Hemoglobin or hematocrit is recommended because anemia is linked with EBL (peripheral smear is not useful as basophilic stippling is not specific for EBL); inhibition of heme synthesis can cause excess porphyrins (free erythrocyte protoporphyrin [FEP] or zinc protoporphyrin [ZPP]) which are useful to follow cases of EBL >25  $\mu\text{g/dL}$
3. What radiological studies might be useful?  
Abdominal x-ray can detect ingestion of lead-contaminated non-food items.
4. Tests that are not recommended:  
Searching for gingival lead lines; testing hair, teeth, or nails for lead; neurophysiologic function testing; renal function testing except during chelation with EDTA; imaging of long bones for lead lines; X-ray fluorescence of long bones to estimate lead in bones

## 5. The lead level determines management:

Blood lead level (µg/dL)	Management
<5	Dietary and environmental education Assess for lead exposure
5-44	Add to above: Confirm within 1-3 months and follow up lead levels Complete history and physical exam Labs-iron status, consider hemoglobin or hematocrit Environment assessment to remove lead exposure Neurodevelopmental monitoring Consider abdominal X-ray if indicated
45-69	Add to above: Confirm within 48 hours Labs-hemoglobin or hematocrit, FEP Abdominal X-ray Oral chelation (hospital if indicated)
>70	Add to above: Confirm urgently Hospitalization for chelation

**Suggestions for Learning Activities:**

- Ask the students to determine the management based on different scenarios with various lead level results
- Present a case of EBL and have the students (in large group or small groups) ask the history to determine the most likely source of lead
- Ask the students to find items recently recalled because of high lead content (available through CDC website)
- Each student investigates home remedies used in own family and whether the home remedy has been linked with lead exposure
- Have students determine whether their state or local county program has recommendation for lead screening

**Other Resources:**

- American Academy of Pediatrics Committee on Environmental Health. Policy statement: Lead Exposure in Children: Prevention, Detection, and Management. Pediatrics. October 2005; 116(4): 1036-1046. (statement of reaffirmation published May 1, 2009).
- Centers for Disease Control National Center for Environmental Health [www.cdc.gov/nceh/lead](http://www.cdc.gov/nceh/lead)
- CDC Advisory Committee on Childhood Lead Poisoning Prevention. Interpreting and managing blood lead levels <10 µg/dL in children and reducing childhood exposures to lead. MMWR. Nov 2, 2007;56(RR08);1-14;16
- CDC Advisory Committee on Childhood Lead Poisoning Prevention. Low level lead exposure harms children: a renewed call for primary prevention. Jan 4, 2012:1-65.
- Local health care agency or public health department
- Pediatric Environmental Specialty Health Unit (PESHU) – regional resource
- U.S. Environmental Protection Agency [www.epa.gov/lead](http://www.epa.gov/lead)

## ISSUES UNIQUE TO ADOLESCENCE

### Issues Unique to Adolescence, Case #5

Written by Len Levine, M.D.

The mother of a thirteen-year-old female expresses concern that her daughter has not yet had the onset of menses. How would you counsel her?

#### **Definitions for Specific Terms:**

**Menarche**- Initial onset of menses in a pubertal female. This most commonly occurs when pubertal development is at Tanner Stage 4. The average age in all U.S. females is 12.7 years

**Primary amenorrhea**- Has never had a menstrual period. Defined as:

- a. the lack of menses by age 13 in the absence of pubertal (breast) development.
- b. the lack of menses by age 15 regardless of pubertal development
- c. the lack of menses by two years after sexual maturation

**Secondary amenorrhea**- Has experienced menarche but is no longer having periods  
Defined as the absence of menses for 6 months in a patient who is post-menarchal.

#### **Review of Important Concepts:**

One of the most important concepts to take away from this case is that assessment of pubertal development will greatly help determine whether the absence of menses is likely normal or abnormal in an adolescent female. If this patient has not had any breast development yet (the first sign of puberty in a female) or over the next year, then there may be an underlying abnormality and she would require further workup and evaluation. The same would be true if she reached sexual maturation (Tanner Stage 5) two years ago or more. However, a 13-year-old otherwise healthy female with some pubertal development who has not yet experienced menarche can be watched expectantly without significant workup at this time. This is because her hypothalamic-pituitary-ovarian axis is still maturing and she has not yet begun to ovulate (which is necessary for onset of menses).

#### **Historical Points**

- Ensure that no episodes of vaginal bleeding have actually occurred yet.  
The first period may be very light and short, and therefore may not be perceived as a “real” period.
- At what age did breast development begin? Has the patient had her “growth spurt” yet?
  - Menarche is a late event in puberty. On average, it occurs approximately 2 years after breast buds appear.
  - It also occurs after an adolescent experiences peak height velocity (time of most rapid linear growth), so usually girls are noted to have had a noticeable “growth spurt” by the time periods begin.
- When did other female family members experience menarche?  
A history of “late bloomers” in the family may be reassuring to a patient like this. However, a girl can certainly experience menarche at a later or earlier age than her mother, sisters, etc.

- Does she have cyclic abdominal pain?  
Genital outlet obstruction such as imperforate hymen may cause this problem as the patient is menstruating but the uterine lining that is shed is unable to get out of the vagina. The back up of menses can lead to pain.
- A careful review of systems may point to some of the more underlying hormonal problems that may contribute to abnormal onset of menses.
- A history of significant acne or hirsutism may suggest high androgen levels (e.g., PCOS, adrenal problem).
- Has the patient experienced any weight loss? Is she an athlete?
- Malnutrition, low body fat percentage, and excessive exercise can lead to hypothalamic dysregulation, affecting the release of gonadotropins from the pituitary.
- A history of weight loss, palpitations, tremors, may suggest hyperthyroidism, which can lead to absence of menses. (Hypothyroidism can also lead to abnormal periods, so history should explore those symptoms as well).
- A history of nipple discharge suggests hyperprolactinemia, possibly from a tumor or medication side effects (drugs that decrease dopamine release).
- A history of abdominal pain and diarrhea may suggest inflammatory bowel disease (IBD) or celiac disease, which can affect nutritional status and therefore affect regulation of hormones.
- Has the patient ever had sex or been forced to have sex?  
The possibility of pregnancy should never be overlooked, even in a very young adolescent. Questions regarding sexual activity are best asked of the patient with the parent/guardian out of the room after a discussion about confidentiality and its limits when caring for adolescent patients.

### Physical Exam Findings

1. Assess the patient's Tanner Stage (Sexual Maturity Rating).
  - a. Most girls experience menarche in Tanner Stage 4, while some begin periods at Tanner Stage 3 or 5. At 13 years old, the patient can be reassured if she has not yet completed sexual maturation.
  - b. If breast development has not yet begun, consider non-functioning ovaries since estrogen is necessary for breast development.
  - c. Most common etiology is Turner syndrome ("streak gonads"), so look for characteristic stigmata: short stature, webbed neck, broad chest with wide-spaced nipples, etc.
2. Check growth parameters and plot on growth curves
  - a. Body mass index (BMI): As mentioned above, low body weight can disrupt normal menstrual cycles or delay onset.
  - b. Height: Short stature may suggest endocrinopathy or chronic disease (e.g., IBD)
3. External genital exam  
This is crucial, since an examination of the introitus can identify an imperforate hymen. A speculum exam is not necessary.
4. Look for clinical signs of hormonal abnormalities that commonly affect menses (see historical points above).
5. Check for acne, hirsutism, clitoromegaly, enlarged thyroid, and galactorrhea.

## Clinical Reasoning

1. What is the difference between primary and secondary amenorrhea?  
(See definitions listed above) Some variation may be seen in the age used to define primary amenorrhea (e.g., 13 vs. 14 years old in the absence of pubertal/breast development; 15 vs. 16 years when there is pubertal/breast development). Newer recommendations favor using the younger age for each of these situations.
2. Generate a differential diagnosis for this patient's absence of menses.
  - a. Unless there has been no breast development at all, the most likely diagnosis in this patient is normal puberty, as her hypothalamic-pituitary-ovarian axis is still undergoing maturation.
  - b. As discussed above, other diagnoses to consider include pregnancy, hyperandrogenism, thyroid disease, hyperprolactinemia, imperforate hymen, malnutrition, and excessive exercise. Unless history or physical exam suggests any of these, they are less likely in this patient.
3. What further workup is needed for this patient?
  - a. In the absence of pubertal delay or any significant history or physical exam findings suggestive of the diagnoses listed above, no further workup is needed for this patient as this is most likely normal puberty. Reassurance to the patient and her mother is all that is needed at this time.
  - b. A pregnancy test should be obtained, even if the patient denies sexual activity.
  - c. LH and FSH levels can be helpful if pubertal development has not begun by age 14. Very high levels point to a problem with ovarian production of estrogen (lack of feedback inhibition) and very low levels point to a problem with the pituitary or hypothalamus ability to send a signal to the ovary.
  - d. If any of the other diagnoses mentioned in the differential were suspected, relevant labs should be obtained (e.g., TSH, prolactin, testosterone)
4. Would a pelvic ultrasound be helpful?
  - a. An ultrasound will often ensure normal uterine and ovarian anatomy. Absence of the uterus can be seen with müllerian agenesis (2nd most common cause of primary amenorrhea, after Turner syndrome) or androgen insensitivity syndrome (chromosomes XY but insensitive to effects of androgens so female phenotype).
  - b. Again, in this patient, it would not be necessary until she fits the definition of primary amenorrhea.

## Diagnosis:

The differential diagnosis is listed in the “Clinical Reasoning” section above. If this 13 year old is otherwise healthy and has breast development, the diagnosis in this case is normal pubertal development.

## Suggestions for Learning Activities:

- Consider running through this case with one of four different scenarios
  - 13-year-old female with unremarkable history and physical exam, Tanner stage 3, never had a period
  - 14 year old female with no breast development, never had a period
  - 15-year-old competitive gymnast and cheerleader, Tanner Stage 3, never had a period

- 17 year old female, Tanner Stage 5, never had a period, abdominal pain
- Review the normal menstrual cycle and the hormones involved
- Have students review Tanner staging in adolescents

**Other Resources:**

- Bordini B, Rosenfeld RL. Normal Pubertal Development: Part II: Clinical Aspects of Puberty. *Pediatr Rev.* 2011;32(7):281-92.
- Carswell JM, Stafford DE. Normal physical growth and development. In Neinstein LS (ed.) *Adolescent Health Care: A Practical Guide.* Philadelphia: Lippincott Williams & Wilkins, 2008:3-26.
- Deligeoroglou E, Athanasopoulos N, Tsimaris P, Dimopoulos KD, Vrachnis N, Creatsas G. Evaluation and management of adolescent amenorrhea. *Ann N Y Acad Sci* 2010;1205:23-32.
- Fleischman A, Gordon CM, Neinstein LS. Menstrual disorders: Amenorrhea and the Polycystic Ovary Syndrome. In: Neinstein LS (ed.) *Adolescent Health Care: A Practical Guide.* Philadelphia: Lippincott Williams & Wilkins, 2008: 691-705.
- Master-Hunter T, Heiman DL. Amenorrhea: evaluation and treatment. *Am Fam Physician* 2006;73(8):1374-82.

## **Issues Unique to Adolescence, Case #7**

Written by Len Levine, M.D.

A fourteen-year-old female well known to your practice makes an appointment to see you alone regarding a desire for contraception. What advice would you give her? What are her rights to confidentiality? What are your responsibilities to inform her parents?

### **Definitions for Specific Terms:**

**Consent**- Consent relates to a person's ability to make informed decisions about his or her own health care, with the ability to give permission for care to be delivered.

**Confidentiality**- Confidentiality refers to keeping private information that arises within the health care visit, and only disclosing information with the patient's permission.

### **Review of Important Concepts:**

### **Clinical Reasoning**

1. What advice would you give her?
  - a. Encourage parental involvement, if possible.  
While many states provide minors with the ability to obtain contraception without the involvement of parents, it is important to encourage the patient to discuss sexuality and sexual decision-making with her parents. Trying to keep contraception hidden makes compliance more challenging and may put an adolescent at higher risk for pregnancy. In addition, adolescents often lack a clear understanding of consequences and may not view sexual activity as a risk behavior (e.g., sexually transmitted infections, pregnancy, etc.). Involving adults can help provide perspective regarding health outcomes resulting from sexual activity.
  - b. Discuss available contraception options.  
Discussions about contraception with this adolescent should include a conversation about alternative ways to express intimacy and affection besides sexual intercourse. If she still plans to have sex or wants to be prepared in case the opportunity arises, a discussion regarding the advantages and disadvantages of various methods should be pursued.
  - c. Condoms, combined estrogen/progesterone methods (oral contraceptive pills, the transdermal patch, the intravaginal ring), and progesterone-only methods (intramuscular injections of depot medroxyprogesterone acetate, or Depo-Provera) are commonly used forms of birth control in the younger adolescent population. She should consider ease of use, ability to adhere to the contraceptive regimen, privacy of method, and side effects when choosing a form of birth control.
  - d. Provide education regarding risks of sexually transmitted infections (STIs).  
The patient should be counseled on the risks of STIs, even if using contraception. While barrier methods such as condoms provide protection against the spread of infections such as gonorrhea or Chlamydia, they do not necessarily protect against other infections such as HSV/herpes or HPV/genital warts. It should also be reinforced that hormonal contraception provides good protection against pregnancy, but does not provide protection against STIs. Dual protection with condoms and hormonal methods should therefore be encouraged.

2. What are her rights to confidentiality? What are your responsibilities to inform her parents?
  - a. It is important to clarify the difference between consent and confidentiality. The definitions of these two terms are listed above in the “Definitions” section. Although children generally cannot receive medical care without the consent of their parents, adolescents under the age of 18 years are given the ability consent to their own health care in certain situations. While it is preferred to have a parent involved, it has been shown that some adolescents may not seek care for certain problems, such as sexual health, if a parent must be involved, thereby placing them at risk for negative health outcomes.
  - b. While states vary in the extent to which adolescents may consent to care, generally speaking adolescents may consent to care involving reproductive health (birth control, STI testing and treatment, pregnancy testing, and prenatal care), mental health (outpatient therapy), and treatment for substance abuse. Often they are able to consent to any health care if they are pregnant, are a parent, are married, or are fully and legally emancipated from their parents. In this case, the patient (in most states) would be able to seek contraception from her physician without her parents being involved. The ability to consent to one’s own care implies confidentiality, which is discussed below.
  - c. Confidentiality is a core concept when caring for adolescent patients. As they transition from childhood to adulthood, adolescents need to develop a sense of independence and autonomy from their parents. The ability to talk with a physician alone and in confidence not only reinforces this developmental task, but it also helps the physician build rapport with the adolescent, while also providing an opportunity for teens to talk about or seek care for issues they feel uncomfortable addressing with parents. Stressing the concept of privacy rather than secrecy, the concept of confidentiality should be discussed openly with adolescents and their parents from the initial visit. Everyone should be aware from the outset that when a parent is asked to leave the room during a visit, the content of the discussion will remain confidential between adolescent and health care team, with a few exceptions such as concerns for self-harm (e.g., suicidality), harm to others (e.g., homicidality), or disclosure of physical or sexual abuse.

While it would be ideal for this adolescent to discuss contraception and sexual decision-making with a parent, she can opt to keep the discussion confidential. Your responsibility to the parent is to protect the welfare of the adolescent and act in her best interest. If you have concerns that she may be in an unsafe relationship, you may need to violate the confidentiality for the ultimate benefit and protection of the patient. But discussions about contraception, and even the decision to initiate contraception, can remain confidential (although you should make sure you know the specific confidentiality and consent provisions in your own state, as the specifics vary from state to state).

It is important, however, to recognize that there are challenges to confidentiality when it comes to accessing services such as contraception or testing for sexually transmitted infections, especially with respect to payment. Health care providers should be aware of how the patient’s insurance plan handles issues such as office visits, lab tests, or prescriptions, since some insurance providers send the details of an office visit to the parent. If the health care provider cannot guarantee confidentiality when providing contraception or sexual health services, he or she should be aware of other places in the community (e.g., confidential family planning clinics) where adolescents can be referred for care.



### Suggestions for Learning Activities

- Do a role-play scenario with the adolescent, in which confidentiality is discussed, including the limits to confidentiality. Repeat the scenario with a “parent” in the room.
- Discuss birth control options available to adolescents, and the relative advantages and disadvantages of each method in the adolescent population.
- Have the students investigate the laws in their own state regarding circumstances in which adolescents may consent to their own health care.

### Other Resources

- Blythe MJ., Diaz A., American Academy of Pediatrics Committee on Adolescence. Contraception and adolescents. *Pediatrics*. 2007;120(5):1135-1148.
- English, A. Understanding legal aspects of care. In: Neinstein LS (ed.) *Adolescent Health Care: A Practical Guide*. Philadelphia: Lippincott Williams & Wilkins, 2002: 186-194.
- Ford C, English A, Sigman G. Confidential health care for adolescents: Position paper of the Society for Adolescent Medicine. *J Adolesc Health*. 2004;35:160-167.
- Guttmacher Institute. An overview of minors’ consent law. *State Policies in Brief*. July 2011. Accessed at [http://www.guttmacher.org/statecenter/spibs/spib\\_OMCL.pdf](http://www.guttmacher.org/statecenter/spibs/spib_OMCL.pdf).
- Guttmacher Institute. Minors’ access to contraceptive services. *State Policies in Brief*. July 2011. Accessed at [http://www.guttmacher.org/statecenter/spibs/spib\\_MACS.pdf](http://www.guttmacher.org/statecenter/spibs/spib_MACS.pdf).

## **Issues Unique to Adolescence, Case #11**

Written by Christy Peterson, M.D.

A sixteen year old girl presents with fever and acute lower abdominal pain but denies urinary urgency or frequency. She is sexually active and uses condoms infrequently. How would you evaluate this patient?

### **Definition for Specific Terms:**

**Urinary urgency**- A sudden compelling need to urinate.

**Urinary frequency**- The need to urinate an increased number of times during the day or at night, in normal or decreased volumes.

**PID**- An ascending polymicrobial infection of the upper genital track in women, acute, chronic or asymptomatic.

### **Review of Important Concepts:**

One of the most important concepts to take away from this case is that a pelvic exam is required when a sexually active female presents with abdominal pain regardless of the presence of fever.

### **Historical Points**

- Fully describe the pain: where, when, constant vs intermittent, severity, nature, onset, what are you doing when it comes, association with eating, associated symptoms, radiation of the pain, what makes it better, what makes it worse.
- Associated symptoms: vaginal bleeding, vomiting, diarrhea, vaginal discharge, and back pain are important associated symptoms to discuss.
- Past Medical History/Previous episodes: Ask specifically about previous dx of STI's, UTI's as well as menstrual history, and tampon use.
- Patient Confidentiality: The question already discusses the most important question that you need to answer for this situation, "is she sexually active." This would be a different case if the patient was not sexually active. However, how you get this information is critical. Consider that many adolescents withhold information from their parents especially in the area of sexuality. Thus a private conversation (chaperone as needed) will increase your ability to get accurate information in the history.
- Other social history: This patient is involved in one high risk activity and this fact increases the likelihood that she would also engage in other risky behaviors.
- Also consider asking if she has been sexually or physically abused. She is 16 and in most states a 16 year old has reached the age at which the courts consider her to be able to consent to sexual relations. However, it is still ok to ask her how old her partner is and whether or not she was forced to have sex with him.

## Physical Exam Findings

1st question: Is the patient stable or unstable?

1. Assess vital signs and the general appearance of the patient. Low blood pressure, lethargy would be reasons to admit the patient. Also consider admission for dehydration or vomiting to the point of not being able to keep oral medications down.
2. Abdominal exam:
  - a. Look, listen, palpate light, then palpate deep.
  - b. Assess for signs of acute abdomen which include extreme tenderness to even light palpation or movement, rebound tenderness, high pitched bowel sounds, and absence of bowel sounds after three minutes of auscultation.
  - c. Assess for Fitz-Hugh-Curtis syndrome by palpating over the liver.
3. You must do a pelvic exam with bimanual exam:
  - a. Look for cervical motion tenderness (CMT), also known as the chandelier sign, uterine tenderness or adnexal tenderness. One of the 3 is required for diagnosis of PID.
  - b. Also look for foreign body in the vagina.

## Clinical Reasoning

1. Generate a differential diagnosis for this patient.
  - a. threatened abortion
  - b. tubal pregnancy
  - c. PID
  - d. tubo-ovarian abscess
  - e. UTI
  - f. obstruction
  - g. constipation
  - h. gastroenteritis
  - i. ovarian torsion
  - j. abdominal tumor causing ovarian torsion
  - k. toxic shock syndrome
2. What further work up is necessary for this patient?
  - a. Collect a dirty urine (a dirty urine is one that is simply collected without any cleaning of the vaginal area) initially and use this for GC/Chlamydia DNA probe and a pregnancy test.
  - b. If there is a history of dysuria or you are concerned about a UTI collect a clean catch (collected after cleaning of the vaginal area) urine at the end of the visit to run urinalysis and culture.
  - c. The pelvic bimanual exam is critical. Whether or not there is cervical motion tenderness is an important decisive point. If there is cervical motion tenderness you have diagnosed PID and need to confirm with laboratory evaluation. (GC/Chlamydia probe, CBC, CRP) and rule out other possible pathology with stool for fecal occult blood, and vaginal swab for microscopic analysis. However if she does not have cervical motion tenderness your labs may help support the diagnosis of PID despite the absence of cervical motion tenderness.
  - d. If allergic to penicillin, then other antibiotics can be used but you will need to do a vaginal culture for GC to make sure you choose an antibiotic that the particular species is susceptible to.

- e. A swab of the lining of the vaginal wall can also provide material for a wet prep. Using a wet prep, you can look for clue cells and if higher than 50 % may indicate bacterial vaginosis (BV). However, the diagnosis of BV does not rule out PID and requires three of the following; fishy odor, vaginal discharge, pH higher than 5 and > 50 % of the vaginal wall cells described as “clue cells.”

### Diagnosis:

PID

### Suggestions for Learning Activities:

- Is this case reportable to the state? It depends on the age of the sexual partner. If he is over the age of 18 and she is more than 2 years younger than him this is statutory rape in most states. Also, if you diagnose GC or Chlamydia, those are required to be reported for epidemiology purposes in an area.
- What diagnosis would require that her partner be treated? GC/Chlamydia
- Consider exploring treatment decisions for this case with the following scenarios.
  - A lethargic teenager whose blood pressure is low
  - Cervical motion tenderness (CMT) and a positive Chlamydia DNA probe, but stable and dependable
  - Vomiting and dehydration and CMT
  - Positive UPT
  - Associated diarrhea, no CMT and all labs normal
- Review indications for a pelvic exam in a teenager
  - Primary amenorrhea in an adolescent that started breast bud development 4 years ago
  - Abdominal pain in a sexually active female
  - Excessive bleeding
  - Pregnancy related complaints
  - Severe menstrual cramps
  - Suspected abuse
- Discuss possible antibiotic choices for inpatient and outpatient.
  - Inpatient antibiotics: clindamycin and gentamicin or cefoxitin and doxycycline convert to PO when 24 hours afebrile
  - Outpatient: ceftriaxone x1 and then doxycycline or azithromycin +/- metronidazole

### Other Resources:

- Bar, G Ronald. Abdominal Pain in the Female Adolescent Pediatrics in Review 1983; 4:281-289.
- Beng et al. Index of Suspicion Pediatrics in Review 2005; 26: 329-336.
- Fisher et al. Textbook of Adolescent Health Care. American Academy of Pediatrics 2011. 491-493.
- Nneka A. Holder, Gonococcal Infections. Pediatrics in Review July 2008;29:228-234.
- Paradise, Jan E and Linda Grant, Pelvic Inflammatory Disease in Adolescents Pediatrics in Review 1992 13:216-223.

## **Issues Unique to Adolescence, Case #12**

Written by Christy Peterson, M.D.

A fifteen year-old female comes to your clinic with complaints of bilateral leg pain. On physical examination, you notice that she has lost fifteen pounds since her last visit one year ago and she has missed her last six periods. Her BMI is 15. How would you evaluate this patient?

### **Definition for Specific Terms:**

**BMI**- Body Mass Index. Using the CDC 2000 standards, a teen of the age of 15 should have at least a BMI of 16 to be above the 5th percentile.

**Normal BMI**- Greater than 5 % for age on published charts.

**Anorexia**- There are 4 diagnostic criteria found in DSM IV; 1. Refusing to maintain body weight at or above minimum for normal according to age and height. [weight less than 85 % estimated body weight (EBW)] 2. Intense fear of gaining weight even though under weight. 3. Disturbance in the way one's body weight or shape is experienced or an undue influence of body weight or shape on self evaluation or denial of the seriousness of the current low body weight. 4. Amenorrhea for 3 consecutive cycles in postmenarchal girls.

**% estimated body weight (EBW)** - Patient's BMI divided by the 50% BMI for age. For our patient her BMI is 15. The average 15 year old according to CDC 2000 growth charts would have a BMI of 20, (50<sup>th</sup> percentile).  $15/20$  is 75 %. So her EBW is 75 % of normal.

**Bulimia**- There are 5 criteria according to DSM IV; 1. Binge behavior, 2. Purging behavior, 3. Both occurring on average twice a week for three months, 4. Undue influence of body shape on self evaluation, and 5. Not meeting the criteria for anorexia nervosa.

### **Female athlete triad**

1. Disordered eating/not enough calories
2. Decreased bone mineral density
3. Amenorrhea

**Amenorrhea**- Cessation of menstruation when otherwise expected to occur. Or menorrhea that only occurs following hormonal administration. (The cause is a depressed hypothalamic state.)

**Myopathy**- The word means muscle disease. The pain that the child has may be muscle pain which can be caused by electrolyte disorders like hypokalemia, hypocalcemia and hypercalcemia.

**Restless leg syndrome**- A pain in the legs that is relieved by movement.

**Laxative induced myopathies**- Caused by hypokalemia.

## Review of Important Concepts:

### Historical Points

- Fully expand on the pain; (where, when, timing, onset, description, intensity, when in relation to exercise, what makes it worse, what makes it better, related symptoms.)
- Exercise amount: Be careful to pick up on clues that the patient is minimizing the amount. Keep asking, “and what other forms of exercise?” Keep asking, “and what else?” And then ask one more time, “and what other forms of exercise?”
- Diet: Be careful to ask what they actually eat. Don’t be fooled by assuming that they eat what they tell you. Ask family members about trips to the bathroom after meals or requests to be excused from family meals and preference to eat alone.
- Body image: “How do you see yourself?”
- Binge/purge habits: Go ahead and ask point blank, “Do you sometimes cause yourself to vomit, or take laxatives for weight loss?”
- Ask about menstruation, last menstrual period, typical flow, number of days, regular or irregular.

### Physical Exam Findings and Labs

1. Vitals: Are there any signs of hypovolemia like a drop in blood pressure on standing? Perform orthostatic blood pressure and pulse measurements, lying, sitting and standing.
2. HEENT: Look for evidence of vomiting; enlarged parotids, enamel erosions.
3. Neck: Is there any lymphadenopathy, supraclavicular nodes?
4. Heart: How is the rate? Is there a murmur, a gallop or a rub?
5. Abdomen: Is there any signs of organomegaly?
6. Lymph: Check axillary nodes and inguinal nodes as well as cervical and supraclavicular for any signs of lymphadenopathy or any signs of cancer to explain the weight loss?
7. Must-get labs:
  - a. Order chemistries with lipids, CBC with differential, ESR, and TSH.
  - b. If there is amenorrhea get B-HCG. (See #1 under Clinical Reasoning.)
  - c. Consider EKG if bradycardia or arrhythmia is noted.

### Clinical Reasoning

What information in this patient scenario do you find concerning and how would you approach her evaluation?

1. Amenorrhea: First, rule out pregnancy.

2. The fact that the pain is bilateral would lead you to look for a muscular source rather than the bones. This muscular pain could be from overuse or excessive exercise but a systemic cause is more likely. One likely cause of the pain, if you suspect anorexia nervosa, is hypokalemia, however labs may be normal.
3. If the history does not support disordered eating and, in fact, the patient eats more than would be expected, search for other causes of unexplained weight loss; TB, HIV, SLE, cancer, thyroid disorder, Celiac disease, IBD, tapeworm?
4. If you diagnose anorexia ask yourself, “Does the patient need to be admitted to the hospital?” (See criteria for hospital admission under Suggestions for Learning Activities.) If you do not admit to the hospital keep in mind that early intervention is helpful therefore set up interventions now. Have the patient set a weight goal, keep a food diary and return within one month.
5. Normal lab values are expected. Abnormal values require a second thought about the diagnosis or admission to the hospital. (See criteria for hospital admission under Suggestions for Learning Activities.)

**Differential Diagnosis:**

1. Disordered eating, Anorexia/Bulimia with myopathy from electrolyte disturbances is the number one possibility but the history must support this and even in the face of typical history, a full physical exam and labs are necessary to determine the need or lack thereof for hospital admission and to rule out other causes.
2. Female athletic triad may be present along with the eating disorder and again the muscle pain could be from electrolyte disturbances. Otherwise pain is not typically part of the female athletic triad unless there is a fracture. The fracture could be from decreased bone mineral density and could only be caused by repetitive stress on the weakened bone (stress fracture) but bilateral stress fractures are highly unlikely.
3. Exercise related leg pain (shin splints) is possible but even in the presence of excessive exercise this would be a diagnosis of exclusion.
4. Restless leg syndrome is certainly a possible cause if the history supports it. The history would be of pain more at night and the pain would be at least lessened by movement of the legs.
5. Cancer is a possibility. The possibility increases if you have other signs like lymphadenopathy, hypercalcemia, elevated ESR, ect.
6. Other inflammatory process like SLE, Celiac disease, IBD are less likely but need to be ruled out with labs.

**Suggestions for Learning Activities:**

- Have students discuss the next step after diagnosis of anorexia. Discuss options for inpatient care, intensive outpatient care or weekly visits.

- List criteria for hospital admission in anorexia: weight <75% EBW (see calculation of EBW above), rapid weight loss despite outpatient management, prior knowledge of poor outcome in this situation for this patient, physical abnormality including failure to maintain normal temperature, hematemesis, orthostatic abnormalities, electrolyte abnormalities, other compounding psychiatric issues like depression.

**Other Resources:**

- American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 4th ed. Washington, DC: American Psychiatric Association; 1994
- Comer GD. Eating disorders in adolescents. *Pediatr Rev.* 1988; 10:1-8
- Goldstein, et al. Eating Disorders. *Pediatr Rev* 2011; 32:508-521
- Harper G. Eating disorders in adolescents. *Pediatr Rev.* 1994; 15: 72-77
- Kreipe, R. Eating disorders among children and adolescents. *Pediatr Rev.* 1995; 16: 370-379.



## **Issues Unique to Adolescents, Case #13**

Written by Rachel S-D Fortune, M.D. and Paritosh Kaul, M.D.

A previously healthy sixteen-year-old girl presents for a routine health care supervision visit with her mother. When you ask the mother to leave the room she refuses. How would you approach this situation?

### **Definitions for Specific Terms:**

**Confidentiality**- The ethical principle or legal right that a physician or other health professional will hold secret all information relating to a patient, unless the patient gives consent permitting disclosure.

**Consent**- To give approval, assent, or permission. A person must be of sufficient mental capacity and of the age at which he or she is legally recognized as competent to give consent (age of consent).

### **Review of Important Concepts:**

#### **Clinical Reasoning**

##### 1. Legal issues

Please be familiar with your local laws regarding what treatments a teen can consent to on her-own behalf. All states and Washington DC allow for teens to consent to testing and treatment for sexually transmitted infections, including HIV. Most states, including Washington DC, allow for teens to consent to drug testing and outpatient treatment for addiction. About half of the states plus Washington DC allow for teens to consent for contraceptive services and prenatal care. Although your patient has legal rights to obtain care on her own, some parents are not comfortable with this and will be resistant to you talking to their child alone.

##### 2. Setting the stage

The medical provider needs to be very clear with the patient as to what the provider can keep confidential in the medical setting. The provider should not give the teen the impression that everything they discuss can be kept confidential. Generally speaking, the provider should use a statement such as this: “Many things that we discuss can be kept between you and me. However, if you tell me that you or someone else is in danger, or doing something very dangerous, I will have to share that information with your parents or guardian. If you disclose to me that you have been abused then I need to report this information too”. This confidentiality disclosure should be given while the parent or guardian is still in the room if they are there for the appointment. Medical providers fall into an important group called “mandated reporters”. A mandated reporter is someone who is bound by the law to report cases of abuse and neglect. As a medical provider, if your patient tells you about abuse or neglect, you are required to inform your local child protection services. Local laws might also include informing law enforcement officials. This is a very challenging and important part of your role as a physician.

##### 3. Approaches to the challenging parent

Remember to remain objective and calm, even if the parent is becoming upset. Share with the parent that talking to the patient alone is standard of care for all adolescents and recommended by the American Academy of Pediatrics and the Society for Adolescent Health and Medicine, as well as all

other medical agencies that deal with the medical care of teenagers. This type of communication occurs with all patients and this parent and/or patient is not singled out. Explain that our goal in taking care of adolescents is to assist in their transition to adulthood, and one part of that is encouraging them to take responsibility for their own health. If the parent continues to refuse to leave, you can ask the patient “sensitive questions” in front of her parent, but understand that you are unlikely to get very helpful answers. The provider should also reiterate to the patient, in front of the parent, that she can come in for the legally allowed services without her parent. Remember to do this in a friendly and non-confrontational way. It should be noted that the vast majority of parents and guardians are completely fine with the policy of talking to a teenager alone. In fact, many are relieved that another adult will be discussing important issues with their child.

### **Suggestions for Learning Activities**

- Role-play how to interact with the challenging parent. Pay particular attention to staying calm and not antagonizing the parent.
- Ask students to find resources for legal issues involving confidential adolescent services and to research their local laws by looking at some of the sources below.

### **Other Resources**

- Adolescent Health Care: A Practical Guide, Fifth Edition, Ed. By Neinstein et al. Lippincott Williams & Wilkins.
- Guttmacher Institute, <http://www.guttmacher.org/pubs/tgr/03/4/gr030404.html>
- State Minor Consent Laws: A Summary, 3rd Edition. Center for Adolescent Health and the Law <http://www.cahl.org/web/>
- Physicians for Reproductive Choice and Health- Adolescent Reproductive and Sexual Health Education Project, <http://www.prch.org/arshepdownloads>

## ISSUES UNIQUE TO THE NEWBORN

### Issues Unique to the Newborn, Case #1

Written by Edward Clark, M.D.

A newborn has an Apgar score of 5 at one minute and 9 at five minutes. What are the components of the Apgar score? How is the Apgar score used?

#### **Definitions for Specific Terms:**

**Apgar score-** The Apgar score quantifies and summarizes the response of the newly born infant to the extrauterine environment and to resuscitation. Each of five components is awarded a value of 0, 1, or 2. The Apgar scores should be done at 1 and 5 minutes after birth. The five values are then added and the sum becomes the Apgar score. A total score of 10 indicates the best possible condition.

**Components of the Apgar score-** The five physiologic parameters that are evaluated are heart rate, respiratory effort, muscle tone, reflex irritability, and color.

Sign/Component	0 points	1 point	2 points
Heart Rate	Absent	<100	≥100
Respiratory Rate	Absent	Irregular, weak cry	Vigorous cry
Color	Pale, generalized cyanosis	Acrocyanosis	Pink, including extremities
Reflex irritability	Absent	Grimace	Vigorous, active cry, sneeze, cough
Muscle tone	Absent, flaccid	Weak, slightly flexed	Good flexion, active motion

**Apgar mnemonic-**Appearance, Pulse, Grimace, Activity, Respiratory

**Acrocyanosis-** A blue or purple mottled discoloration of the extremities, esp. the hands and feet.

#### **Review of Important Concepts:**

Virginia Apgar was an anesthesiologist at Columbia Presbyterian Medical Center in New York City when she introduced the Apgar scoring system in 1953 to assess the newborn infant's response to the stress of labor and delivery.

#### **Historical Points**

Obtain a history of any key portions of the delivery that could contribute to an infant being depressed on delivery.

- Was the mother abusing drugs?
- What medications were given to mother prior or during delivery?
- Narcotics?
- Magnesium Sulfate?

- Was this a meconium delivery?
- Was there a nuchal cord at delivery?

### Physical Exam Findings

1. Acrocyanosis- A blue or purple mottled discoloration of the extremities, esp. the hands and feet.
2. Heart Rate – To assess the infant's heart rate quickly or when a stethoscope is not handy, hold the umbilical stump in order to feel the pulse. Count the beats for 6 seconds and then multiply times 10 for a quick heart rate assessment in beats per minute.
3. Grimace- the response to a mild pinch or suctioning of the nose and mouth with a suction catheter.
4. Central cyanosis- Assess central cyanosis in neonates with a dark complexion by looking at the lips, gums, tongue and nose.

### Clinical Reasoning

1. What do the Apgar scores at 1 and 5 minutes indicate or reflect?  
The score at 1 minute is reflective of the intrauterine environment and the birth process, whereas the 5 minute score is more indicative of the neonate's success at transitioning.
2. What might cause a low Apgar score, 0-3?  
An Apgar score of 0-3 may indicate either cardio respiratory arrest or a condition resulting from metabolic acidosis, hypoventilation, or CNS depression. These may be the result of difficulty in establishing adequate ventilation, perinatal depression, congenital malformations, sepsis or other preexisting fetal problems.
3. When should Apgar scores be recorded at longer periods of time?  
If the score is less than 7 at 5 minutes, additional scores should be assigned every 5 minutes for up to 20 minutes.
4. When would resuscitation be needed for lower Apgar scores?  
Indications for resuscitation such as central cyanosis, apnea, gasping for breath, heart rate <100 or <60 are all indicative of low APGAR scores. Different levels and methods of resuscitation are stimulation, blow by oxygen, bag-mask ventilation, chest compressions, and intubation. If resuscitation is indicated, this takes precedence over pausing to obtain APGAR scores. Resuscitate the infant first, score later.

### Suggestions for Learning Activities:

- Describe a neonate at 1 minute and have the student calculate the Apgar score. Example- At 1 minute of life, a newborn's respiratory rate is slow and irregular with a heart rate of 80 beats/min. There is some flexion of his upper and lower extremities, he does not respond when a catheter is placed into his nose, and he is blue and pale. (Answer 3)
- Discuss what kind of resuscitation might be indicated for the infant in the above scenario with a 1 minute Apgar of 3? Answer: If the infant is cyanotic centrally, blow by oxygen should be

applied and since the Heart Rate is  $<100$ , bag-mask ventilation should be initiated. Since the HR is  $>60$ , chest compression would not be initiated at this time. Continue to reassess the infant.

- Ask the student to describe a neonate with an Apgar score of 4,5,6,7, or 8.
- If a student is rotating on newborn or NICU, ask what were some of the Apgar scores presented on rounds and how were they scored.
- Have the student answer how they would explain to a parent what the Apgar scores are, if asked by a parent.

**Other Resources:**

- Nelson Textbook of Pediatrics, Section-The Fetus and the Neonatal Infant, Chapter: The Newborn Infant: Routine Delivery Room Care

## **Issues Unique to the Newborn, Case #2**

Written by Edward Clark, M.D.

A six-hour-old infant born at term is persistently tachypneic with respiratory rates in the 80's. What additional information would be helpful in evaluating this infant? Discuss the diagnostic considerations and initial approach to the evaluation of this child.

### **Definitions for Specific Terms:**

**Term infant**- An infant with a gestational age that is considered full term ( $\geq 37$ wks), versus a preterm infant ( $< 37$ wks).

**Tachypnea**- An elevated respiratory rate. A normal respiratory rate in a newborn is 40-60 breaths/min.

### **Review of Important Concepts:**

#### **Historical Points**

- Maternal History – diabetes, multiple gestation, Group B Strep infection, other infections, drug use?
- Obstetrical History-Type of delivery, difficulty of delivery, maternal fever during delivery, characteristics of the amniotic fluid, drugs used during delivery (magnesium, narcotics)?
- Gestational age- preterm, term, postdates ( $\geq 42$ wks). How would your differential change?

#### **Physical Exam Findings**

1. Assess that the students know the different terms when discussing respiratory distress in the neonate:
  - a. Retractions and the different types
  - b. Grunting
  - c. Cyanosis
  - d. Nasal flaring
  - e. Apnea
2. Be familiar with other Physical findings that may indicate a cause for Respiratory distress:
  - a. Dysmorphic features
  - b. Scaffoid abdomen
  - c. Asymmetrical facies
  - d. Unusual cry or stridor, macroglossia
  - e. Meconium staining
  - f. Poor tone
  - g. Decreased breath and heart sounds consistent with pneumothorax, pneumopericardium, pneumomediastinum
  - h. Color, the patient may be anemic or plethoric leading to tachypnea.

## Clinical Reasoning

1. How does the gestational age of term, preterm, or postdates change your differential?
  - a. The more preterm the infant, the risk for respiratory distress syndrome, Group B Strep pneumonia increases.
  - b. The more postdates the infant, the higher the risk for meconium aspiration syndrome.
2. What perinatal infections may present as respiratory distress in the newborn?
  - a. Group B Streptococcus
  - b. Listeria monocytogenes
  - c. Escherichia coli and other gram-negative organisms
  - d. Congenital syphilis and herpes simplex viral infections should be considered especially in at risk situations
3. How would a maternal history of insulin dependent diabetes affect your differential?
  - a. An infant of a diabetic mother is at an increased risk for respiratory distress syndrome (RDS), large for gestational age (LGA), and cardiac dysfunction, a difficult delivery and its complications.
  - b. A cesarean section increases the risk of transient tachypnea of the newborn (TTN).
4. How would a history of maternal fever affect your differential?  
Consider causes of infection, sepsis, and possible chorioamnionitis.
5. What pulmonary and non-pulmonary causes are in your differential for respiratory distress?
  - a. Airway obstruction
  - b. Poor respiratory muscle effort
  - c. Space-occupying lesions
  - d. Parenchymal disease
  - e. Hematologic
  - f. Cardiac
  - g. Shock
  - h. Metabolic in origin
6. After you have considered the differential for this patient, what would be the initial evaluation?  
Unless the cause is obvious, consider the following for the patient's evaluation: pulse oximetry, the need for oxygen, chest x-ray findings, and the need for laboratory evaluation of glucose, electrolytes (calcium, magnesium, pH, ammonia), CBC with a differential, and sepsis workup.

## Diagnosis:

There could be multiple causes depending on the scenario. Most likely transient tachypnea of the newborn, respiratory distress syndrome, and /or pneumonia

## Suggestions for Learning Activities:

- Discuss the different parenchymal pulmonary causes of respiratory distress (transient tachypnea of the newborn, respiratory distress syndrome, pneumonia, meconium aspiration syndrome, pulmonary hypoplasia) and how each one differs in presentation and course.

- Review chest radiographs of different causes listed above (Google image search or your local radiologist may be good sources)
- Role play – have the students explain to you as the “parent” what the problem is with this patient (respiratory distress) and what treatment plan they will use.
- Have the student discuss how the differential changes when some of the “other physical findings” mentioned above are found on exam. I.e. scaphoid abdomen-diaphragmatic hernia; stridor- tracheomalacia, vocal cord paralysis, choanal atresia, etc.

**Other Resources:**

- Nelson Textbook of Pediatrics: Section-The Fetus and the Neonatal Infant, Chapter: Delivery Room Emergencies, and Respiratory Tract Disorders



## **Issues Unique to the Newborn, Case #4**

Written by Cassandra Wilson, M.D.

A full-term infant appears yellow at 48 hour of age. She weighs 3700 g. The total bilirubin is 13 mg/dl and the indirect is 12.7 mg/dl. What components of the history, physical examination and laboratory data would be helpful in evaluating this child?

### **Definitions for Specific Terms:**

**Jaundice**- The yellow-orange discoloration (skin, mucous membranes, sclera) seen with increased bilirubin levels (generally is seen with total serum bilirubin of  $>5\text{mg/dl}$ ). Approximately 60% of term infants and 80% of preterm have at least some degree of jaundice.

**Bilirubin**- The product of heme catabolism, primarily from RBC breakdown. It can be present in many forms in the blood, but its unconjugated form is primarily bound to albumin. The free, unconjugated form is lipophilic and can easily cross the blood-brain barrier, where irreversible damage can be caused (bilirubin encephalopathy/kernicterus).

**Indirect Hyperbilirubinemia**- Elevation of unconjugated bilirubin; the level that is considered “pathologic” or would require treatment is dependent on several variables, such as age in hours, gestational age, presence of hemolysis/Coombs positivity, prior sibling with notable hyperbilirubinemia, etc.

**Direct Hyperbilirubinemia**- Elevation of conjugated bilirubin; a level of 2.0 mg/dL or greater is always considered pathologic.

### **Review of Important Concepts:**

#### **Historical Points**

##### **Important Considerations**

- Physical examination findings
- Mother & baby blood type, DAT/Coombs positive
- Family history (eg, sibling that required phototherapy, RBC disorders, hemoglobinopathies, history of splenectomy, etc)
- Ethnicity
- Maternal complications – Diabetes mellitus, hypertension, infections, certain medications (eg TMP-SMX), drug abuse
- Gestational age
- Breast or bottle feeding?
- Is the infant feeding well?
- Percentage of weight loss since birth
- Has the newborn passed meconium/stooling adequately?
- Other signs of illness in the baby? (eg lethargy, temperature instability, vomiting, decreased urine output, etc)
- History of birth trauma or difficult delivery (eg large for gestational age/macrosomia, forceps-assisted, bruising, cephalohematoma)

- Delayed cord clamping (i.e. if born at home)
- Rate of rise of serum bilirubin
- Conjugated or unconjugated hyperbilirubinemia?

Discuss why the above points are relevant in the management of this patient.

### Physical Exam Findings

1. Discuss the approximate serum bilirubin level as jaundice progresses in cephalocaudal manner (Jaundice to – head: ~5mg/dL; mid abdomen: ~15 mg/dL; soles of feet: ~20 mg/dL).
  - a. Ask student to demonstrate physical assessment of jaundice in a newborn, by pressing on skin gently and looking for any yellowish tint in the blanched area. It should be discussed, however, that there is great variability in clinicians' estimations of serum bilirubin based on physical exam alone.
  - b. Note that unconjugated hyperbilirubinemia results in a more yellow to yellow-orange, whereas conjugated hyperbilirubinemia usually causes more of a greenish to yellow-brown appearance.
2. With student, go through complete examination, assessing for and discussing any possible signs that could put the baby at increased risk of worsening or pathologic jaundice.
  - a. Signs of Down's Syndrome: LGA or SGA infant, plethora, lethargy, decreased tone, syndromic features
  - b. Poor peripheral perfusion or signs of dehydration: Abdominal distention, decreased bowel sounds (or any other signs that could be associated with decreased GI motility or decreased/absent stooling and hence increased enterohepatic circulation)
  - c. Signs of congenital hypothyroidism: (While not typically symptomatic at birth, this is something to keep in mind as can commonly present with prolonged jaundice.) Bruising, petechiae, cephalohematoma; hepatosplenomegaly; wide fontanelles, umbilical hernia, sluggishness.

### Clinical Reasoning

1. What laboratory studies would be indicated in the evaluation of the jaundiced neonate?
  - a. Although the case prompt describes a newborn with elevated indirect bilirubin, the student should keep in mind that it is critical to differentiate between conjugated and unconjugated hyperbilirubinemia.
  - b. In the patient with unconjugated hyperbilirubinemia, laboratory studies are not always indicated (other than monitoring of serum or transcutaneous bilirubin). History and physical examination should be used to determine extent of lab workup.
  - c. If there is jaundice in the first 24 hr of life, rapidly rising serum bilirubin, hyperbilirubinemia unresponsive to phototherapy, or if hemolysis is suspected, basic labs that should be considered include: blood type (mother and baby) and Coombs, reticulocyte count, complete blood count, and a peripheral smear to assess RBC morphology.
  - d. The student should also understand why these studies are relevant and how an abnormality would change management. For example: With hemolysis, abnormal laboratory results could include fragmented red blood cells, microspherocytes, and a positive Coombs. In such cases the serum bilirubin would need to be monitored more closely and phototherapy initiated at lower serum bilirubin levels.

2. Discuss additional clinical findings that may guide further workup as indicated.
  - a. In a baby that is ill-appearing, lethargic, poor feeding, in respiratory distress, hypotonia, or has temperature instability, a sepsis evaluation should be done. Include a CBC with differential, blood culture, +/- CSF studies &/or urine culture (depending on age & other symptoms/signs).
  - b. A central hematocrit should be done if polycythemia is suspected (Either based on history, such as infant of diabetic mother, &/or based on physical exam findings or clinical signs, for example: a ruddy/plethoric appearance).
  - c. Infants with metabolic disorders may present with neonatal jaundice. Such babies may exhibit prolonged jaundice (3 weeks old or more), sepsis/serious bacterial infections, feeding intolerance, or signs of hypothyroidism, such as wide fontanelles, constipation, and umbilical hernia. In the case of such findings, check thyroid studies (serum thyroxine and TSH), and urine reducing substances (positive in galactosemia). Although state screens do test for these disorders, there can be false-negatives, and it is recommended to test for the condition if there are clinical signs, regardless of state newborn screen results.
3. Using bilirubin nomogram, determine along with the student what your next step in management should be. Demonstrate how, per AAP guidelines, the acceptable bilirubin level varies by age in hours, gestational age, risk factors such as isoimmune hemolytic disease, asphyxia, significant lethargy, etc.

### Diagnosis:

Given the information in the case prompt, this is most likely an example of physiologic jaundice of the newborn. The patient's weight of 3.7 kg may be indicative of mild macrosomia, which can be associated with increased heme load and hence, hyperbilirubinemia. However, the student must take into consideration other data obtained as discussed above. The history, physical examination, and laboratory studies should be used to guide further evaluation, management, and consideration of other diagnostic possibilities.

### Suggestions for Learning Activities:

- Have student explain to parents what causes jaundice in newborns, as well as the problems it can cause, and worrisome signs to watch for upon discharge (e.g. poor feeding, lethargy/somnolence, decreased wet diapers). Also should reinforce the importance of the newborn follow-up that will take place 24-48hr after discharge.
- Discuss the main contributing factors to physiologic jaundice of the newborn (increased heme load due to higher Hgb level and decreased RBC lifespan in neonates; decreased activity of hepatic enzymes that function in formation of conjugated bilirubin (UDP glucuronyl transferase), increased enterohepatic circulation).
- Discuss the indicators of pathologic jaundice.
- Explain why babies that are breastfeed or are poor feeders are more likely to have hyperbilirubinemia.
- Differentiate between breastfeeding jaundice and breastmilk jaundice.

**Other Resources:**

- <http://bilitool.org/>
- Lange Neonatology: Management, Procedures, On-Call Problems, Diseases, and Drugs by Tricia Lacy Gomella, et al. 6th edition.
- Pediatrics in Review: Neonatal Jaundice, by M. Jeffrey Maisels, MB, BCh. Pages 443-453.

## **Issues Unique to the Newborn, Case #6**

Written by Yameika Head, M.D.

A twenty-four-hour-old full term infant has not passed meconium. Discuss the possible explanation and your concerns.

### **Definition for Specific Terms:**

**Meconium**- The first stools of an infant. Unlike later feces, meconium is composed of materials ingested during the time the infant spends in utero: intestinal epithelial cells, lanugo, mucus, amniotic fluid, bile, and water. The term Meconium derives from meconium-arion, meaning "opium-like", in reference either to its tarry appearance or to Aristotle's belief that it induces sleep in the fetus.

Assess if student knows difference between meconium, transitional stools, breastfed stools. Meconium is the baby's first stool and is a thick dark green to black sticky material. Transitional stool represents the change from meconium to the normal yellow, seedy stools that characterize infants feeding on milk only. Normal breastfed baby stool is usually a mustardy yellow color, grainy in texture and quite runny.

What is the timeframe for an infant to have his first stool? Answer: Most infants stool and have their first void within the first 24 hours (95% at 24 hours and >99% at 48 hours old).

### **Review of Important Concepts:**

#### **Historical Points**

- Maternal history- general anesthesia, drug use, narcotics, maternal OTC medicine use (antacids, iron) family history of delayed stooling
- Was there a stool while in the womb i.e. Meconium baby? Infants at risk have a history of fetal distress or a post-term, post-dates infant.
- Was there a stool at the stand after delivery or in the nursery? Did the mother or nurse fail to document any stools? Sometimes stools may not be documented so don't be afraid to ask again.
- Does this child have an anatomic reason that may cause a delay in stooling? I.e., imperforate anus, spina bifida, volvulus, or meconium ileus.

#### **Physical Exam Findings**

1. Be familiar with physical findings that may indicate a cause for delayed meconium passage: abdominal distension, displaced/imperforate anus
  - a. Absent anal wink
  - b. Midline hair tuft
  - c. Sacral dimple
  - d. Pigment changes
  - e. No lumbar-sacral curve
  - f. Decreased strength/tone in the lower extremities

2. What do the abnormalities mean?
  - a. Abdominal distension: volvulus, obstruction;
  - b. Absent anal wink, midline tuft, sacral dimple, pigment changes, no lumbar-sacral curve, decreased strength/tone in lower extremities: spina bifida, tethered cord

### **Clinical Reasoning**

1. How does maternal history of narcotic ingestion, medicine use, or general anesthesia affect infant stooling?  
All of these causes slow the gastrointestinal tract and may cause a delay in passage of meconium.
2. What is the most common reason that one may miss noting a stool?  
Failure of documentation by nurse or mother.
3. What is meconium plug syndrome?  
Meconium plug syndrome, also termed functional immaturity of the colon, is a transient disorder of the newborn colon characterized by delayed passage (>24-48 h) of meconium and intestinal dilatation.
4. What are some differential diagnoses of metabolic causes that can lead to a delay in stooling?
  - a. Hypothyroidism
  - b. Cystic fibrosis (meconium ileus)Neonatal metabolic screens are very important in that they can diagnosis these conditions early.
5. After you have considered your differential diagnoses excluding failure of documentation, what is your workup for this infant?
  - a. If the physical exam is unremarkable you may want to watch the infant for 48% since >99% of infants will have a stool by this time.
  - b. If physical exam depicts otherwise then consider an abdominal x-ray for abdominal distension or a general overview of the abdomen looking for possible ileus, Hirschsprung's or other causes of obstruction.
  - c. Consider a MRI if sacral issues, thyroid studies for concerns of hypothyroidism, barium or air contrast enema for imperforate anus, or sweat chloride test for cystic fibrosis (meconium ileus).

### **Diagnosis:**

Depending on the scenario there could be multiple causes. The most likely diagnosis would be either a normal infant or failure to document a stool or a meconium plug syndrome.

### **Suggestions for Learning Activities:**

- Discuss normal stooling from birth to childhood.
- Review radiological studies for conditions that can cause delayed meconium passage or obstruction.
- Role play delivering concerns about the delayed passage of the first stool.

**Other Resources:**

- Nelson Textbook of Pediatrics, 19th edition, pp 600-601: Meconium Plugs, Meconium Ileus
- Primary Care of the Newborn: Gastroenterology Chapter: Delayed passage of meconium/constipation

## **Issues Unique to the Newborn, Case #7**

Written by Jennifer Hudson, MD

The mother of a newborn infant asks your advice about why she should breast-feed her infant. She will need to return to work in 8 weeks and wonders if she should just use formula. How would you counsel her?

### **Definition for Specific Terms:**

**Exclusive breastfeeding-** Exclusive breastfeeding means that a newborn is given no formula or other fluids by mouth. The American Academy of Pediatrics and other experts recommend exclusive breastfeeding as the optimal nutrition for infants 0 to 6 months of age. After 6 months, complementary foods should be added for additional nutrients needed for growth and brain development. Breastfeeding should continue until 12 months of age, or as long as a mother and baby are comfortable with breastfeeding.

**Formula feeding-** Human milk substitutes, such as commercial infant formulas, cannot match the nutritional quality of human milk, but their use is appropriate when medically indicated, or when a mother cannot or chooses not to feed her baby breast milk. Some medical reasons to use formula supplements when a mother is not able to supply breast milk include: hypoglycemia, inadequate urine output, excessive weight loss, and poor milk production due to maternal conditions such as a history of breast reduction surgery.

### **Review of Important Concepts:**

The US Department of Health and Human Services has established national breastfeeding goals in its “Healthy People 2020” objectives. Our national goals for breastfeeding habits are that 82% of mothers should initiate breastfeeding after birth, 61% of mothers should be breastfeeding at 6 months, and 34% of mothers should be breastfeeding at 1 year. Current breastfeeding rates are much lower than these goals.

### **Clinical Reasoning**

1. Benefits of breastfeeding for the infant include lower rates of:
  - a. Infection and hospitalization – especially otitis media, vomiting and diarrhea, and lower respiratory tract infections
  - b. Sudden Infant Death Syndrome (SIDS)
  - c. Eczema (atopic dermatitis) and asthma
  - d. Childhood obesity and type II diabetes mellitus
  - e. Childhood leukemias
  - f. Child abuse and neglect
2. Benefits of breastfeeding for the mother:
  - a. Lower rates of breast and ovarian cancer
  - b. Lower fertility levels and improved child spacing while exclusively breastfeeding
  - c. Improved psychosocial well-being, bonding and attachment to infant



- d. Economic benefits of lower feeding and health care costs (Bartick study + Business case for breastfeeding—see references)
3. Barriers to breastfeeding:
- a. Lack of knowledge of specific benefits
  - b. Hospital practices and provider attitudes toward breastfeeding (Baby Friendly Hospital Initiative; BF-friendly office practices)
  - c. Lack of family and social support
  - d. Different social norms for their cultural group
  - e. Embarrassment
  - f. Lactation problems and concern about supply
  - g. Employment and child care issues—Workplace support for nursing mothers in health care reform law
  - h. Lack of prenatal education—for mothers, secondary to lack of OB training (ABM Protocol available)

### **Suggestions for Learning Activities:**

- Role play – have students tell exactly how they would counsel a mother prenatally and also after delivery about the benefits of breastfeeding
- Demonstrate basic breastfeeding holds and how to help a mother get her infant latched to the breast successfully
- Show how to assemble and use a standard breast pump
- Check YouTube for a good latch demonstration video
- <http://www.breastfeedinginc.ca/>
- <http://www.youtube.com/watch?v=VHs2Ql5Kylo>
- Introduce students to your lactation consultants and suggest that they spend an hour or two rounding with them during their nursery rotation. It is important to talk about Baby Friendly Hospital Initiative.

### **Other Resources:**

- The Surgeon General's Call to Action to Support Breastfeeding, 2011 (DHHS online publication): [www.womenshealth.gov](http://www.womenshealth.gov)  
<http://www.surgeongeneral.gov/topics/breastfeeding/>
- Lactation Self-Study Modules, Level 1 – a free download from Wellstart International at: [www.wellstart.org](http://www.wellstart.org)  
[www.breastfeedingtraining.org--free](http://www.breastfeedingtraining.org--free) training modules, CME available
- Academy of Breastfeeding Medicine: <http://www.bfmed.org>
- Position on Breastfeeding
- Educational Objectives and Skills for the Physician with Respect to Breastfeeding
- Protocols: <http://www.bfmed.org/Resources/Protocols.aspx>
- Clinical Protocol-Hypoglycemia:  
<http://www.bfmed.org/Media/Files/Protocols/hypoglycemia.pdf>
- Clinical Protocol-Supplementation:  
<http://www.bfmed.org/Media/Files/Protocols/Protocol%203%20English%20Supplementation.pdf>

- Clinical Protocol-Jaundice:  
<http://www.bfmed.org/Media/Files/Protocols/Protocol%2022%20Jaundice.pdf>
- AAP Policy Statement Pediatrics. 1997 Dec;100(6):1035-9.  
Breastfeeding and the use of human milk. American Academy of Pediatrics.  
Work Group on Breastfeeding.  
Section on Breastfeeding <http://www.aap.org/breastfeeding/>
- AAP Speaker's Kit—full Power Point available to educate:  
<http://www.aap.org/breastfeeding/healthProfessionalsResourceGuide.html#speakersKit>
- ACOG-<http://www.acog.org/departments/underserved/clinicalReviewv12i1s.pdf>
- Baby Friendly Hospital Initiative: <http://www.babyfriendlyusa.org/>
- <http://www.babyfriendlyusa.org/eng/10steps.html>
- US Breastfeeding Committee: <http://www.usbreastfeeding.org/>
- La Leche League: <http://www.llli.org/>
- Business Case for Breastfeeding: <http://www.womenshealth.gov/breastfeeding/government-in-action/business-case-for-breastfeeding/index.cfm>
- CDC-BF report card: <http://www.cdc.gov/breastfeeding/data/reportcard.htm>
- Workplace support for working mothers (time and space required for nursing/pumping mothers)  
Part of Health reform law- PPA from March 23, 2010  
<http://www.usbreastfeeding.org/Workplace/WorkplaceSupport/WorkplaceSupportinHealthCareReform/tabid/175/Default.aspx>
- Bartick M, Reinhold A. The burden of suboptimal breastfeeding in the United States: a pediatric cost analysis. Pediatrics. 2010 May;125(5):e1048-56. Epub 2010 Apr 5.

## **Issues Unique to the Newborn, Case #8**

Written by Pat Patterson, M.D.

A term newborn weighs 4800 grams. His mother is an insulin dependent diabetic who had good control during her pregnancy. What immediate complications might this infant experience in the nursery?

### **Definitions for Specific Terms:**

**Large for Gestational Age (LGA infants)**- Infants whose birth weight (or length, or head circumference) lies above the 90th percentile for that gestational age. Currently, an infant is considered LGA if birth weight is over 4.0 kg.

**Macrosomia**- Excessive weight for gestational age secondary to increased adiposity

**IDM**- Infant of a Diabetic Mother

**IDDM**- Insulin Dependent Diabetes Mellitus (former name for Type 1 Diabetes Mellitus)

**Gestational Diabetes**- Carbohydrate intolerance of variable severity with onset or first recognition during pregnancy. Management of gestational diabetes is generally achieved through close glucose monitoring to insure normalization of blood glucose values after dietary and exercise changes.

**Gestational Diabetes Requiring Insulin**- Insulin is added to the treatment plan of a woman with gestational diabetes if good glucose control is not achieved with appropriate changes in diet and exercise.

### **Review of Important Concepts:**

- Complications associated with infants born to mothers with insulin dependent diabetes and are large for gestational age
  - Signs and symptoms of hypoglycemia in newborns
  - The suspected etiology of the hypoglycemia and macrosomia associated with infants born to a mother with IDDM
1. Immediate Complications Associated with LGA infants born to mothers with IDDM
    - a. Hypoglycemia: The highest incidence of hypoglycemia occurs 4-6 hours after delivery but can occur any time after delivery up to 48 hours after birth. Hypoglycemia is more apt to occur if maternal history is positive for diabetes but can occur in LGA infants without a maternal history of IDDM.
    - b. Signs and Symptoms of hypoglycemia in the newborn: Jitteriness, tachypnea, hypotonia, poor feeding, apnea, temperature instability, seizures, lethargy
      - Note: infants can experience hypoglycemia without displaying signs and/or sx prompting protocols to check glucoses frequently especially in the first 24 hours of life in infants born to mothers with IDDM even if asymptomatic.
    - c. Diagnostic tests: blood glucose, usually bedside. Normal > 45 mg/dl infants <24 hours of age and > 50 mg/dl infants >24 hours of age

- d. Treatment: Dependent upon severity of hypoglycemia and the infant's clinical condition; infant offered either enteral supplemental feeds orally or via nasal-gastric tube or D10 IV for glucoses under 30.
  - e. Prevention: Good metabolic control in the last trimester may decrease the incidence of neonatal hypoglycemia. Early feeding of infants born to mothers with IDDM.
2. Other Complications of Infants Born to Mother's with IDDM
- a. Macrosomia: Increased body fat, muscle mass and organomegaly especially of the heart and liver
  - b. Congenital anomalies: Sacral agenesis, femoral hypoplasia, heart defects (see below) and cleft palate are among the anomalies more commonly associated with IDMs
  - c. IDM's experience 3x's the risk for malformations compared with infants of mothers without diabetes. Poor control of IDDM in the first trimester appears to significantly increase the risk of major congenital malformations for the infant.
  - d. Congenital Heart Disease: double-outlet right ventricle, truncus arteriosus, transposition of the great vessels, congestive or hypertrophic cardiomyopathy. Signs and symptoms will vary based on the specific defect. The infant may exhibit: tachypnea, respiratory distress, difficulty feeding, tachycardia, +/- cyanosis, abnormal pulses or may be asymptomatic if the defect is mild.
  - e. Birth Trauma: (Birth Trauma can occur in LGA infants with or without maternal history of IDDM) Shoulder dystocia, brachial plexus injury, clavicular fracture, facial nerve palsy, ocular hemorrhage, cephalohematoma, subdural hematoma, abdominal organ injury, diaphragmatic paralysis, external genitalia hemorrhage
  - f. Asphyxia: May be associated with macrosomia and may acutely affect respiratory, renal, central nervous system and gastrointestinal functioning.
  - g. Respiratory Distress: Transient tachypnea of the newborn, meconium aspiration, air-leak syndromes and diaphragmatic paralysis all occur in increased numbers in IDM's.
  - h. Poor Feeding: Occurs in almost 1/3 of IDM's. Etiology unclear.

### Clinical Reasoning

1. How might the presence of maternal hyperglycemia contribute to the ultimate development of neonatal hypoglycemia in IDMs? What is the baby's insulin level in such a case and why?
  - a. Infants born to mothers with hyperglycemia have upregulated their insulin production to compensate for the higher levels of glucose they experienced in utero.
  - b. After birth, this increased production of insulin in the infant drives glucose levels down placing the infant at risk for hypoglycemia.
2. If an IDM persists with jitteriness after correction of an initial period of hypoglycemia what other metabolic derangements might you consider that would account for persistence of jitteriness in this infant?
 

Hypocalcemia can cause persistent jitteriness and may occur in IDM's secondary to suppression of neonatal parathyroid function.
3. Why are IDM's often macrosomic?
 

Insulin functions as the primary anabolic hormone of fetal growth and development resulting in visceromegaly and macrosomia.

**Other Resources:**

- Cowett RM. Neonatal care of the infant of diabetic mother. NeoReviews. 2002;3:e190-e196.

## **Issues Unique to the Newborn, Case #9**

Written by Pat Patterson, M.D.

A mother with no prenatal care and a history of known substance abuse delivers a baby at term. What special medical and social concerns do you have about caring for this infant? What evaluations and treatments are necessary before discharge?

### **Teaching Points for Students:**

- The importance of prenatal care and the impact it has on the health of the infant
- The potential problems for the newborn if exposed to substances of abuse in utero including neonatal abstinence syndrome (NAS)
- The role of social workers in assessing potential health and safety risks to the infant.

### **Definitions for Specific Terms:**

**SGA**- Small for gestational age: infants whose birth weight (or length, or head circumference) lies below the 10% for that gestational age.

**LGA**- Large for Gestational Age, LGA infants: Infants whose birth weight (or length, or head circumference) lies above the 90th percentile for that gestational age.

**IUGR**- Growth restriction of the fetus in utero.

**LBW**- Low Birth Weight: a weight of less than 2500 g (up to and including 2499 g), irrespective of gestational age.

**Neonatal abstinence syndrome scoring system**- A system of scoring that assigns points based on each symptom of withdrawal the newborn exhibits and its severity. The infant's score can help determine treatment.

### **Review of Important Concepts:**

#### **Historical Points**

- The importance of prenatal care:  
The primary purposes of prenatal care are to identify and treat complications of pregnancy and fetal health and to promote healthy behaviors. Outcome data suggest that babies born to mothers who do not receive prenatal care are more likely to be of low birth weight and more likely to die compared with babies born to mothers who receive prenatal care.  
Lack of prenatal testing places the infant at increased risk for a host of diseases and conditions routinely picked up with adequate prenatal care. These include:
  - Infectious Diseases: Group B Strep, Hepatitis B, HIV, GC, Chlamydia, Syphilis, Rubella
  - Other: Hemolytic disease secondary to maternal red blood cell antibodies, hypoglycemia; abnormal fetal growth, structural abnormalities of the skeleton and organ systems routinely picked up on ultrasound including congenital heart disease and neural tube defects.

- Which substances did the mother use and what are the risks to the infant exposed to one or more substances of abuse?  
 NAS: A generalized disorder presenting a clinical picture of CNS hyperirritability, gastrointestinal dysfunction, respiratory distress and vague autonomic symptoms. Manifestations of neonatal abstinence syndrome depend upon various factors including the drug used, its dose, frequency of use, and the infant's specific ability to metabolize and excrete the drug. Several scoring systems exist to monitor signs and symptoms of NAS in the newborn. Generally, the need for pharmacologic treatment for withdrawal symptoms is limited to neonates exposed to opioids or opiates. Pharmacologic treatment may involve morphine, methadone, phenobarbital, buprenorphine or diazepam.
- Does the infant have current issues or signs of withdrawal i.e. feeding problems, jittery, excessive crying, loose stools?

### Physical Exam Findings

1. Weight loss
2. Adequate suck vs. weak suck
3. Jitteriness, tremors
4. Increased tone
5. Skin excoriations

### Clinical Reasoning

1. Which classes of drugs have been associated with causing neonatal psychomotor behavior consistent with withdrawal?
  - a. Opiates and Opioids are the substances of abuse most likely to cause withdrawal NAS and produce the most dramatic effects on the neonate. In addition to NAS, infants exposed to these substances show an increased risk of LBW with 50% of those infants being SGA. 50-75% show clinical manifestations of withdrawal within 48 hours. Seizures during withdrawal are possible with this risk being higher in the methadone exposed infant compared with the infant exposed to heroin.
  - b. Stimulants: The stimulants cocaine and methamphetamine do not commonly cause NAS and, if present, the symptoms are generally much less severe compared with NAS associated with narcotics. The abnormalities seen in stimulant exposed infants likely represent the effect of the drug and not a withdrawal from the drug. Infants exposed to cocaine or methamphetamine also are at increased risk for IUGR, asphyxia, placental abruption and prematurity.
  - c. Depressants and Sedatives: Alcohol: increased risk of hypoglycemia and acidosis. Withdrawal is uncommon but when present, the symptoms may be indistinguishable from narcotic induced withdrawal although milder in severity. Infants exposed to alcohol in utero are at increased risk for Fetal Alcohol Syndrome: a constellation of physical, behavioral and cognitive abnormalities.
  - d. SSRI's: May cause NAS in up to one third of the infants exposed in utero but symptoms are usually mild and self-limited
2. What Medical Evaluations and Treatments are needed prior to discharge (in addition to 'Routine Newborn Care')?
  - a. CBC with differential, platelets (consider blood culture)
  - b. Consider C Reactive Protein. CRP's are elevated in response to infection and inflammation.
  - c. Serum glucose

- d. Calcium
  - e. Urine and meconium toxicology screen
  - f. Offer HIV testing to mother if not already done
  - g. Confirm maternal hepatitis status (B and C), RPR, GC, Chlamydia and treat accordingly  
Hepatitis B vaccine should be administered to infant immediately and HBIG if Hepatitis B status not available <48hrs
  - h. Neonatal Abstinence Scoring in nursery
  - i. Social Work Consult: The role of the social worker in this setting is to help evaluate the capability of the mother to provide a safe, supportive environment for her infant. This involves in depth discussions with the mother and often other family members and close friends and relatives. The social worker would assist the mother in arranging for financial support, medical care and substance abuse cessation programs, if desired, by mother. In most cases where there is a lack of prenatal care and substance abuse, the social worker would involve Child Protective Services to help in the determination as to the placement of the infant once the infant is medically stable. Infants are not generally allowed to be discharged with Mom until they are medically stable and a social worker has had the opportunity to evaluate the ability of the mom to care for the child and assess the general safety of the home environment.
  - j. Maternal toxicology screen
3. What treatment is available for NAS and what are the indications for treatment?  
The decision to use drug therapy for neonatal drug withdrawal should depend on the presence of signs of withdrawal. Some protocols quantify the signs of withdrawal from a neonatal abstinence scoring system. Be familiar with your institutions protocol. Treatment should be based on the drug that the infant is withdrawing from and the degree of withdrawal. Treatment options may include the use of phenobarbital, methadone, paregoric, tincture of opium, as well as, techniques to decrease stimuli to the infant (swaddling, quiet environment, minimal stimulation, low lighting, etc.).

## Diagnosis:

### Withdrawal

1. What factors may affect the timing of the symptoms of withdrawal in the neonate?  
The timing of withdrawal is most closely linked to the half-life of the substance the infant is withdrawing from.
  - a. Morphine has a short half life and symptoms are seen within 24 hours of birth and generally peaking around 48-72 hours after birth.
  - b. Methadone has a longer half-life of over 24 hours with symptoms of withdrawal in the infant often not in evidence before 48 hours of age and sometimes not seen for as long as 1-4 weeks later; even longer for sub acute signs.
2. What characteristics of the drug increase the likelihood that the drug would affect the CNS of the fetus?  
Substances that cross the placenta are lipophilic and of low molecular weight more readily cross into the CNS of the fetus.



**Suggestions for Learning Activities:**

- Assign students in small groups to research the effects of various substances on the neonate
- Role play, having the student disclose the infant's toxicology screen result to the parent or that the infant has NAS.
- Have the students obtain and review the Neonatal abstinence protocol at your institution and prepare a plan based on an infant with severe withdrawal from methadone with a weight of 2.5 kg.

**Other Resources:**

- Neonatal Abstinence Protocol at your institution
- Nelson Textbook of Pediatrics 19th Edition, pp 624-625

## **Issues Unique to the Newborn, Case #10**

Written by Yameika Head, M.D.

The parents of a newborn ask your opinion about whether the baby should be circumcised. How should you counsel these parents?

### **Definition for Specific Terms:**

**Circumcision**- Surgical removal of some or the entire foreskin (prepuce) from the penis. The word "circumcision" comes from Latin circum (meaning "around") and cædere (meaning "to cut"). Early depictions of circumcision are found in cave paintings and Ancient Egyptian tombs.

**Phimosis (Greek for muzzle)**- Stenosis or narrowness of the preputial orifice so that the foreskin cannot be pushed back over the glans penis.

**Paraphimosis**- Strangulation of the glans penis due to retraction of a narrowed or inflamed foreskin.

### **Review of Important Concepts:**

#### **Historical Points**

- Circumcision is a very controversial topic around the world.
- There are spiritual and religious reasons that circumcisions are performed. For example, Judaism, Islamic, and Christianity practice circumcisions. For Jewish families, the circumcision is performed by a rabbi on the 8th day after birth.
- Prolonged bleeding from circumcisions can be the first sign of a bleeding disorder.

#### **Physical Exam Findings**

Does the male infant have normal penile anatomy?

Hypospadias, epispadias, hooded prepuce, and any other penile deformities are contraindications for circumcision.

#### **Clinical Reasoning**

1. What are the different types of circumcision techniques and how are they performed?
  - a. Plastibell Method: once the glans is freed the Plastibell is placed over the glans, and the foreskin is placed over the Plastibell. A [ligature](#) is then tied firmly around the foreskin and tightened into a groove in the Plastibell to achieve [hemostasis](#) to cut off circulation. The Foreskin distal to the ligature is excised and the handle is snapped off the Plastibell device. The Plastibell falls from the penis after the wound has healed, typically in four to six days.
  - b. Gomco Method: With a Gomco clamp, a section of skin is dorsally crushed with a [hemostat](#) and then slit with scissors. The foreskin is drawn over the bell shaped portion of the clamp and inserted through a hole in the base of the clamp. The clamp is tightened, "crushing the foreskin between the bell and the base plate." The crushed blood vessels provide hemostasis. The flared bottom of the bell fits tightly against the hole of the base plate, so the foreskin may be cut away with a scalpel from above the base plate.

- c. Mogen clamp method: The foreskin is pulled dorsally with a straight hemostat, and lifted. The Mogen clamp is then slid between the glans and hemostat, following the angle of the corona to "avoid removing excess skin ventrally and to obtain a superior cosmetic result" to Gomco or Plastibell circumcisions. The clamp is locked, and a scalpel is used to cut the skin from the flat (upper) side of the clamp
2. What is the response to parents if they question about the pain with circumcision? What ways do physicians ensure that infants have minimal pain?  
Explain to parents that there are simple anesthesia methods that can be given to their child to ensure that they are not in pain such as Sweetease (oral sucrose), injectable 1% Lidocaine without epinephrine as a pudendal nerve block, and topical prilocaine cream. Some institutions use all three and some use none. What is your institution's policy?
3. What are different organizations stances on the subject of circumcision?  
For example, the American Academy of Pediatrics (2012) states "that the health benefits of newborn male circumcision outweigh the risks and that the procedure's benefits justify access to this procedure for families who choose it". If parents choose to circumcise, analgesia should be used to reduce pain associated with the circumcision.
4. What are some of the complications of circumcisions?  
Most common is bleeding and less common is infection, or damage/disfigurement to the penis.
5. What are the pros for circumcision?
  - a. Less UTIs
  - b. No phimosis
  - c. Decreased risk of penile cancer
  - d. Protection against STDs including HIV
6. What are the cons for circumcision?
  - a. Pain
  - b. Risk of infection
  - c. Decreased sensation
  - d. Poor hygiene
  - e. Paraphimosis
  - f. Cosmetic problems
7. What is the care for the circumcised versus uncircumcised penis?
  - a. The circumcised penis has to be kept clean with a mild soap and water.
  - b. With uncircumcised penis, the parents may feel the need to pull back the foreskin and clean around the glans with mild soap and water the best that they can.

### **Suggestions for Learning Activities:**

- Watch a pediatrician perform a circumcision.
- Have student role-play discussion about circumcision with parents.
- Have student obtain consent s for circumcisions and discuss pros and cons.
- Have students obtain articles on female circumcision and its controversy.

**Other Resources:**

- AAP policy statement on circumcision
- AMA policy statement on circumcision
- WHO policy on circumcision

**Issues Unique to the Newborn, Case #11**

Written by Jennifer Hudson, M.D.

What anticipatory guidance would you give to the parents of a healthy, full-term, first born infant at the time of discharge from the newborn nursery?

**Definitions for Specific Terms:**

**Anticipatory Guidance-** A personal discussion with a pediatrician about what to expect after discharge helps to lay the groundwork for healthy lifestyles starting in the newborn period. It is best to have both parents, or whichever caregivers will be primarily responsible for the newborn, present during this teaching session.

**Metabolic Screening-** It's not just the "PKU test" any longer! Every state is different. Genetic or metabolic disorders caused by changes in the genes. If caught early, some diseases can be treated to minimize long term effects.

**Review of Important Concepts:****Clinical Reasoning (Anticipatory Guidance)**

1. Nutrition
  - a. Normal breast- and formula-feeding patterns
  - b. Normal voiding and stooling patterns
  - c. Normal weight loss and gain patterns for the first 2 weeks
  - d. Normal "spitting up"
2. Safety
  - a. Sleeping habits
  - b. SIDS prevention and pacifiers
  - c. Crying and Shaken Baby Syndrome
  - d. Car seat recommendations
  - e. Smoke exposure
3. Hygiene
  - a. Bathing, cord, nail and skin care
  - b. Circumcision, vaginal discharge and other genital care issues
  - c. Infection prevention
4. Fever in a newborn-taking a temperature
5. Jaundice awareness
6. Irregular breathing patterns in the newborn
7. Newborn screening results:  
When and where?

8. Normal Habits:  
Sneezing, hic-ups, and passing gas!
9. Postpartum depression awareness
10. Follow-up plan and when to call the doctor for concerns
11. Opportunity for questions

**Suggestions for Learning Activities:**

- Role play – ask students typical questions related to anticipatory guidance that a new parent may be curious about i.e. Explain to the “mother” the definition of jaundice and what she should be monitoring.
- Role play- Practice telling the “mother” the discharge anticipatory guidance spill.
- Shopping trip – have students guess the price of a list of common baby supplies, and then research actual costs online or in stores

**Other Resources:**

- Bright Futures Guidelines for Health Supervision
- Goldenring JM. What to tell parents before they leave the hospital. Contemporary Pediatrics, April 2007

## **Issues Unique to the Newborn, Case # 13**

Written by Jennifer Hudson, M.D.

A full term newborn weighs 2000 grams. What factors might have contributed to this infant's small size? How do you assess the maturity of this infant? What should you monitor in the nursery?

### **Definitions for Specific Terms:**

**Large, appropriate, and small for gestational age-** Weight measurements for all newborns should be plotted on standardized growth curves published by the CDC. Infants with birth weights less than 10th percentile for gestational age are classified as small for gestational age (SGA), while those with birth weights more than 90th percentile are classified as large for gestational age (LGA). All infants with birth weights between 10th and 90th percentiles are classified as appropriate for gestational age (AGA).

**Intrauterine growth restriction (IUGR)-** Poor fetal growth caused by one or more general problems in pregnancy: placental insufficiency, maternal health problems, and fetal factors.

**Ballard (Dubowitz) scoring-** The gestational age of a neonate can be estimated by two methods: 1) obstetrical dating (using menstrual history and ultrasound) or 2) assessment by physical exam. The Ballard Score is obtained after examination for signs of physical maturity (such as skin and genital appearance) and signs of neuromuscular maturity (such as posture and measures of joint flexibility). It is generally considered accurate to within two weeks of actual gestational age. Any significant discrepancies between obstetrical dating and Ballard scoring should be documented on the newborn's chart, with a final physician determination of which gestational age will be used for the patient care plan.

### **Review of Important Concepts:**

- IUGR, or poor fetal growth, can be caused by one or more general problems in pregnancy: placental insufficiency, maternal health problems, and fetal factors.
- Placental insufficiency may be caused by small size of the placenta, placental tumors, and hypertension from chronic causes, pregnancy itself, or drugs (such as cocaine and nicotine.)
- Maternal health problems such as poor nutrition or chronic illness can cause fetal undergrowth.
- Inherent fetal problems, such as genetic disorders or anomalies, exposure to teratogens, infections, multiple gestation and endocrine disorders are also causes of IUGR. Growth-restricted fetuses are at risk for fetal demise and postnatal hypoglycemia and polycythemia.

### **Physical Exam Findings**

1. Fetal growth restriction usually results in one of two patterns.
  - a. Early, toxic, and severe insults to the fetus cause symmetric growth restriction, with the newborn's head and body size both being proportionately small.
  - b. In contrast, insults toward the end of pregnancy, such as poor nutrition or late gestational hypertension, tend to result in asymmetric growth restriction, with the newborn's head size being relatively normal compared with a smaller body and overall weight.

2. All growth-restricted infants tend to have poor subcutaneous fat stores. A careful examination should be performed to assess for dysmorphologies and signs of infection or drug effects. In addition, plethora (ruddy skin) may indicate polycythemia, and tremors, irritability, or other neurologic symptoms may indicate the presence of hypoglycemia.
3. Screening tests:
  - a. All SGA and LGA newborns should be screened for hypoglycemia (serum or whole blood glucose before feedings) from birth to 12 or 24 hours.
  - b. Other workup may be obtained, depending on physical examination findings. Tests to consider may include complete blood count or hematocrit measurement, genetic testing, drug screens, and specific tests for TORCH infections.

**Suggestions for Learning Activities:**

- Have students watch a nurse or physician perform a Ballard assessment and then practice performing one
- Have students practice obtaining newborn weight, length, and head circumference measurements and plot them on the growth chart appropriately
- Have students review newborn glucose screening protocol for your institution and practice blood collection methods in your nursery (procedural pain control, heel-stick, labeling and filling collection tube or using a glucometer)

**Other Resources:**

- Nelson Textbook of Pediatrics, 19th ed., 2011
- Guidelines for Perinatal Care, 6th ed. AAP and ACOG, 2008
- Stellwagon L and Boies E, Care of the Well Newborn. Pediatrics in Review, 2006;27;89-98
- AAP Committee on Fetus and Newborn, Postnatal Glucose Homeostasis in Late-Preterm and Term Infants, Pediatrics 2011;127;575-579



## NUTRITION

### **Nutrition, Case # 4**

Written by Debra Best, M.D.

A healthy 4-month-old breast-fed child presents for a well-child examination. The parents want to know when he can begin solid foods and when he should be weaned from breast milk. How would you counsel them?

#### **Definitions for Specific Terms:**

**Complementary foods**- Any food or beverage other than breast milk or formula. Also referred to as “solids”

#### **Review of Important Concepts:**

#### **Learning Objectives**

- Know when complementary foods should be introduced.
- Learn how to what developmental milestones must occur for a baby to be ready for complementary foods.
- Describe the anticipatory guidance that is given to families about the introduction of complementary foods.
- Learn the recommendations for counseling patients about weaning from breast milk.

#### **Clinical Reasoning**

1. When can complementary foods be introduced?
  - a. Solid foods should not be introduced before 4-6 months of age as this may lead to choking/aspiration, increased risk of atopy and increased risk of obesity.
  - b. There is some difference of opinion within the American Academy of Pediatrics as to their recommendations for the timing of the introduction of complementary foods. The AAP Committee on Nutrition states that complementary foods can be introduced into a developmentally ready infant’s diet between 4 and 6 months of age. The AAP Section on Breastfeeding recommends exclusive breastfeeding until 6 months of age. Both Sections agree that these complementary foods should be in addition to, and not in replacement of, breast milk or formula.
  - c. The World Health Organization recommends exclusive breastfeeding until 6 months of age.
  - d. There is little nutritional value of introduction of solids before 6 months of age which tends to replace the benefits of breast milk. Breastfeeding exclusively through 6 months of age confers significant benefits to the infant, including immune protection and decreased risk of obesity, SIDS and atopic diseases.
  - e. There is no benefit to starting foods prior to 4 months of age. In fact, starting foods earlier than 4 months may be harmful. Infants may choke on foods if they aren’t developmentally ready to swallow them. They may have an increased risk of obesity and atopic disease. They may also obtain less nutrition from breast milk or formula as solids may take the place of these

- f. For infants at high risk of developing atopic disease (such as asthma, allergies or eczema), there is evidence that exclusive breastfeeding for at least 4 months of age decreases the incidence of eczema and cow's milk allergy in the first two years of life. There is not sufficient data currently to recommend delaying introduction of solids past 4-6 months of age to further decrease risk of atopic disease.
  - g. There is evidence that exclusive breastfeeding for at least 3 months protects against wheezing in early life
  - h. Delaying introduction of complementary foods beyond 6 months is not recommended because of increasing risk of energy, nutrient and vitamin deficiencies (specifically iron and zinc) and development of food aversion.
2. How can you tell a baby is developmentally ready for complementary foods?

Around 4 to 6 months of age, babies become more interested in the environment around them. This includes becoming more interested in what other members of the family are eating. Infants should have obtained the following milestones prior to the introduction of complementary foods:

  - a. Gross motor: Infants should be able to sit with support and have adequate head and neck control as evidenced by no head lag when pulled to a sitting position.
  - b. Fine motor: Infants should be able to bring their hands and toys to their mouths.
  - c. Oral-motor: Around this time, babies lose the tongue thrust reflex or extrusion reflex which allows baby to accept a spoonful of food when placed in the mouth. They are able to use their tongue to propel the food into the posterior oropharynx to enable swallowing.
  - d. Behavioral: Infants should show signs of hunger by drooling, opening their mouths and leaning in when presented with food. They should be able to show signs of satiety as well, such as turning the head away or closing the mouth.
3. How would you educate a family to start these foods?
  - a. While there is sparse evidence supporting a particular way to introduce solid food to babies, the American Academy of Pediatrics Committee on Nutrition recommends starting with a single grain iron fortified cereal or pureed meat. These foods are recommended because they provide infants with the nutrients that they are most likely to be deficient in, specifically iron and zinc. Rice cereal appears to be less likely to cause allergic reactions compared with other foods.
  - b. Parents should mix a small amount of this cereal with breast milk or formula to about the consistency of applesauce. Parents should be advised to feed from a bowl with a spoon instead of putting the cereal in the bottle. Many families will put cereal in a bottle because they think it will help the baby sleep longer; studies have shown this does not make any difference in length of sleep. However, it can contribute the development of future obesity.
  - c. Once the baby is accepting this food, the parents can introduce single ingredient pureed foods in 3 to 5 day intervals to observe for possible allergic reactions, such as wheezing, urticarial and vomiting.
4. Is juice recommended for babies?
  - a. Juices are not recommended within the first six months of life. After this time, it is recommended to limit juice to 4 to 6 ounces daily and offer only 100% fruit juices. Juice should never be offered in a bottle, only in a cup. However, it must be stressed to parents that even 100% fruit juice is high in calories and sugar, which can contribute to many childhood health problems including obesity, diarrhea and early tooth decay/dental caries. Certain juices (pear, prune, apple) may be used sparingly to help aid in treating constipation.

- b. Even beyond 6 months, juice is not generally recommended as this can replace healthy calories in the child's diet leading to vitamin deficiencies, anemia and malnutrition.
5. What do you recommend about weaning from breast milk?  
 The 1997 policy statement on breastfeeding of the American Academy of Pediatrics recommends breastfeeding for at least the first year of life and as long thereafter as mother and child wish to continue. The World Health Organization recommends breastfeeding up to 2 years of age. If the child is weaned prior to one year of age, then he/she should be given cow's milk formula. If the child is weaned after one year of age, it is appropriate to wean to whole milk. Before advising against breastfeeding or recommending premature weaning, weigh the benefits of breastfeeding against the risks of not receiving human milk.

### **Suggestions for Learning Activities:**

- Students can role play giving anticipatory guidance about these topics.
- Students can provide guidance about importance of breastfeeding, especially as it relates to obesity prevention.
- Students can visit a local retail baby supply store and familiarize themselves with the different stages of baby foods, cereals, etc.

### **Other Resources:**

- <http://brightfutures.aap.org/>
- American Academy of Pediatrics. "The use and misuse of fruit juice in pediatrics". Pediatrics. May 2001;107(5):1210-1213.
- American Academy of Pediatrics, Section on Breastfeeding. "Breastfeeding and the use of human milk". Pediatrics. 2005; 115(2):496-506.
- Committee on Nutrition American Academy of Pediatrics. Complementary feeding. In: Pediatric Nutrition Handbook, 6th ed, Kleinman, RE (Ed), American Academy of Pediatrics, Elk Grove Village, IL 2009. p.113-143.
- Greer FR, Sicherer SH, Burks AW, et al. "Effects of early nutritional interventions on the development of atopic disease in infants and children: the role of maternal dietary restriction, breastfeeding, timing of introduction of complementary foods, and hydrolyzed formulas". Pediatrics 2008; 121:183.
- World Health Organization. Complementary feeding. [http://www.who.int/nutrition/topics/complementary\\_feeding/en/index.html](http://www.who.int/nutrition/topics/complementary_feeding/en/index.html) (Accessed on October 17, 2011).
- Zutavern A, Brockow I, Schaaf B, et al. "Timing of solid food introduction in relation to atopic dermatitis and atopic sensitization: results from a prospective birth cohort study". Pediatrics 2006; 117:401.

## **Nutrition, Case #5**

Written by Debra Best, M.D.

A mother is concerned that her 5-day-old infant is not breast-feeding well. What historical or physical examination findings would help you investigate her concerns? What additional resources may be available to help support this mother?

### **Review of Important Concepts:**

#### **Learning Objectives**

Students will know appropriate historical questions to ask related to an infant who is not breastfeeding well

Students will be able to perform a physical exam pertaining to this concern

Students will be able to provide additional resources to support mothers in breastfeeding

#### **Physical Findings**

What should you be looking for on physical exam?

Physical examination of the infant should include the following:

- Review of vitals:
  - The physician should look at the growth parameters noting birth weight, weight when discharged from the hospital, and the weight at that day's visit. Babies can lose up to 10% of their birth weight in the first few days of life. Babies should then gain about 20 grams per day until regaining their birth weight at approximately 10-14 days of life. Babies who have lost more than 10% of their birth weight should have a thorough nutritional and latch assessment to determine if problems with breastfeeding are contributing to their weight loss. The newly revised WHO growth charts should be used for breastfed infants.  
[http://www.cdc.gov/growthcharts/who\\_charts.htm](http://www.cdc.gov/growthcharts/who_charts.htm)
  - Tachycardia may be a sign of late dehydration. Earlier signs of dehydration may include dry lips/mucous membranes, decreased urine output or "brick dust" in the diaper (reddish-brown uric acid crystals that form in the urine when a baby is dehydrated).
- Examination of the infant: A complete physical exam should be performed with particular attention to the following systems.
  - HEENT: Fontanelles should be open, soft and flat. A sunken fontanelle may indicate dehydration. Mucous membranes should be moist without dryness to the lips. Eyes should be examined for scleral icterus as an indication of elevated bilirubin levels which could contribute to a sleepy baby who does not feed well. Observe for anatomic variants such as small mandible size, ankyloglossia (tongue tie), cleft lip/ palate, which could also contribute to difficulties with feeding.
  - Cardiac: Tachycardia may be a sign of dehydration. A significant murmur may indicate an underlying cardiac problem which could lead to feeding problems. Sweating during feeds possible sign of cardiac pathology.
  - Skin: Skin turgor is a sign of hydration status as well. Observe for jaundice as a sign of elevated bilirubin level.
  - Neuro: Overall tone should be noted as infants with low tone may have difficulties with latching and sustaining a breastfeeding session.

## Clinical Reasoning

1. What questions should you ask about birth history?
  - a. Was the baby full term?
    - Late preterm babies (35-37 weeks) may have difficulty with breastfeeding.
    - Establishing breastfeeding in the late preterm infant is frequently more problematic than in the full-term infant. Because of their immaturity, late preterm infants may be sleepier, have less stamina and have more difficulty with latch, suck, and swallow than a full-term infant.
    - The sleepiness and inability to suck vigorously may be misinterpreted as sepsis, leading to unnecessary separation and treatment.
    - Given the known increased risk of medical problems of the late preterm as compared with the term infant, close observation and monitoring are required, especially in the first 12–24 hours after birth when the risk of inadequate adaptation to extrauterine life is highest.
    - Each delivery service must determine where and how this can best be accomplished while supporting the mother-infant dyad and breastfeeding.
  - b. Was it a normal vaginal delivery or cesarean section?
    - Mothers should expect their milk to come in within 2-5 days after delivery.
    - Delay in breastfeeding initiation is common after c-section due to hospital/OR protocols, delay in getting baby to mom's breast within one hour, positioning difficulties secondary to incision, and excessive drowsiness of baby secondary to peri-operative meds.
  - c. Were there any complications (respiratory distress, infection, hypoglycemia, jaundice, etc)?
    - Babies with significant medical problems or difficulty transitioning in the early perinatal period may experience difficulties with feeding.
    - These babies may also be separated from the mother for periods of time for medical testing or treatment which can lead to difficulties in establishing breastfeeding.
    - These mothers should be provided with a breast pump in order to help establish their milk supply.
    - In addition, in these situations, the infants may be unable to breastfeed because of their illness or may ineffectively breastfeed.
  - d. Any other problems that might cause lactation problems?
    - Other problems that may cause difficulty with breastfeeding include the following: low birth weight, multiple gestation, maternal history of breast surgery.
2. Any problems with breastfeeding while in the hospital?
  - a. What questions should be asked in obtaining a nutritional assessment?
    - How often is the baby feeding? How long is the baby feeding on each breast?
    - Baby should be fed on demand in the neonatal period. There is neither a schedule nor a time requirement on each breast. Mothers should be fully emptying their breasts every 2-3 hours to maintain breast milk supply. Infants should feed at least 8 times in 24 hours. Mothers should be taught hand expression and how to use an electric breast pump. They should be reminded that baby's suckling is most effective for emptying the breast.
  - b. Is the baby having any difficulties with latching?
    - Difficulty in latching is one of the most common reasons for difficulties with breastfeeding.
    - This could be secondary to the baby not being positioned at the breast correctly or not latching to the nipple/areola correctly. Latch for breastfeeding should NOT be focused on the nipple as the baby's mouth should be fully around the nipple and take in most of the areola.

- This can also occur if the baby has an anatomical abnormality (such as “tongue-tie” or cleft palate) or if the mother is engorged or has flat nipples.
  - Babies with cleft palate are at increased risk of otitis media, so the protective effects of breast milk should be stressed.
  - A full breastfeeding/latch evaluation should be done on each mother-baby dyad.
  - If the baby is unable to latch on right away, expressed breast milk or pasteurized donor breast milk given by a cup or syringe is favorable to formula.
- c. Is the mother having any problems with engorgement or sore nipples?
- Engorgement can make it very difficult for an infant to latch at the breast. Sore nipples are a very common problem and may indicate that the baby is not latching correctly.
  - Proper latch should be evaluated and techniques to prevent engorgement should be taught to mom, i.e. properly and fully emptying the breast
- d. How often is the baby urinating?
- Beginning in the first days of life, babies should have at least 2-3 wet diapers per day. At 5 days of life, the infant in this vignette should be having 6-8 voids in 24 hours. Once the maternal milk supply is established, infants are typically urinating with each feeding.
- e. How many stools has the baby had in the past 24 hours and what color/consistency are they?
- The initial stool that a baby passes is a thick, sticky, black substance known as meconium. As the baby feeds better, the stools change from this tar-like substance to the typical yellow, seedy stools of a breastfed infant. Knowing what the stools look like and how often they are occurring can help you understand how well a baby is feeding and if the milk supply is adequate. For breastfed infants, typically the transitional stools occur on day three with 3 to 4 yellow stools expected per day by day 5.  
BF babies generally stool more than formula fed infants.
- f. Is the baby having any problems spitting up?
- Spitting up can be a normal part of infancy or a sign that there is an underlying problem such as pyloric stenosis or gastroesophageal reflux. This is particularly common in preterm infants where immaturity of the GE sphincter can lead to problems with reflux.
- g. What are you looking for when observing a breastfeeding session?
- Appropriate positioning at the breast
  - Infant should be held at the level of the mother’s breast. Pillows may be required to get the baby to the appropriate level. The mother should be sitting comfortably with her back well-supported and avoid leaning forward to prevent the baby from falling off of the breast.
  - Adequate latching to the breast: It is a common misconception that breastfeeding is just on the nipple. For effective breastfeeding to occur, the baby’s mouth should be open at least 90 degrees when latching to the breast to allow as much of the areola into the mouth as possible. Latching only on the tip of the nipple can cause significant problems with nipple soreness. Lips should be flanged outward (aka “fish lips”) to prevent irritation to the mother’s nipples. The nose and chin should just touch the breast. Mother’s breasts should be examined with particular attention to determining if her milk has come in and the anatomic characteristics of the nipple.
  - Can use the LATCH assessment tool to help assess breastfeeding (Latch, Audible Swallowing, Type of nipple, Comfort (breast/nipple), Hold)  
<http://www.cdph.ca.gov/programs/breastfeeding/Documents/MO-LatchBreastfeedingAssessment.pdf>
  - Assist the mother in achieving a comfortable position and effective latch (attachment).
  - Observe infant for signs of effective positioning:

- Is the infant well supported and placed at the level of the mother’s breast (mother-led attachment)?
- Is the infant well supported and placed between the mother’s breasts (baby-led attachment)?
- Observe infant for signs of effective latch:
  - Wide opened mouth
  - Flared lips
  - Chin touching the breast
  - Asymmetric latch (more areola visible above the baby’s mouth)
- Observe infant for signs of milk transfer:
  - Sustained rhythmic suckle/swallow/breathe pattern with periodic pauses
  - Audible swallowing
  - Relaxed arms and hands
  - Moist mouth
- Observe mother for signs of milk transfer:
  - Breast softening while feeding
  - Relaxation or drowsiness
  - Thirst
  - Uterine contractions or increased lochia flow during/after feeding
  - milk leaking from the opposite breast while feeding
  - nipple elongated but not pinched or abraded after feeding
- h. How do you know a baby is feeding well?
  - If a baby is feeding well, you should observe jaw movement and hear an audible “cuh” sound as the infant swallows.
  - The infant will be content in between feeds.
  - Mother’s breasts subjectively feel softer after feeds.
  - The infant has adequate weight gain of 20 grams per day and adequate urine and stool output.
- i. Teach mothers to recognize and respond to early infant feeding cues and confirm that the baby is being fed at least 8 times in each 24 hours.
  - Early infant feeding cues include sucking movements and sounds, hand-to-mouth movements, rapid eye movements, soft cooing or sighing sounds and restlessness.
  - Crying is a late feeding cue and may interfere with effective breastfeeding.
- j. What resources can you offer to a mother who is having difficulties with breastfeeding?
  - Lactation consultant: Some pediatric practices have lactation consultants on staff who are specially trained to work with lactating mothers and to troubleshoot breastfeeding problems. Independent lactation consultants are also typically available in the community. Many M.D.s are also certified lactation consultants.
  - Local mother’s groups: These groups may be beneficial to mothers to be able to have the support of other mothers who are breastfeeding as well.
  - WIC offices: Many WIC offices have a lactation consultant on staff. In addition, mothers who are exclusively breastfeeding will receive a more comprehensive food package from WIC. WIC can provide these mothers with a free electric pump to use, if indicated.
  - La Leche League International: LLLI is an organization devoted to breastfeeding. There are local groups in all fifty states. They also have a website that provides answers to many common breastfeeding questions.

### Suggestions for Learning Activities:

- Students can role play giving anticipatory guidance about these topics.
- Students can examine infants in a nursery or outpatient setting paying particular attention to the physical exam characteristics that signify adequate breastfeeding.
- Students can learn about and promote the WHO/Unicef Ten Steps to Successful Breastfeeding. (<http://www.babyfriendlyusa.org/eng/10steps.html>)
- Students can accompany a lactation consultant either in the hospital or in outpatient practice to observe how to troubleshoot breastfeeding problems.
- Students should learn about the medically indicated reasons to supplement with formula. <http://www.bfmed.org/Media/Files/Protocols/Protocol%203%20English%20Supplementation.pdf>

### Other Resources:

- <http://brightfutures.aap.org/>
- American Academy of Pediatrics, Section on Breastfeeding. “Breastfeeding and the use of human milk”. Pediatrics. 2005; 115(2):496-506
- Chandran, L. et. Al. “Breastfeeding: The Essential Principles”. Pediatrics in Review. 2006; 27:409-417.
- [www.bfmed.org](http://www.bfmed.org)
- Protocols on: Engorgement, Supplementation, Infants with jaundice, Hypotonic infants, Infants with Cleft Palate, Breastfeeding the Late Preterm Infant, How to Create a Breastfeeding-Friendly Office
- [www.wellstart.org](http://www.wellstart.org)
- Lactation Management Self-Study Modules (case based)
- [www.aap.org/breastfeeding](http://www.aap.org/breastfeeding)
- [www.breastfeedingtraining.org](http://www.breastfeedingtraining.org)
- [www.babyfriendlyusa.org](http://www.babyfriendlyusa.org)
- [www.surgeongeneral.gov/topics/breastfeeding](http://www.surgeongeneral.gov/topics/breastfeeding)
- Surgeon general’s call to action to support breastfeeding, 2011



## **Nutrition, Case #6**

Written by Debra Best, M.D.

A healthy two-month-old infant is seen in your office for a routine visit. The mother asks about the need for vitamin and fluoride supplementation in her child. Discuss which supplements should be considered and at what age.

### **Review of Important Concepts:**

### **Learning Objectives for the Students**

- Know when fluoride supplementation should be introduced.
- Understand the recommendations for vitamin D supplementation in breastfed versus formula fed infants.
- Describe the recommendations for iron supplementation in breastfed versus formula fed infants.

### **Clinical Reasoning**

1. When would you recommend fluoride supplementation?
  - a. Fluoride supplementation is not indicated until after the eruption of primary teeth, which usually occurs at about 6 months of age. At that time, the pediatrician evaluates the need for fluoride supplementation based upon the child's risk of dental caries and total fluoride exposure. Risk factors for early childhood caries include:
    - Ethnicity, minority or low socioeconomic status
    - Bottle propping
    - Parents with less than a high school education
    - Limited or no dental insurance or access to dental care
    - Inadequate fluoride exposure (well water, etc)
    - Caries in a parent or sibling (especially in the past 12 months)
    - Children with special health care conditions
    - Low birth weight (less than 2500 grams)
    - Gingivitis
    - Chronic conditions that weaken enamel, promote gingivitis, or cause decreased saliva production
    - Poor nutritional/feeding habits
    - Poor oral hygiene
    - Total fluoride exposure is assessed by asking the family about their water source. City water is fortified with fluoride. Well water may or may not have fluoride present, so the water must be tested to determine the amount of fluoride. Even if a family has well water at home, all sources of water intake for the child should be discussed (ie grandparent's water supply, daycare, etc) as they child may be getting appropriate fluoride away from the home.
    - Generally, bottled water does NOT contain fluoride. It can be difficult to discern from bottled water versus bottled water with fluoride geared towards infants. It may be sold as "fluoridated nursery water". It is important to educate parents about the differences in bottled water.

2. Why is vitamin D recommended as a supplement?
  - a. Adequate Vitamin D intake is necessary for the prevention of rickets, a disorder which can lead to softening and weakening of the bones. Vitamin D can be obtained through dietary supplementation and through direct cutaneous synthesis from exposure to sunlight. However, because of the risk of skin cancer, the AAP recommends sunscreen for infants older than 6 months and limited sun exposure for all which leads to reduced cutaneous vitamin D synthesis. In addition, breastmilk does not contain sufficient amounts of vitamin D.
  - b. What are the AAP recommendations for vitamin D supplementation in exclusively or partially breastfeeding infants versus formula feeding infants?
    - Breast fed Infants  
For exclusively breastfed or partially breastfed infants: Breastmilk is not typically sufficient in vitamin D. Because of this, parents are encouraged to give their breastfed babies a vitamin D supplement which contains at least 400 IU of vitamin D3. Typically the vitamin is started once breastfeeding is fully established.  
If an infant is ingesting less than 30 ounces of formula per day, they should also be given a supplement with 400 IU vitamin D3.
    - Formula fed infants  
For formula fed infants: All formulas sold in the United States have at least 400 IU/L of vitamin D3. Because most formula-fed infants ingest nearly 1 L (approximately 30 ounces) of formula per day after the first month of life, they will achieve an adequate vitamin D intake each day.  
Supplementation should be continued until the infant is taking 1L per day of infant formula or is weaned after 12 months to vitamin D fortified whole milk.
3. Why is iron recommended as a supplement?
  - a. Iron deficiency may result in cognitive and behavioral problems, some of which may be irreversible. Eighty percent of an infant's iron stores are obtained maternally during the third trimester. Infants born prematurely or to mothers with a history of diabetes, hypertension or anemia may have lower than normal iron stores. Full term infants typically have enough iron stores until 4 to 6 months of age.
  - b. When and how should iron be introduced?
    - The recommendation for iron supplementation in exclusively breastfed infants is controversial. Breastmilk remains the ideal nutrition for infants for the first 6 months of life. In addition, iron in breastmilk is more bioavailable than that in iron-fortified formula. Because of this, most exclusively breastfed babies do not need any additional nutrient or iron supplementation until 6 months of age. By 6 months, infants should be introduced to iron fortified foods (cereal or meat) or an iron containing multivitamin. They should receive 1mg/kg per day of supplemental iron. If the infant was premature or born to a mother with a history of diabetes, hypertension or anemia, they may need supplementation by 4 months.
    - In partially breastfed infants who receive more than one-half of their daily feedings as breastmilk, they should also receive 1 mg/kg per day of supplemental iron if they are not receiving iron-containing complementary foods.
    - For formula-fed infants, their iron needs can be met by their formula which contains about 12 mg of iron per liter and the introduction of iron-containing complementary foods at 4 to 6 months of age.
    - Whole milk should not be introduced before 12 months of age.

- Complementary foods that are a good source of iron include iron-fortified single grains cereals (such as rice, oatmeal, barley) and pureed meats.

**Suggestions for Learning Activities:**

- Students can role play giving anticipatory guidance about this topic.
- Students can be asked to go to local pharmacy or retail baby supply store to look at different options of supplements that parents have to choose from.
- Students can be given scenarios after discussion to determine what supplements infants should be given.
- 4 month old infant solely breastfed (vitamin D)
- 7 month old infant in Hawaii on well water, breastfed, with solids of homemade fruits (Vitamin D, Fe, Fluoride).

**Other Resources:**

- <http://brightfutures.aap.org/>
- American Academy of Pediatrics, Section on Breastfeeding. "Breastfeeding and the use of human milk". Pediatrics. 2005; 115(2):496-506.
- Baker RD, et.al. American Academy of Pediatrics, Committee on Nutrition. "Diagnosis and Prevention of Iron Deficiency and Iron Deficiency Anemia in Infants and Children." Pediatrics. 2010; 126(5):1040-1050.
- Lewis CW, Milgrom P. Fluoride. Pediatr Rev. 2003; 24(10):327-336.
- Rozier, et. al. "Evidence-Based Clinical Recommendations on the Prescription of Dietary Fluoride Supplements for Caries Prevention." The Journal of the American Dental Association. 2010;141(12) 1480-1489.
- Wagner, et. al. American Academy of Pediatrics, Section on Breastfeeding and Committee on Nutrition. "Prevention of Rickets and Vitamin D Deficiency in Infants, Children, and Adolescents" Pediatrics. 2008; 122:1142-1152.

## **Nutrition, Case #7**

Written by Angela Beeler, M.D.

A five-year-old boy is now at the 95th percentile for weight and 50th percentile for height whereas previously he had been at the 50th percentile for both height and weight. How would you counsel him and his family? Include the consequences of childhood obesity in your discussion.

### **Definition for Specific Terms:**

**Body Mass Index**- A person's body weight divided by the square of the person's height (weight in kg / height in meters<sup>2</sup>). Used as a proxy for measurement of adiposity.

**Obesity**- In children is defined as a BMI >95th percentile for age and gender.

**Overweight**- In children is defined as BMI between the 85th and 95th % for age and gender.

**Striae**- Areas of linear skin thinning and erythema associated with rapid skin stretching.

**Non-alcoholic fatty liver disease**- Deposition of fat into the liver and elevation of liver enzymes, generally associated with being overweight. Typically benign but can lead to hepatic fibrosis and cirrhosis.

### **Review of Important Concepts:**

#### **Historical Points**

- Children should be their thinnest from about 4-6 years of age as they tend to gain more height than weight during this time. It is normal for a child to look skinny and for parents to be able to count ribs in this age group. Many parents feel that their normal child is too thin or fail to recognize that their "normal" looking child is actually obese.
- Do the parents have any concerns about the child's weight? Many parents may have noticed the child's increasing waist but not length of pants. Families with parental obesity may show more concern about weight gain, or conversely may be more likely to try to normalize the excess weight.
- Dietary history should assess food choices at meals and snacks, fluid types and amounts, and portion sizes.
- Consider asking about: excess thirst/urination as a screen for Type 2 diabetes, night breathing difficulties as a screen for obstructive sleep apnea, limp as a screen for slipped capital femoral epiphysis, and signs and symptoms of depression.
- Ask about activity and screen time.

#### **Physical Exam Findings**

1. In children it is critical to graph height, weight and BMI to determine if the child is growing appropriately. Knowing the trend on the growth chart is more important than knowing the actual numbers. It is frequently difficult to identify a child who is overweight or mildly obese just by looking at the child.

2. Blood pressure should be measured and compared to norms for height percentiles.
3. Look for skin striae, acanthosis nigricans, hepatomegally.

### **Clinical Reasoning**

1. What diseases can cause excess weight gain in children?
  - a. Hypothyroidism, Cushing's Disease and Prader Willi syndrome can all cause excess weight – but will also cause decreased linear growth.
  - b. In a child whose development is otherwise normal and linear growth is not delayed, it is unnecessary to screen for causes of obesity other than excess caloric intake.
2. Will this child “thin out” and lose the “baby fat”?

Starting at about age 3 years there is a positive correlation between childhood obesity and adult obesity – meaning if you are overweight at 3 or older you are likely to be overweight as an adult. The older you become, the stronger the correlation.
3. What are the health consequences of childhood obesity?
  - a. Obese children are more likely to suffer from depression and other mood disorders, have obstructive sleep apnea, develop insulin resistance or even Type 2 diabetes in childhood, and have non-alcoholic fatty liver disease.
  - b. Obese patients can also have elevated LDL levels and the early stages of atherosclerosis which can persist into adulthood even if no longer obese as an adult.
4. What screening bloodwork might you do?

None would be recommended in this child. Children over 10 years old, consider fasting lipids, glucose and liver enzymes.
5. What is the best way to treat obesity in children?

Obesity in children, as with adults, is a complex and difficult condition to treat and should be considered a chronic condition. We can manage side effects but obtaining long term stable weight loss is difficult. The most effective programs engage the entire family in behavior change by having family meals, healthier food choices in the home, engaging in physical activity together and monitoring more frequently than once a year.
6. How much weight should this child lose?
  - a. In children who are obese but still growing taller, the goal would be decreased weight velocity or weight maintenance to help them “grow into” their weight.
  - b. If the child was significantly overweight or had complications, then gradual weight loss would be recommended.
  - c. Adolescents who are no longer gaining height can work on gradual weight loss, up to 2 pounds per week if they are experiencing complications from their obesity.

### **Diagnosis:**

Obesity:

- a. Given the percentiles above, the child would have a weight of 53 pounds (24 kg), height of 43 inches (109 cm), and a BMI of 19.8 kg/m<sup>2</sup>. This places him greater than the 97th % on the CDC BMI charts for boys.
- b. Given that he has maintained his linear growth at the 50th % it is unlikely that he has some other disease process causing his weight gain.

**Suggestions for Learning Activities:**

- Review how to plot height/weight on a growth chart and interpret the results. Review how to calculate BMI and graph that as well. Demonstrate the use of BMI “wheels”, as well as, smart phone/internet apps.
- Practice taking a dietary history from a parent. What is a normal portion size for a 5 year old?
- Review the medical complications of obesity that can be seen in children and how they persist or progress in adulthood.
- Discuss any state or local initiatives related to childhood obesity in your area (school lunch changes, limits on sugary beverages/snacks in schools, etc).
- Review some simple tools for giving anticipatory guidance related to maintaining a healthy weight. For example 5-2-1-0: Each day get 5 servings of fruits and vegetables, 2 or fewer hours of screen time, 1 or more hours of physical activity, 0 servings of sugary beverages.

**Other Resources:**

- Expert Committee Recommendations on the Assessment, Prevention and
- Treatment of Child and Adolescent Overweight and Obesity – 2007: An Implementation Guide from the Childhood Obesity Action Network
- <http://www.nichq.org/documents/coan-papers-and-publications/COANImplementationGuide62607FINAL.pdf>
- Maine Center for Health “Keep Me Healthy” 5-2-1-0 Program: [Keep ME Healthy](#)
- CDC BMI calculators: [Healthy Weight: Assessing Your Weight: Body Mass Index \(BMI\) |](#)

## **Nutrition, Case #9**

Written by Angela Beeler, M.D.

The health conscious parents of a healthy, non-obese 15-month-old ask if they can switch her to nonfat milk, as they are concerned about obesity and heart disease. How would you counsel them?

### **Definitions for Specific Terms:**

**Full fat dairy-** Dairy products which have not had fat removed from them during processing. Whole milk is a full fat dairy product and is 4% fat.

**Non-fat dairy-** Dairy product with the natural fat removed, or “skimmed.” Skim milk is non-fat.

**Reduced fat milk-** Milk with only 2% fat

**Low fat milk-** Milk with only 1% fat

### **Review of Important Concepts:**

1. The second year of life is one of rapid physical and neurologic growth needing myelination of brain cells, requiring relatively large amounts of calories per kg of body weight compared to adults.
2. Full fat dairy allows toddlers to get more calories in smaller volumes, important as they can be scattered and low volume eaters.
3. Dairy fat restriction could be considered for a child who is overweight or has a very strong family history of obesity as these would be risk factors for hyperlipidemia later in life.

### **Historical Points**

- Ask the parents to elaborate on their concerns and review family history for significant obesity, heart disease or hyperlipidemia. Are there health consequences that the parents have seen which scare them?
- Take a thorough dietary history to evaluate for eating patterns and content. Toddlers can have “food jags” either of quantity or content
  - They will eat very small amounts of food for a time then eat large amounts, or eat one food excessively for a while then refuse to eat it.
  - Some will start to refuse certain food groups on a regular basis.
- Review developmental milestones
  - Toddlers become ambulatory and begin to burn more calories through activity (but less through growth) than in the first year.

### **Physical Exam Findings**

1. Important to review the growth charts (weight, height, and head circumference) and which percentiles the child is following. She is not currently obese but has she been having rapid weight gain compared to length?

2. Basic neurologic exam looking for any developmental delay that might impact caloric needs. Children who are less active due to hypotonia or delayed gross motor skills may have lower caloric needs.

### Clinical Reasoning

1. What are the caloric needs of a healthy toddler compared to those of an adult?  
An average weight 15 month old (10.6kg) requires about 870 calories per day, which is 82 kcal per kg. If a 70 kg adult ate 82 kcal/kg per day they would take in 5740 calories. So a toddler needs to take in relatively much more energy in a smaller stomach.
2. What is the nutritional difference between non-fat and whole milk? How does this affect a toddler's diet?  
Whole milk contains 4% milk fat and is 150 calories per 8oz. Non-fat milk is 85.5 calories per 8oz. Toddlers are recommended to get at least 16oz of milk per day – whole fat milk provides them over 100 extra calories, or more than 10% of their caloric needs for the day. Whole milk does have 5gm saturated fat per cup compared to 0.5gm in non-fat milk. In young children, obesity rather than dietary composition alone seems to be a stronger risk factor for atherosclerotic changes at a young age.
3. When should you check lipid levels on this child if the parents are worried about heart disease?
  - a. There are no recommendations to routinely check children less than 2 years of age.
  - b. If there was a strong family history of a genetically mediated hyperlipidemia syndrome with premature death then it might be reasonable to check a child this young.
  - c. In general, obese children should be checked as they enter puberty.
  - d. There is some evidence that lipid levels can be volatile and a single elevated number may not consistently remain elevated in an untreated child as it would in an adult.

### Diagnosis:

Non-obese, healthy 15 month old.

Child should remain on whole fat dairy until 2 years of age to support caloric needs for growth and development.

### Suggestions for Learning Activities:

- How might your counseling change if the toddler was at the 90th % for weight and 10th % for length? What if both parents were morbidly obese? Discuss that full fat dairy is not a hard and fast rule and there are times when it is reasonable to have a toddler on low fat dairy.
- Review growth charts for children 0-36 months showing that while growth slows compared to the first year of life it is still occurring at a much faster rate than later in childhood.
- Review gross motor milestones and activity level of toddlers.
- Review clinical reasoning questions above.
- Discuss dietary sources of fat: when it is recommended that 12-23 month old children not have a fat restricted diet that does not mean they should eat foods with lots of added fat (fried foods for example) but rather eat foods where natural fats have not been removed?



**Other Resources:**

- Pediatric Nutrition Handbook, American Academy of Pediatrics (Chapter 32 reviews issues of dietary fat in toddlers)
- [Factors affecting the stability of blood lipid and lipoprotein levels from youth to adulthood: evidence from the Childhood Determinants of Adult Health Study.](#) Archives of Pediatrics & Adolescent Medicine. 165(1):68-76, 2011 Jan.

## PEDIATRIC EMERGENCIES

### Pediatric Emergencies, Case #1

Written by Becky Latch, M.D.

A three-year-old child presents to the Emergency Department with acute onset of stridor and tachypnea. Discuss your approach to this patient including important aspects of the history and physical exam, the differential diagnosis and management principles.

#### **Definitions for Specific Terms:**

**Stridor**- What is stridor? Stridor is a short, medium- to high-pitched sound heard during inspiration that is consistent with upper airway obstruction.

Describe the physiologic causes of stridor. Narrowing of the upper airway space causes resistance to airflow through the airway. Negative pressure during inspiration leads to further narrowing of that space with partial obstruction, leading to inspiratory stridor.

**Tachypnea**- What is a normal respiratory rate for a 3yo? (24-40 bpm)

How does respiratory rate vary with age? Respiratory rate is generally higher in infants and gradually decreases until adolescence.

#### **Review of Important Concepts:**

#### **Historical Points**

- Acute onset: The differential diagnosis varies between patients with acute onset of respiratory distress and a more gradual onset. The history of an acute onset of distress leads one to think about one precipitating event, such as aspiration of a foreign body or exposure to an allergen leading to anaphylaxis and respiratory distress. More gradual onset and other associated symptoms such as fever or rhinorrhea leads one to put infectious causes such as croup, epiglottitis or bacterial tracheitis higher on your differential diagnosis.
- Events immediately preceding onset of symptoms: Asking about preceding symptoms or events is very important in these patients. In addition, the age of the patient may change your differential. Crawling infants and toddlers notoriously put items such as toys or buttons in their mouths, but they're unable to relate that history back to their parents or doctors. Older siblings may increase a patient's risk for foreign body aspiration or ingestion by "feeding" their younger siblings small toys or other items. It is also important to ask about any known allergies.
- Other associated symptoms: Associated symptoms such as fever, rhinorrhea and sick contacts may help you narrow your differential. If the patient has urticaria, you may move allergic reaction/anaphylaxis higher on your differential.
- Immunization status: Underimmunized patients with stridor, fever and a toxic-appearance may have epiglottitis secondary to *Haemophilus influenza* type B.

## Physical Exam Findings

1. Primary Survey:  
ABC: Airway, Breathing, Circulation
2. Evaluation of degree of respiratory distress.
  - a. Tachypnea, subcostal and intercostal retractions, nasal flaring, head-bobbing, tripodding, cyanosis, and altered mental status are all signs of respiratory distress.
  - b. Cyanosis and altered mental status are late findings and immediate intervention is needed.
3. Adjuncts to physical exam.
  - a. Pulse oximetry can be an important adjunct to your physical exam. A normal pulse oximetry reading is greater than 95%. Patients may be significantly hypoxemic before appearing cyanotic; therefore, an accurate pulse oximetry reading in addition to visual inspection can be helpful during assessments of patients with respiratory distress.
  - b. Stridor vs. Wheezing: It is important to differentiate stridor from wheezing on physical exam, as stridor is typically associated with upper respiratory tract obstruction and wheezing is associated with lower respiratory tract obstruction. Stridor is a medium- to high-pitched noise heard mostly on inspiration. It can typically be heard both with and without a stethoscope. Wheezing is a noise heard over the lung fields on expiration and usually requires a stethoscope to auscultate.

## Clinical Reasoning

1. Generate a differential diagnosis for stridor and tachypnea in a three-year-old.
  - a. Foreign body aspiration
  - b. Anaphylaxis
  - c. Croup
  - d. Epiglottitis
  - e. Bacterial tracheitis
  - f. Retropharyngeal abscess
2. Given the information above, what is the most likely diagnosis and why? What would you expect to see or hear on physical exam?

Given the acute onset, age of the child and lack of other symptoms, foreign body aspiration with partial upper airway obstruction is most likely. Partial obstruction in the upper airway will result in inspiratory stridor, whereas lower airway obstruction will cause wheezing and/or diminished breath sounds on the side with the foreign body. Foreign bodies are most often found in the right mainstem bronchus.
3. What would be your initial approach to this patient?
  - a. ABC: airway, breathing, circulation.
  - b. Supplemental oxygen may be helpful.
  - c. Leaving the patient in a position where he is most comfortable (in mom's arms) may alleviate some respiratory distress until you can offer further management.
  - d. Airway and/or chest radiographs may help you identify or locate the foreign body.
4. What is the management of a patient with a foreign body aspiration?

Patients with a foreign body in their airway require rigid bronchoscopy to remove them.

5. How can you differentiate between a foreign body aspiration and an infectious cause of stridor?
  - a. Infectious causes of stridor include croup and epiglottitis. These patients typically have other signs and symptoms of infection as well.
    - Epiglottitis is a serious infection that can cause rapid deterioration and airway occlusion, it is a medical emergency. These patients usually have a high fever and are toxic-appearing.
    - Croup is caused by a viral infection and patients may have some fever or upper respiratory symptoms in addition to the stridor.
    - Both of these infections have a more gradual onset.
  - b. On chest auscultation of a patient with foreign body aspiration, you will likely hear diminished breath sounds on the side with the foreign body.

**Suggestions for Learning Activities:**

- Ask the student to develop a differential diagnosis and list supporting findings for each diagnosis.
- Review chest and lateral neck radiographs of patients with croup, epiglottitis, retropharyngeal abscess, foreign body aspiration and foreign body ingestion.
- Review appropriate anticipatory guidance for toddlers, specifically discussing injury prevention.
- Develop a simulated patient scenario with a high-fidelity mannequin for students to work through this case, including emergency care and recognizing the diagnosis and ultimate management.

**Other Resources:**

- Louie M, Bradin S. Foreign body ingestion and aspiration. *Pediatr. Rev.*, Aug 2009; 30: 295 - 301.
- Audio clip of stridor. <http://www.rale.ca/Stridor.htm>
- Audio clips of wheezing.
- [http://www.rale.ca/Wheezing\\_a.htm](http://www.rale.ca/Wheezing_a.htm)
- [http://www.rale.ca/Wheezing\\_b.htm](http://www.rale.ca/Wheezing_b.htm)
- [http://www.rale.ca/Wheezing\\_c.htm](http://www.rale.ca/Wheezing_c.htm)

## **Pediatric Emergencies, Case #2**

Written by Becky Latch, M.D.

A four-month-old baby presents to the Emergency Department with a fever of 104°F and petechiae. How would you evaluate and manage this patient?

### **Definitions for Specific Terms:**

**Petechiae**- Tiny 1-2 mm red or purple non-blanching flat lesions caused by hemorrhage of small blood vessels.

### **Review of Important Concepts:**

#### **Historical Points**

- Significance of petechiae: Patients with invasive bacterial disease frequently develop petechiae and/or purpura (larger non-blanching lesions caused by hemorrhages of blood vessels). Patients may progress to have fulminant disseminated intravascular coagulation (DIC). Approximately 8 to 20% of patients with fever and petechiae have a serious bacterial illness, requiring thorough evaluation and prompt management.
- Onset and associated symptoms (What other questions should you ask during the history?)
  - How long has this patient been sick? Rapid onset of symptoms should prompt more concern for bacterial process. A slower onset is more likely with some viral illnesses, such as parvovirus.
  - What other symptoms has the patient experienced? Forceful vomiting or coughing can result in a petechial rash localized to the face, shoulders and upper extremities.
  - What has the patient's mental status been like? Infants who are lethargic are much more concerning than those who demonstrate a normal mental status. It is important to differentiate between sleepy or listless children and those who are truly lethargic. Patients who are lethargic are difficult to arouse on exam and may not respond to normal stimuli. For example, lethargic infants may not cry with noxious stimuli such as IV placement or catheterization. In addition, it is helpful to differentiate between infants who are fussy, but consolable and those who are truly inconsolable. Inconsolable infants are more concerning and one should maintain a high index of suspicion for occult injury or illness.
- Exposure history: As with any patient with an infectious disease, it is important to take a thorough social history, specifically exploring any possible exposures. A detailed knowledge of such things as sick contacts, travel history or certain exposures could significantly alter your differential diagnosis.
- Immunization status: What immunizations should a four month-old have received that would protect her from meningitis? Both *S. pneumococcus* and *H. influenza* type B can cause meningitis in infants. At four months of age, she should have received two doses of both the conjugate pneumococcal vaccine and the *H. flu* vaccine. The conjugate pneumococcal vaccine previously covered the 7 most common pneumococcal serotypes that cause invasive disease. As we have protected patients from those 7 serotypes, we have seen an increased incidence of severe disease from several other serotypes, leading to the recent release of a new 13-valent conjugate pneumococcal vaccine. Other common causes of bacterial meningitis in children include *N.*

meningitidis, *Staphylococcus aureus*, *Haemophilus influenzae*, and in neonatal patients, group B streptococcus, *Escherichia coli*, and *Listeria monocytogenes*.

- Family History: Obtaining a detailed family history of bleeding or clotting disorders could be important in this patient with petechiae. In addition, family history of immune deficiencies could raise your index of suspicion for something similar in this patient

## Physical Exam Findings

### 1. Vital Signs:

- a. Recognizing tachycardia as an early sign of shock is imperative in pediatric patients. Infants and children are able to increase their cardiac output by increasing their heart rate, so may easily have a heart rate in the 200 range when in shock.
- b. When they are no longer able to compensate with elevated heart rate, their blood pressure will fall. Hypotension is a very late symptom and prompt, aggressive fluid resuscitation before this point will lead to the best outcome for the patient.

### 2. Perfusion:

Along with vital signs, assessing perfusion is very important. This can be done by measuring capillary refill and assessing pulses, both centrally and distally.

### 3. Mental Status:

- a. Altered mental status can also be a late sign of shock in pediatric patients. The mental status of an infant or toddler can be quickly assessed using the AVPU (Alert, responds to Voice, responds to Pain, Unresponsive) scale.
- b. Infants who are unresponsive or who only respond to pain are much more concerning than those who are fully alert.
- c. Altered mental status is a sign of poor cerebral perfusion.

### 4. Fontanelle:

Infants with bacterial meningitis may have a bulging or full fontanelle.

### 5. Skin/Rash:

A detailed evaluation of the rash is important in this patient. As mentioned before, petechiae located over the upper body in a non-toxic-appearing child with history of forceful vomiting or coughing is less worrisome than generalized petechiae in a toxic-appearing child. In addition, petechiae can rapidly progress to purpura and areas of poor-perfusion and necrosis in septic patients. Recognizing these signs as early as possible is important.

## Clinical Reasoning

### 1. What would be your initial management of this patient?

Rapid assessment and management of this patient is very important. Initial management should include placing the patient on a monitor, on oxygen if needed, and obtaining intravenous access. Rapid fluid resuscitation using isotonic fluid, is essential with any signs of shock. In addition, broad-spectrum antibiotics should not be delayed.

2. What are most common causes of invasive bacterial disease in this age range? What antibiotics would you start empirically?
  - a. Streptococcus pneumoniae and Neisseria meningitidis are the most common, Haemophilus influenzae in unimmunized patients, Staphylococcus aureus, group A streptococcus and gram negative bacilli are all less common causes.
  - b. Antibiotic choice should cover gram negative and gram positive bacteria. A third generation cephalosporin such as cefotaxime or ceftriaxone will cover Neisseria, haemophilus and some strains of pneumococcus. Adding vancomycin will broaden coverage to include resistant pneumococcus and staphylococcus aureus.
3. What are some other causes of petechiae in patients this age?

Viral illnesses, thrombocytopenia of various causes including HUS and ITP, leukemia, aplastic anemia, tick-borne illnesses and trauma.

### Suggestions for Learning Activities:

- Ask the students to generate a differential diagnosis using only the case prompt, then work through the case keeping that differential in mind. Using that method, you may cover the illness scripts for bacterial meningitis, certain viral illnesses, thrombocytopenia, new onset leukemia and tick-borne diseases such as ehrlichia and Rocky Mountain spotted fever.
- What would the cerebral spinal fluid gram stain results be for patients with meningitis caused by each of the following pathogens?
  - Neisseria meningitidis (gram negative diplococci)
  - Streptococcus pneumoniae (gram positive cocci in chains)
  - Haemophilus influenzae (gram negative coccobacillus)
  - Staphylococcus aureus (gram positive cocci in clusters)
  - Enterovirus (negative)
- Ask the student to list signs of shock. Sort these signs into the uncompensated vs. compensated categories.
- Use a high-fidelity simulator to review the management steps of this patient with the students. If a simulator is not available, simply discussing what your management plan and reviewing the sequence of your orders with the students could be helpful.
- Discuss indications for antibiotic prophylaxis and need for isolation in patients with each of the illnesses on your differential diagnosis.

### Other Resources:

- AAP Red Book; 2009 Report of the Committee on Infectious Disease.
- American Society of Hematology Image Bank: <http://imagebank.hematology.org/> Search for “petechiae,” “purpura,” or “thrombocytopenia,” for images to demonstrate terms above.

### **Pediatric Emergency, Case #3**

Written by Noa Cohen, M.D.

A three-year-old boy presents to the Emergency Department with worsening cough, wheezing and shortness of breath. He has difficulty talking in the Emergency Department. How would you manage this child?

#### **Definition for Specific Terms:**

**Asthma**- A chronic disorder of the airways that is complex and characterized by variable and recurring symptoms, airflow obstruction, bronchial hyperresponsiveness, and an underlying inflammation.

**Bronchiolitis**- An inflammation of the bronchioles usually caused by a lower respiratory tract infection, most commonly due to RSV. It may also be defined as the first episode of wheezing in a child younger than 12 to 24 months who has physical findings of a viral respiratory infection and has no other explanation for the wheezing.

**Wheeze**- A musical and continuous sound produced by the forceful movement of air through a narrowed airway.

**Hypoxia**- Body/tissue deprivation of adequate oxygen supply

**Hypoxemia**- Oxygen concentration within the arterial blood is abnormally low  
Respiratory distress: characterized by signs of increased work of breathing, such as stridor, wheeze, tachypnea, use of accessory muscles, and/or retractions

#### **Review of Important Concepts:**

##### **Historical Points**

- How would you determine the etiology of wheezing?
- The key to managing this patient correctly will come from a thorough history and physical examination.
- Features in the history that favors asthma diagnosis: Wheezing  
Plus a history of any of the following:
  - Cough, worse particularly at night
  - Recurrent wheeze
  - Recurrent difficulty in breathing
  - Recurrent chest tightness
- Symptoms occur or worsen in the presence of:
  - Exercise
  - Viral infection
  - Changes in weather
  - Animals with fur or hair, House-dust mites, Mold, Pollen
  - Smoke, Airborne chemicals or dusts
  - Strong emotional expression (laughing or crying hard)



- Symptoms occur or worsen at night, awakening the patient
- History of Eczema or hay fever
- Family history of asthma or atopic diseases
- Good response to asthma medications
- Features in history that suggests a diagnosis other than asthma:
  - Poor response to asthma medications
  - History of a congenital abnormality
  - Wheezing associated with feeding or vomiting more consistent with GERD or aspiration complication
  - History of choking or sudden onset of wheezing suggests foreign body aspiration, even if it does not immediately precede onset of wheezing symptoms
- Bronchiolitis:
  - Prodromal phase: few days of upper respiratory tract infection symptoms as nasal congestion and/or discharge, mild cough and low grade fever
  - Progressive phase: over 3-7 days; symptoms of lower respiratory tract infection; worsening cough, noisy- raspy breathing and audible wheeze.

### Physical Examination Findings:

1. Asthma:
 

Findings of physical exam depend on severity of the asthma attack; mild, moderate, or severe, and include:

  - a. Tachypnea,
  - b. Tachycardia,
  - c. Wheeze either inspiratory, expiratory or both,
  - d. Retractions,
  - e. Diminished air entry,
  - f. Agitation,
  - g. Inability to speak,
  - h. Tripod sitting position,
  - i. Paleness,
  - j. Cyanosis,
  - k. Pulsus paradoxus (decrease in blood pressure with inspiration >15 mm Hg)
2. Bronchiolitis:
  - a. Inspection: Tachypnea, intercostal and subcostal retractions, grunting, and nasal flaring.
  - b. Auscultation: Prolonged expiratory phase, expiratory wheezing and inspiratory crackles.
  - c. Percussion: Hyperresonance of the chest.

### Clinical Reasoning

1. How would you evaluate respiratory status?
 

Different clinical scoring systems exist to evaluate the severity of the respiratory distress and detect an impending or existing respiratory failure based on the signs and symptoms of airway obstruction, use of accessory respiratory muscles, oxygenation, and cerebral function. “Wood’s Scoring System” is the most commonly used in clinical practice, as shown in the following table:

## Wood's Scoring System

Variables	0	1	2
PaO <sub>2</sub> (mm Hg) OR O <sub>2</sub> Saturation (%)	70-100 on RA OR ≥ 91% on RA	< 70 on RA OR < 91% on RA	< 70 on 40% FiO <sub>2</sub> OR < 91% on 40% FiO <sub>2</sub>
Cyanosis	None	In Room Air	In 40% FiO <sub>2</sub>
Inspiratory Breath Sounds	Normal	Unequal	Decreased to Absent
Accessory Muscles Used	None	Moderate	Maximal
Expiratory Wheezing	None	Moderate	Marked
Cerebral Function	Normal	Depressed or Agitated	Coma

2. Features of impending respiratory failure include:
  - a. Respiratory distress score of five or greater
  - b. Hypercapnia with a Pco<sub>2</sub> greater than 40 mm Hg in the presence of dyspnea and wheezing
  - c. Metabolic acidosis
  - d. ECG abnormalities
3. How would you manage this child?
  - a. Assess Respiratory Distress Score and assign a severity level (follow a clinical Pathway when available).
  - b. Chest x-ray: is warranted in this patient, especially for a first time episode of wheezing, to rule out other etiology. A chest x-ray reading of generalized hyperinflation suggests diffuse air trapping and airway disease. Localized findings may suggest structural abnormalities or foreign body aspiration.
  - c. Spirometry: objective measurements of pulmonary function help establish the diagnosis and treatment of asthma. Bedside peak flow measures can be done in the emergency department in children five years and older.
  - d. Blood gas analysis: is usually unnecessary in the emergency room setting.
4. Asthma management:
  - a. First Line medications for acute asthma attack are:
    - Oxygen supplement: usually delivered to the patient by nasal cannula or a mask to keep the oxygen saturation >92%
    - Nebulized/inhaled Bronchodilators: Beta2-Adrenergic Agonists (Albuterol or Levalbuterol), or Anticholinergic (Ipratropium Bromide)
    - Bronchodilators can be given individually or in combination, and as single doses or as continuous nebulization depending on the severity of the respiratory distress
    - Systemic Corticosteroids: Prednisolone, Methylprednisolone, or Dexamethasone
    - A first loading dose of steroids can be given orally, intravenously, or intramuscularly
  - b. Second line medications are:
    - Intravenous Bronchodilators; such as Terbutaline
    - Magnesium Sulfate, can be used as airway smooth muscle relaxant
    - The patient should be assessed and re-evaluated with every intervention to determine the level of improvement, response, or deterioration.

5. Bronchiolitis management:
  - a. Supportive Therapy: respiratory monitoring, control of fever, good hydration, upper airway suctioning, and oxygen administration.
  - b. Bronchodilators; such as Albuterol and Racemic Epinephrine can be tried, if there is improvement, then it can be repeated as needed.
  - c. The use of 3% hypertonic saline nebulizer and/or systemic corticosteroids treatment is controversial.
6. Does this patient need to be hospitalized?
  - a. The determination of hospitalization will be made by the severity of respiratory distress and the response to interventions. Indications for hospitalization include:
    - Age < 6 months old
    - Moderate to severe respiratory distress
    - Hypoxemia ( $P_{aO_2} < 60$  mm Hg)
    - Oxygen Saturation <92% on room air
    - Apnea
    - Inability to tolerate oral feeding
    - Lack of appropriate care at home
  - b. Patients who have the following clinical signs and therapeutic requirements that suggest respiratory failure require admission to the ICU:
    - Impending or existing respiratory failure as assessed by an asthma score of five or greater
    - Intravenous bronchodilator infusion
    - Respiratory or cardiac arrest
    - Mechanical ventilation

### Suggestions for Learning Activities:

- Review specific emergency asthma medications.
- Review signs and symptoms of respiratory distress.

### Other Resources:

- Fakhoury, Khoulood. "Approach to Wheezing in Children." In: UpToDate, Basow, DS (Ed), UpToDate, Waltham, MA, 2011.
- Hill, V.L., Wood P.R. "Asthma Epidemiology, Pathophysiology and Initial Evaluation." *Pediatr. Rev.* 2009; 30; 331-336.
- Murphy, S.J., Kelly, H.W. "Advances in the Management of Acute Asthma in Children." *Pediatr. Rev.* 1996; 17; 227-234.
- Wagner, Tamara. "Bronchiolitis." *Pediatr. Rev.* 2009; 30; 386-395.
- Wood DW, Downes JJ, Locks HI. A clinical score for the diagnosis of respiratory failure. *Amer J Dis Child* 1972; 123: 227-9
- National Heart, Lung, and Blood Institute. National Asthma Education Program Expert Panel Report 3 (EPR-3). Guidelines for the Diagnosis and Management of Asthma. Bethesda, MD: National Institutes of Health; 2007. NIH Publication No. 08-58461
- Marcadante KJ. Bronchiolitis. *Nelson Essentials of Pediatrics*. 6th Ed (2011), Chapter 109, pp 397-398
- Marcadante KJ. Asthma. *Nelson Essentials of Pediatrics*. 6th Ed (2011), Chapter 78, pp 311-321

- 5 Sahhar SH. Status Asthmaticus Management Guidelines. Spartanburg Regional Children's Health. Copyright 2012
- 6 Light MJ et al. Pediatric Pulmonology. Policy of the American Academy of Pediatrics. 1st Ed. 2011

## **Pediatric Emergencies, Case #4**

Written by Rebecca Kidd, M.D.

A previously healthy fourteen-month old presents to the Emergency Department following a 2-3 minutes of generalized, symmetric tonic-clonic movements. There is no prior history of seizures.

Discuss your approach for the following scenarios:

- The child was sleepy initially but is now awake, alert and easily consoled by her parents. Her temperature is 104 F. Her examination is normal.
- The child remains somnolent and appears to have nuchal rigidity.

### **Definition for Specific Terms:**

**Tonic-clonic movements**- Classic seizure activity. The tonic phase is sustained contraction in flexion or extension which is interrupted by periods of clonic activity (rhythmic contractions of extremities and trunk).

**Febrile seizure**- A seizure that occurs between the age of 6 and 60 months with a temperature of 38°C or higher, that are not the result of central nervous system infection or any metabolic imbalance, and that occurs in the absence of a history of prior afebrile seizures. Febrile seizures occur in 2-5% of neurologically healthy infants and children, recur in 30% of those experiencing a first episode, and in 50% after 2 or more episodes.

### **Review of Important Concepts:**

#### **Historical Points**

- History of present illness – It is important to ask the informant details about how the child was acting prior to the event. Also information should be gathered about oral intake, urine output, energy level and other indicators of possible intercurrent illness.
- Developmental history – has this child met milestones appropriately or does this child have a history concerning for an established central nervous system abnormality?
- Immunization history – Because of the concern for meningitis in a child with fever and seizure, it is important to obtain a clear immunization history. A lumbar puncture may be indicated in a patient 6-12 months old whose immunization status is either unknown or deficient.
- Family history – Children with family history of febrile seizures are at an increased risk of having a febrile seizure.

#### **Physical Exam Findings**

1. Signs of meningitis on PE:
  - a. Nuchal rigidity: Pain and resistance upon flexion of neck.
  - b. Kernig sign: flexion of the leg at the hip with subsequent pain on knee extension.
  - c. Brudzinski sign: involuntary leg flexion on passive neck flexion.
  - d. Note: Markers of meningeal irritation are not consistently present in those younger than 12-18 months of age.

2. Level of consciousness: The initial assessment of a patient should include a rapid assessment of their level of consciousness. If the patient's level of consciousness is decreased or other vital signs are non-reassuring, initial assessment for focus on the ABCs (airway, breathing, and circulation) prior to further examination.
3. Sources of infection: A thorough physical exam must be done to look for source of infection, i.e. acute otitis media, pneumonia.

### **Clinical Reasoning**

1. What are the classic symptoms of meningitis? Classic symptoms include nausea, vomiting, headache, lethargy and stiff neck. However symptoms can also present as mental status or behavior changes, seizure and focal neurologic signs.
2. What differentiates a simple vs. complex febrile seizure?
  - a. Simple: primary generalized seizure, usually tonic-clonic, that lasts for less than 15 minutes and does not recur within 24 hours.
  - b. Complex: focal, prolonged, and/or recurs within 24 hours
3. What would be your next step and how would it differ with these two patients?
  - a. The patient in scenario "A" most likely had a simple febrile seizure unless the seizure lasted longer than 15 minutes or recurred within 24 hours. It would be important to counsel parents to watch for recurrence of seizure activity prior to discharge from the Emergency Department. In general, a simple febrile seizure does not need further evaluation (i.e. neuroimaging or EEG) other than thorough evaluation for source of fever. However if there is any doubt of the source of fever, and the possibility of meningitis exists, a lumbar puncture is indicated.
  - b. For scenario "B", this case is much more concerning for meningitis and further management will be guided by the initial results of your work-up. Initially this patient should be placed on a monitor and have intravenous access established. It will be important to obtain a peripheral blood culture and, once the patient is deemed stable enough, a lumbar puncture should be completed to evaluate for meningitis.
4. Who needs to be admitted to the hospital?

Any child with a febrile seizure needs to be watched in the emergency room for several hours. If the cause of fever is identified and treated appropriately and the child has returned to baseline, as in scenario "A", the child may be discharged home. However, if child is still unstable and if there is any concern for meningitis, the child should be hospitalized.
5. Topics to counsel parents on:

Parents need to be counseled on fever management, including how to take their child's temperature and correct dosing of antipyretics. Because approximately 30-50% of children have recurrent seizures with later episodes of fever, it is important to stress correct and rapid management of fever to parents.

### **Suggestions for Learning Activities:**

- Discuss causes of meningitis in this age patient
- Discuss CSF results for bacterial vs. viral meningitis

- Practice giving advice to parents on fever management, including doses of acetaminophen and ibuprofen. Practice writing prescriptions for both.
- Review and demonstrate the Kernig and Brudzinski signs

**Other Resources:**

- AAP Clinical Practice Guideline -- Febrile Seizure
- Pediatrics in Review, Febrile Seizures
- Febrile Seizures Fact Sheet  
[http://www.ninds.nih.gov/disorders/febrile\\_seizures/detail\\_febrile\\_seizures.htm](http://www.ninds.nih.gov/disorders/febrile_seizures/detail_febrile_seizures.htm)

## **Pediatric Emergencies, Case #5**

Written by Branson Bolden, M.D.

A four-year-old boy presents with brief loss of consciousness and vomiting after falling off a six-foot high slide. How would you evaluate him and what are your concerns?

### **Review of Important Concepts:**

#### **Historical Points**

- **Epidemiology:** Head injury is a leading cause of morbidity and mortality in children. In the U.S., there are more than 1.5 million head injuries annually and approximately 300,000 pediatric hospitalizations. Males are twice as likely as females to sustain head injuries. Motor vehicle accidents are the most common cause of head injury in children, followed by falls. Most children sustaining a blunt head impact have minor traumatic brain injury, resulting in a brief change in mental status or consciousness (1).
- **Informant:** With any childhood injury presenting for medical evaluation, it is important to obtain a reliable history from a first-hand observer. Depending on age, developmental level and degree of injury, the patient may or may not be able to help provide this information. In nonambulatory patients, you must always consider nonaccidental trauma (child abuse) as the etiology of a traumatic event.
- **History of Present Illness/Event:** In obtaining the history of a child presenting from a fall, it is important to gain a good understanding of the events surrounding the incident. Time of injury, mechanism of injury, height of fall, ground/surface composition, bodily area of impact/injury, loss of consciousness and mental status are a few factors to consider.
- **Review of Systems:** A thorough neurologic and musculoskeletal review should be performed. Things to consider include behavioral changes, headache, vomiting, lethargy, confusion, coordination/gait disturbances, swelling, bleeding, bruising, and skeletal deformities to name a few.
- **Past Medical History/Previous Episodes:** Knowledge of a child's past medical history and underlying medical condition(s) is imperative in appropriately evaluating and treating a patient presenting from a fall. Considerations should include developmental level, risk of bleeding complication (e.g. hemophilia), underlying neurologic conditions (e.g. hydrocephalus status post ventriculoperitoneal shunt placement) and other risks of injury complication.

#### **Physical Exam Findings**

1. Modified Pediatric Glasgow Coma Scale (GCS) is used to assess neurologic status in children.
  - a. GCS 15 (highest score) = normal neurologic status
  - b. GCS <9 = consider intubation to protect airway
  - c. GCS 3 (lowest score) = no neurologic response
  - d. Minor head trauma - GCS 13-15
  - e. Moderate head trauma - GCS 9-12
  - f. Severe head trauma - GCS 3-8 (1)

**Table 3. Modified Pediatric Glasgow Coma Scale\***

#### **Eye Opening**

- 4 Spontaneously
- 3 To voice
- 2 To pain
- 1 No response

#### **Motor Response**

- 6 Obeys
- 5 Localizes pain
- 4 Flexion withdrawal
- 3 Flexion abnormal (decorticate posturing)
- 2 Extension (decerebrate posturing)
- 1 No response

#### **Verbal Response**

- 5 Appropriate words, spontaneous cooing
- 4 Inappropriate words
- 3 Cries
- 2 Incomprehensible sounds, grunts
- 1 No response

\*The Glasgow Coma Scale score is the sum of the best scores obtained from each column.  
Data from American College of Emergency Physicians and American Academy of Pediatrics. *Advanced Pediatric Life Support-The Pediatric Emergency Medicine Course*. 1998.



2. Cranium exam for abrasion, laceration, hematoma, fracture, skull depression
  - a. Signs of basilar skull fracture:
    - ‘Raccoon eyes’ – periorbital ecchymoses
    - Battle sign – posterior auricular ecchymoses
    - Hemotympanum – presence of blood in the middle ear
    - CSF rhinorrhea or otorrhea
  - b. Neurologic exam:
    - Sensorium
    - Pupil size and reactivity
    - Gross visual exam
    - Fundoscopic exam
    - Cranial nerves
    - Strength
    - Sensory
    - Reflexes
    - Gait
3. Bodily or extremity trauma could include:
  - a. Bruising,
  - b. Abrasion,
  - c. Laceration,
  - d. Extremity deformity

### Clinical Reasoning

How would you manage a patient with minor, moderate, or severe head trauma?

1. Minor head trauma (GCS 13-15): May be associated with loss of consciousness (<1min), seizure immediately following injury, headache, vomiting, lethargy or other neurologic symptoms.  
 Recommendations for CT scan in children <2 yrs and >2 yrs (2)  
 CT recommended: <2 years of age  
 GCS <15  
 Signs of AMS (agitation, somnolence, repetitive questioning, slow response to verbal communication)
  - a. Palpable skull fracture
    - CT recommended: >2 years of age
    - GCS <15
    - Signs of AMS (as above)
  - b. Basilar skull fracture
    - CT or observation: <2 years of age
    - Occipital/parietal/temporal scalp hematoma
    - LOC >5 seconds
  - c. Severe mechanism of injury (MVA with death or ejection of passenger or rollover, fall > 3ft, head struck by high impact object, pedestrian or bicyclist without helmet struck by a motor vehicle)
  - d. Not acting normally according to parent/guardian
    - CT or observation: >2 years of age

- LOC >5 seconds
  - e. Severe mechanism of injury (as above, with exception - fall > 5ft)
    - History of vomiting
    - Severe headache
  - f. Note: “CT should be more strongly considered for children with multiple findings, worsening symptoms or signs, and for infants younger than 3 months. Clinician experience and parental preference should also be taken into account in CT decision making for this intermediate-risk group.” A child in the minor head trauma category, presenting without any of the above CT recommendations and a normal physical/neurologic exam likely requires no further immediate evaluation. He/she should be observed 4-6 hours for evidence of neurologic deterioration. This may be done in a physician’s clinic or at home after appropriate instruction is given to caretakers regarding reasons for return.
2. Moderate (GCS 9-12) / Severe head trauma (GCS 3-8):
- a. Initial resuscitation should focus on attention to the ABC’s (airway, breathing, circulation) of emergency medicine. Patients with cardiopulmonary arrest, hypoventilation, apnea, GCS <9 or other severe injury causing respiratory compromise should be intubated and placed on mechanical ventilation. Initial efforts should focus on minimizing secondary brain injury. Maintenance of adequate oxygenation and hemodynamics are vitally important.
  - b. After initial resuscitation and stabilization, all patients with moderate or severe head injury should receive a CT scan of the head. Significant epidural or subdural hemorrhage may require emergent evacuation to prevent further injury.
  - c. Note: It is imperative that the clinician consider the possibility of a spinal cord injury in all patients with significant head injury. Spinal cord immobilization should be performed pending spine evaluation (3).
  - d. Special Considerations: Nonaccidental trauma must be suspected if the clinical presentation does not coincide with the history of injury. In this situation, a thorough evaluation should be performed and a report submitted to authorities of concern for child maltreatment.
3. Diagnoses to consider in fall injuries:
- a. Concussion:
    - Caused by traumatic forces applied directly or transmitted to the head
    - Generally associated with self-limited minor impairment of mental status without focal neurologic deficits
    - No evidence of intracranial injury on CT or MRI scan
    - An estimated 25% of patients suffering minor head trauma develop a concussion
  - b. Skull Fracture:
    - Linear
      - Most require no specific intervention; exception is frontal bone fractures if frontal sinus is involved
      - Exclude nonaccidental trauma
    - Depressed
      - Significant depressions may be associated with contusions or lacerations of brain parenchyma
    - Basilar
      - Fracture through the skull base

- Increased risk of infection if CSF otorrhea or rhinorrhea on exam
- May be associated with facial nerve or carotid artery injury
- c. Intracranial hemorrhage:
  - Epidural hemorrhage
    - Caused by tears of the meningeal arteries or veins
    - Often associated with temporal bone fracture
    - Convex shape of hematoma on imaging
  - Subdural hemorrhage
    - Caused by tears of the parasagittal bridging veins
    - Commonly sustained from motor vehicle collisions, child abuse, and falls from significant heights
    - Often associated with skull fractures and other intracranial lesions
    - Concave/crescent shape of hematoma on imaging
  - Subarachnoid hemorrhage
    - Caused by tears of small cerebral vessels
    - Often associated with high impact injury or significant shear forces
    - Blood seen layering along sulci and fissures, or filling cisterns on imaging
- d. Cerebral contusion:
  - General bruising of cortical brain matter
  - Often caused by blunt head trauma
  - May be accompanied by cerebral edema and elevated intracranial pressure
  - Frequently associated with intracranial hematomas or skull fractures
- e. Diffuse axonal injury:
  - Caused by rapid acceleration/deceleration injuries of the head
  - Injury causes widespread shearing injury of the cerebral white matter
  - Suspected in patients with diffuse subarachnoid bleeding and cerebral edema

### **Suggestions for Learning Activities:**

- Practice giving anticipatory guidance to parents regarding injury prevention (e.g. falls, bicycle helmets, car seats, etc.)
- Practice assigning a GCS score to patients presenting with varied clinical presentations.
- Review CT scan finding of intracranial hemorrhage and determine epidural/subdural/subarachnoid location and associated injuries.

### **Other Resources:**

- AAP: Pediatrics in Review. Pediatric Head Injury. 2007; 28; 215-224.
- Kuppermann, N., Holmes, J.F., Dayan, P.S., Hoyle, J.D., Atabaki, S.M. and et al. (2009). Identification of children at very low risk of clinically-important brain injuries after head trauma: a prospective cohort study. *Lancet*, 374, 1160-1170.
- AAP: Pediatrics in Review. Head Injury. 2001; 22; 118-124.
- UpToDate: Schutzman, S. Minor head trauma in infants and children. Nov. 2010.
- Additional Resource - CDC – Playground Injuries: Fact Sheet.  
<http://www.cdc.gov/HomeandRecreationalSafety/Playground-injuries>

## **Pediatric Emergencies, Case #6**

Written by Branson Bolden, M.D.

The mother of an eighteen-month old calls to say her child has pulled hot tea off the stove and splattered it across his face and chest. How would you counsel her?

### **Review of Important Concepts:**

#### **Historical Points**

- Epidemiology: More than 120,000 children annually receive care in emergency departments for burn injuries. Scald burns account for 60-80% of burn injuries for children <5 years of age. For children, 6 months to 2 years of age, spillage of hot liquids such as coffee, tea or other item is the most common scenario for scald burns.
- Older children are more likely to receive burn injuries from fire. Inhalational injuries of children involved in fires contribute significantly to morbidity and mortality.
- Burn injuries are the 3rd leading cause of accidental death among children in the U.S.
- History of Present Illness/Event: It is important to obtain an adequate history of the events leading to and involving the burn injury. Source and situation of burn injury - scald, fire, chemical, electrical, etc - is important to determine. Time of event, length of exposure, risk of inhalation and other potential injuries should also be elucidated.

#### **Physical Exam Findings**

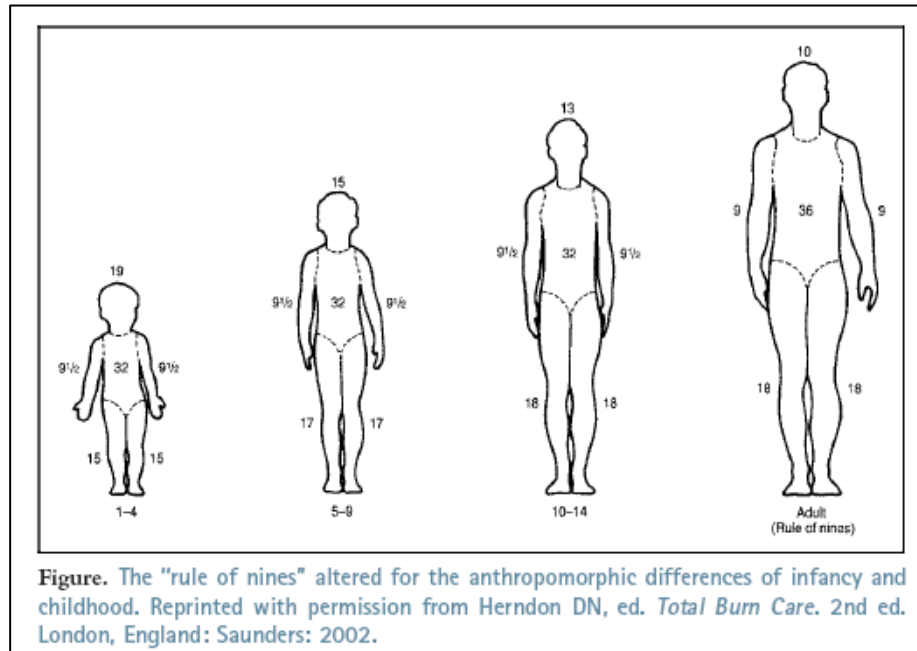
Important in the evaluation of burn injuries is determination of depth and percentage of body surface involved.

1. Burn depth classification and characteristics:
  - a. 1st degree (involving only epidermis)
  - b. 2nd degree (involves epidermis and into the dermis)
  - c. 3rd degree (destruction of entire dermis)



TABLE. General Characteristics of Burn Wounds		
TYPE OF BURN	PHYSICAL CHARACTERISTICS	SUBJECTIVE FINDINGS
First-degree	<ul style="list-style-type: none"> <li>• Red</li> <li>• Dry</li> <li>• No epidermal sloughing or blisters</li> <li>• Blanches with pressure</li> <li>• Sensate</li> </ul>	<ul style="list-style-type: none"> <li>• Painful</li> </ul>
Second-degree (partial-thickness)	<ul style="list-style-type: none"> <li>• Epidermal sloughing or blisters</li> <li>• Pink-pale pink</li> <li>• Moist</li> <li>• Sensate</li> <li>• Blanches with pressure</li> </ul>	<ul style="list-style-type: none"> <li>• Painful</li> </ul>
Third-degree (full-thickness)	<ul style="list-style-type: none"> <li>• White/mottled/charred</li> <li>• Dry</li> <li>• May be firm/leathery</li> <li>• Insensate</li> <li>• No blanching</li> </ul>	<ul style="list-style-type: none"> <li>• Relatively nonpainful</li> </ul>

2. Calculating total body surface area (TBSA) percentage of burn:
  - a. 'Rule of nines' – most accurate for adults; child's head is relatively large and legs relatively smaller; see Figure below
  - b. Palm of patient's hand (including area of digits) roughly equals 1% of burn
  - c. Areas of 1st degree burn are not included in TBSA of burn



### Clinical Reasoning

1. What is to be considered first in your initial resuscitation of a burn patient?  
Initial resuscitation should focus attention to the ABC's (Airway, Breathing, Circulation) of emergency medicine.
  - A. Airway – look for soot in or around patient's mouth or nose, facial burn, other burns to signify possible inhalation injury. Patients may or may not have stridor, hoarseness, drooling or difficulty swallowing. Patients with airway involvement should be intubated early to secure a patent airway prior to compromise from edematous swelling.
  - B. Breathing - toxins potentially associated with burns, e.g. cyanide and carbon monoxide, may cause a decrease in level of consciousness and interfere with oxygenation and/or ventilation.
  - C. Circulation – may be compromised by associated injuries or a condition called burn shock.
2. How would you fluid resuscitate a burn patient?
  - a. Parkland Formula:
    - Used to calculate fluids for the 1st 24 hours following a burn injury.
    - 4ml/kg per %TBSA. Add maintenance fluids for children <5 yrs old.
    - Give ½ of total fluids in the first 8 hours; remaining ½ over the next 16 hours.
    - Lactated Ringers is the fluid of choice at most burn centers.

3. What burn patients do you admit to the hospital?
  - a. Patients with superficial burns of <10% TBSA can usually be treated on an outpatient basis.
  - b. Exceptions include concern for child abuse, unreliable caregivers, parental concern or additional injuries necessitating hospitalization.
4. What special considerations need to be considered?

Non-accidental injury must be suspected if the clinical presentation does not coincide with the history of injury. It is estimated that 10-30% of burns in young children are associated with child abuse. In this situation, a report to authorities of concern for child maltreatment must be made and a thorough evaluation performed.

#### **Suggestions for Learning Activities:**

- Practice calculating TBSA percentage of burn by marking a burn on a human model or sketching.
- Practice calculating the initial 24 hour fluid resuscitation of a child with:
  - 20% TBSA involvement of a 2 year old.
  - 50% TBSA involvement of a 7 year old.
  - 75% TBSA involvement of a 13 year old.

Note: 24hr maintenance fluids calculation – 100ml/kg initial 10kg; 50ml/kg next 10kg; 20ml/kg thereafter.

#### **Other Resources:**

- UpToDate: Joffe, M.D. Emergency care of moderate and severe thermal burns in children. Jan 2011.
- Pediatrics in Review. Klein, G.L. & Herndon, D.N. Burns. 2004; 25; 411-417.
- Pediatrics in Review. Hansbrough, J.F. & Hansbrough W. Pediatric Burns. 1999; 20; 117-124.

## **Pediatric Emergencies, Case #7**

Written by Matt Neal, M.D.

A four-year-old girl is brought to the Emergency Department following the acute onset of cough, increased work of breathing and tachypnea while at a friend's birthday party. What is your differential diagnosis? How would you evaluate and manage this patient?

### **Definition for Specific Terms:**

**Tachypnea**- The general trend in pediatrics for normal respiratory rates is that as age increases, respiratory rates decrease. Newborns have higher respiratory rates and these rates decrease as one ages. Adolescents have respiratory rates close to adult ranges. The four year old in question should have a resting respiratory rate of between 20-30 bpm

**Increased work of breathing**- Increased work of breathing occurs when children are in respiratory distress. There is a large continuum of respiratory distress. Signs of increased work of breathing include nasal flaring, head bobbing, retractions, tracheal tugging, tripod positioning.

### **Review of Important Concepts:**

#### **Historical Points**

- Has the patient ever experienced similar symptoms?
- Does the patient have any known allergies?
- Is there a history of reactive airway disease?
- Were symptoms preceded by the choking spell?
- Did any witnesses see the patient with objects that could be a choking hazard?
- Are there any associated symptoms? e.g. fever, upper respiratory symptoms, sick contacts, etc.

#### **Physical Exam Findings**

1. General:
  - a. Presence and degree of respiratory distress
  - b. Is the patient able to speak/cough?
  - c. Is the patient well appearing or anxious?
  - d. Is there any altered mental status?
2. Respiratory:
  - a. Look for tachypnea, subcostal or intercostal retractions, nasal flaring, head bobbing, tracheal tug.
  - b. Observe how freely the patient is able to speak. It is more worrisome if the patient is only able to speak in 1-2 word phrases.
  - c. Listen for inspiratory vs expiratory timing. Asthma exacerbations will have prolonged expiratory phase
  - d. Listen for generalized wheezing as seen in asthma or focal monophasic wheezing as heard in foreign body aspiration
  - e. Listen for even air movements in all lung fields. Focally decreased air entry in this patient is likely to represent foreign body aspiration

3. HEENT:

Is there evidence of upper respiratory tract infection that could be contributing to a potential asthma exacerbation?

4. Skin:

- a. Is there peripheral or central cyanosis?
- b. Is there an urticarial rash that could suggest an allergic reaction?
- c. Is swelling of the face or extremities present?

### Clinical Reasoning

1. What is the differential in this patient?

- a. Given the information above, three things must be considered:
  - Exacerbation of reactive airway disease
  - Foreign body aspiration (FBA)
  - An allergic reaction
- b. Given the age of the child and if we assume that she hasn't displayed a history of reactive airway disease before, FBA and allergic reaction become most likely. If there are no systemic symptoms such as edema or urticaria, FBA becomes the most likely diagnosis in this 4 year old patient.

2. FBA is a common cause of mortality in children less than 5 years old. Death by suffocation following FBA is the fifth most common cause of unintentional injury mortality in the U.S. Peak incidence is between 1-2 years old. Toy balloons are the most common cause of fatal FBA, with balls, peanuts, marbles, and pieces of toys being commonly involved.

3. Presentation typically depends on the degree of airway obstruction.

- a. Patients with true respiratory distress, cyanosis, and altered mental status require life support and rigid bronchoscopy to remove the obstruction.
- b. More commonly however, patients have cough, generalized wheezing, tachypnea or focal findings like monophasic wheezing or decreased air entry. A history of choking has a sensitivity of 76-92% for FBA.
- c. The most common area for FBA is right mainstem bronchus. Chest x-rays can be helpful if the foreign body is radioopaque, but the diagnosis of FBA should not be discounted based on normal chest x-rays as many objects, particularly foods, may be radiolucent. Definitive treatment for FBA is rigid bronchoscopy.

4. If the child in this presentation had also had physical exam findings of urticarial rash, swelling of the hands or face, itchiness, sense of choking an allergic reaction to a food at the party, what would be the most likely etiology? IgE food mediated allergic reaction can lead to anaphylaxis. In the U.S., peanuts and tree nuts are responsible for most food induced anaphylaxis, followed by shellfish. Treatment always begins with assessment of airway, breathing and circulation and should be followed with epinephrine, H1 and H2 blockers, B2 agonists and glucocorticoids.

5. If the child in question had a known history of reactive airway disease, would an exacerbation be more likely?

- a. Factors that can lead to a reactive airway disease exacerbation include:



- Seasonal allergies
  - Upper respiratory tract infection
  - Cold exposure, exercise
  - Increased pollutant/smoke exposure
- b. Evaluation must begin with patient's level of respiratory distress. A root cause of the exacerbation should be sought, but the patient's respiratory distress must be treated first. Treatment involves inhaled Beta 2 agonists and ipratropium, systemic glucocorticoids and when necessary, supplemental oxygen.

**Diagnosis:**

Allergic reaction vs. Foreign body aspiration vs. Reactive Airway exacerbation

**Suggestions for Learning Activities:**

- Develop a list from history and physical exam findings that would support and detract from each of the above differential diagnosis
- Review chest x-rays in patients with asthma vs. patients with FBA, specifically looking for areas of hyperlucency in the ipsilaterally affected lung of a patient with known FBA
- Review appropriate anticipatory guidance for young children regarding FBA prevention
- Familiarize oneself with epinephrine injection devices and their proper use

**Other Resources:**

- Wells et. al. Arch Dis Child. 2005 Nov 90 (11) 1117-1121. Age related reference ranges of respiratory rate and heart rate in ages 4-16 years old.
- Airway foreign bodies in children. Ruiz et. al. Uptodate. Jan, 2011
- Anaphylaxis: Rapid recognition and treatment. Simmons et al. Uptodate Jan, 2011

## **Pediatric Emergencies, Case #8**

Written by Quang-Tuyen Nguyen, M.D.

During a routine health care visit a fifteen year old girl with a history of depression confides to you that she would like to end her life. What should you do?

### **Definition of Specific Terms:**

**Depressive episode-** DSM criteria, primarily applicable for adults – and currently requires 5/9 symptoms (depressed mood, decreased interest/pleasure, weight changes, insomnia or hypersomnia, psychomotor agitation or retardation, fatigue or energy loss, worthlessness or guilt, inability to concentrate or think, recurrent thoughts about death). Diagnosis by the DSM varies however, as it gets revised regularly.

**Gestures-** Cutting, ingestion of extra pills, episodes of self-inflicted harm. These must be taken seriously because the child/adolescent may have believed that the “gesture” could have caused death.

**Cluster-** Three or more suicides in the same community with temporal relationship to one another.

**Suicide-** Is the 3rd leading cause of death in US among ages 10-24 years of age. Among girls, the most common method is by hanging. Among boys, it is the use of firearms.

### **Review of Important Concepts:**

#### **Historical Points**

- Adolescent social and psychiatric history: can have a range of mild depressed mood to all the way to pervasive depression with decreased function and suicidality. The prevalence of depression will go up from 1-2% prepubertal to 3-8% among adolescents. Girls are especially at 3:1 risk for unipolar disease and early onset of puberty increases this risk. Assessment is particularly challenged by normal developmental changes during adolescence which includes: intense moodiness, impulsivity, and erratic behavior. Adolescents also undergo a number of different stresses as they approach adulthood: developmental stress (identity crisis, boundaries, accepting limitations, planning for the future), body changes and self-image, peer pressure (group acceptance, dating, romantic involvement, peer competition), school pressure (academics, need to succeed, parental expectations), family pressure (expectations, parental impairment, marital conflict/divorce, financial or job related crisis), societal influences (romanticizing of violence and suicide), and adolescent depression (physiologic vulnerability, situational stress, sexual identity)
- Symptoms can be sadness, irritability, anger, school or behavior problems, somatic complaints (headache, stomachache, and muscle weakness), appetite changes, sleep changes, fatigue, self-injurious behavior, suicide ideation with plan and intent. Psychosis can also happen.
- Risk factors: early puberty, abuse/neglect by parents, parental substance abuse, parental marital problems, parental depression (or being emotionally unavailable), low socioeconomic status or education level, loss of parent/sibling/friend, stress related to development, early puberty, issues of sexuality (especially homosexuality). Genetic factors include parental depression. Other risk factors: certain medications (steroids, immunosuppressive agents, isotretinoin, antivirals),

chronic illnesses (diabetes, seizure disorder, cystic fibrosis, IBD, sickle cell anemia, organ transplant, cancer).

- Risk factors for suicide: mood disorder, substance abuse, loss of a loved one, family discord, social isolation, family history of suicidal behavior, previous attempt, and availability of firearms.
- History from the patient, but also must obtain history from the parent, teachers, and coaches, as well.
- Intention versus plan

### Physical Exam Findings

1. Check for organic or iatrogenic causes for mood changes including thyroid nodules or goiter, nystagmus, proptosis, fingernail bed changes, track marks, and cutting or other self immolation.
2. Check also for signs of somatic changes i.e. weight change, unruly or unkempt appearance, signs of poor sleep such as circles under the eyes, and slow movements.
3. Mental status examination  
Standardized tests available: CDI (Children's Depression Inventory), Beck Depression Inventory (BDI), Reynolds Adolescent Depression Scale, Mood and Feelings Questionnaire

### Clinical Reasoning

1. What would be the medical workup?  
Consider testing for thyroid dysfunction, urine toxicology, lupus, inflammatory disorders, and chronic illnesses.
2. What co-morbidities or other psychiatric diagnoses should you consider?
  - a. Adjustment disorders
  - b. Anxiety can also be present and predate depression symptoms
  - c. Attention deficit hyperactivity disorder, substance abuse
  - d. Behavioral problems from oppositional defiance to conduct disorder should all be considered
3. Should you disclose information with the guardians in life threatening situations?  
Patient confidentiality is not maintained in these situations and the appropriate guardians must be informed. "No suicide contracts," have not been shown to be protective. Clinical evidence does not show that questioning or interviewing patients about risk behaviors with regards to suicide or suicidal intentions, predisposes the patient to carrying out harmful acts.
4. What are treatment options for mild depression?
  - a. Supportive counseling
  - b. Problem solving discussions
  - c. Education of family members
5. What are treatment options for moderate/severe depression?
  - a. Medication
  - b. Interpersonal therapies
  - c. Cognitive behavioral therapies

6. When should you consider a psychiatry referral or use of the 24 hour hotline?

Children who fail to respond within 6-8 weeks of treatment, have severe mood disorders, impairment in psychosocial functioning, have coexisting substance abuse, psychosis, suicidal ideation, plan, or intent should be referred to a child psychiatrist or mental health specialist. Those who are actively suicidal, homicidal, or psychotic should be institutionalized.

**Differential Diagnosis:**

1. Bullying
2. Learning disabilities
3. Drug use
4. Home environment or abuse
5. Home or school stressors
6. Depression
7. Bipolar disorder
8. Other mood NOS
9. Chronic illness
10. Thyroid dysfunction
11. Look at co-morbidities above

**Suggestions for Learning Activities:**

- Discussion of different kinds of pharmacologic agents. Fluoxetine is the most commonly used agent and best studied at this time, also the only agent to be approved by the FDA though other medications are used: bupropion, duloxetine, venlafaxine, mirtazapine.
- Act out role playing with sensitive questions so that students can get used to asking sensitive questions to teenagers.

**Other Resources:**

- Prager, L. Pediatrics in Review Vol. 30 No. 6 June 1, 2009 pp. 199 -206
- Fleisher, Ludwig. Textbook of pediatric emergency medicine. Lippincott Williams and Wilkins. 2010 pp. 1710-1716

## POISONING

### Poisoning, Case #2

Written by David Eldridge, M.D.

A two year-old child is found in the bathroom with an open bottle of liquid drain cleaner. She has a small area of bleeding on her lips. What is the most serious toxicity of this ingestion/exposure?

#### Definitions for Specific Terms:

**Liquid drain cleaner**- What is “liquid drain cleaner? It is a strongly alkaline solution that typically contains sodium hydroxide. Exposure to this, and other caustic solutions, can lead to burns and necrosis of tissue.

**Caustic**- A broad, descriptive category that includes a variety of substances that can cause inflammatory or ulcerative tissue damage – including acids, alkali, and other corrosive agents.

#### Review of Important Concepts:

#### Historical Points

- What is the exact identity of chemical involved (composition of active ingredients)?
- Amount taken?
- How long ago did the ingestion occur (timeline)?
- Symptoms that may be concerning?
  - Refusal to drink
  - Drooling
  - Abdominal pain
  - Vomiting
  - Stridor or respiratory distress

#### Physical Exam Findings

1. Assess airway, breathing, and circulation (ABC's) with particular attention to airway as stridor may indicate laryngeal edema secondary to caustic injury and pending airway compromise.
2. Check for dermal or ocular burns.
3. Check for erythema or ulceration of the lips, mouth, and oropharynx
4. Palpate for abdominal tenderness

#### Clinical Reasoning

1. What is the role of gastrointestinal decontamination in this patient?

Methods used to either adsorb or remove toxins from the stomach are generally contraindicated in caustic ingestions. The risk of emesis and further damage to the esophagus and airway is a concern. Gastric lavage specifically carries with it the risk of perforation with these ingestions. Activated charcoal does not bind these chemicals well and can obscure endoscopic evaluation when performed to assess the extent of caustic damage.

2. Should you attempt to neutralize ingested acids/base ingested with the opposite (e.g. administering a weak base to neutralize a strongly acidic ingestion)?  
Though this technique has been advocated by some in the past, most agree that this is not helpful as caustic tissue injury occurs immediately after contact. Also, such a mixture may produce significant heat and produce further damage.
3. Would giving the child water to drink in an attempt to dilute the liquid drain cleaner be helpful?  
Diluting a caustic chemical with water is also advocated by some, but it is controversial. Immediate dilution will theoretically reduce the contact that gastrointestinal tissue will have with a concentrated caustic substance. However, given that caustic injury occurs so quickly after contact, the clinical benefit is unclear. Furthermore, drinking water at this point may induce vomiting and subsequent reinjury with repeat contact with the caustic substance.
4. What signs and symptoms might indicate significant gastrointestinal injury?
  - a. Children that present with refusal to eat or drink, pain with swallowing, drooling, abdominal pain, and vomiting may all indicate significant caustic injury.
  - b. Visible mouth and oropharyngeal burns on physical exam suggest that other esophageal and gastric injuries have occurred. However, significant gastrointestinal injury has been reported in the absence of visible mouth or oropharyngeal injury.
5. What symptoms might indicate airway injury?  
Stridor and respiratory distress in this patient could indicate pending airway loss subsequent to laryngeal edema. Endotracheal intubation may be indicated.
6. What complications may occur after this type of ingestion?
  - a. Severe esophageal and gastric burns are a concern after these ingestions.
  - b. Subsequent perforation may also occur.
  - c. Depending on the initial extent of these injuries, patients may also suffer from strictures after the initial injuries resolve.
7. Is there a role for steroids to prevent the complications from this ingestion?  
The use of steroids in the management of caustic ingestions remains controversial. Steroids have been examined as a therapy to decrease inflammation in an attempt to prevent subsequent stricture formation. Studies have shown mixed success with this therapy. If steroids are utilized in this setting, subsequent infection is a concern and concurrent use of antibiotics is generally recommended.
8. What further diagnostic evaluation should be considered in these types of ingestions?  
When strongly acidic or alkaline chemicals are ingested, or a patient's symptoms suggest significant gastrointestinal injury, endoscopic evaluation is needed to assess the esophagus and stomach. This assessment can be helpful in planning future management and anticipating the risk of stricture development in the future.

**Suggestions for Learning Activities:**

- Provide the students with the case scenario and ask them the questions under the clinical reasoning section.
- This case provides an opportunity to discuss the assistance that the Poison Control Center can provide in the management of these patients.
- This case provides an opportunity to discuss the importance of prevention. Students can be asked to identify other common caustic chemicals that are typically found in the home, which age groups that are at risk for these accidental exposures, and common failures of childproofing (e.g. storing chemicals in inappropriate containers). Household bleach (sodium hypochlorite) is one such chemical that, in contrast to liquid drain cleaner, rarely leads to serious injury. Subsequently, students could be asked to discuss the anticipatory guidance that could be provided to parents to prevent these exposures.

**Other Resources:**

- Pediatric Toxicology: Diagnosis and Management of the Poisoned Child, Erickson, TB, et al. (Eds.), Chapter 48. Acids and Alkali.

## **Poisoning, Case #3**

Written by David Eldridge, M.D.

A two-year-old boy is brought to the Emergency Department in a coma after his mother found him limp and unresponsive in his room. What questions would you want to ask the mother to help learn why this patient might be unresponsive?

### **Definitions for Specific Terms:**

**Coma** - What is a coma? A coma refers to a state of severely depressed mental status. Clinically the patient is unarousable and demonstrates an inability to respond (e.g. eye opening, speak, purposeful movement) to a variety of stimuli (e.g. verbal commands, questions, and painful stimuli).

### **Review of Important Concepts:**

#### **Historical Points**

- Was her son behaving normally before she found him unconscious?
- How long was her son unobserved and unconscious (i.e. the timeline)?
- Was the child breathing when his mother found him? Cyanosis?
- Had the child vomited?
- What medications are available in the household (complete inventory of every family member's medications)?
- Did the child have access to other substances in the household (e.g. ethanol)?
- Are any other members of the household affected (e.g. carbon monoxide).

#### **Physical Exam Findings**

1. Assess airway, breathing, and circulation (ABC's).  
Auscultate the lungs - paying particular attention for crackles or decreased air entry.
2. Examine skin for breakdown and pressure necrosis that may have formed during prolonged immobility.
3. Check pupil size and reactivity to light.
4. Careful neurologic exam to assess for any neurologic deficits and severity of patient's coma (e.g. Glasgow Coma Scale).

#### **Clinical Reasoning**

1. How can pupillary size and reactivity assist in making the diagnosis of a toxin-induced coma?  
This portion of the physical exam can help narrow the spectrum of the differential diagnosis for this patient. Along with sedation, certain toxins also commonly induce a distinct change in pupillary size. Such associations include (but are not limited too):
  - a. Miosis (constricted)
    - Opioids/opiates



- Clonidine
  - Organophosphate/carbamate poisoning
  - Phenothiazines and atypical antipsychotics
- b. Mydriasis (dilated)
- Antihistamines
  - Tricyclic antidepressants
  - Anticholinergics (e.g. scopolamine and atropine)
2. Poor pupillary response to light may be concerning for increased intracranial pressure.
  3. Other physical exam findings may help identify a responsible toxin and help direct therapy. For example organophosphate poisoning may produce classic DUMBBELS findings [diarrhea, urination, miosis, bradycardia (or tachycardia), bronchorrhea/bronchoconstriction, emesis, lacrimation, and salivation.] Identifying a toxic syndrome such as this can be more immediately helpful than laboratory testing in terms of directing treatment.
  4. What are the main causes of morbidity and mortality in this case?
    - a. When a patient is comatose, apnea and subsequent hypoxic injury is a major cause of morbidity and mortality.
    - b. Pulmonary aspiration is also a concern.
    - c. For these reasons, providing supplemental oxygen along with assisted ventilation and airway protection (intubation) are therapeutic priorities for these patients.
    - d. If a patient has been immobile for a significant period of time, areas of pressure necrosis may also have begun to form, and rhabdomyolysis may become a subsequent concern.
  5. Will drug testing be helpful in making the diagnosis in this case?
    - a. Laboratory testing for poisons and substances should be focused. A urine drug screen may be helpful in this case, but these tests typically only detect some drugs of abuse. Even then, not all drugs in a category may be detected (e.g. an opioid screen may not detect methadone).
    - b. If substances are accessible according to a patient's history, specific drug levels may be helpful (e.g. phenobarbital).
    - c. Also key physical exam findings (e.g. miosis) may help narrow the differential diagnosis and guide laboratory testing, making it higher yield.

### Diagnosis:

1. What toxins can cause this clinical picture?  
The list of poisons and substances that can cause coma is extensive. Some examples include (but are not limited to):
  - a. Anticholinergics
  - b. Antihistamines
  - c. Atypical antipsychotics
  - d. Barbiturates
  - e. Benzodiazepines
  - f. Carbon monoxide
  - g. Clonidine
  - h. Ethanol
  - i. Opioids/Opiates

- j. Organophosphates/carbamates
  - k. Phenothiazines
  - l. Tricyclic antidepressants
2. Besides a toxic exposure, what other causes of coma are on the differential diagnosis for this patient? The list may be broad, but certain emergent diagnoses should be considered. Examples include:
- a. Encephalitis/meningitis
  - b. Head trauma
  - c. Epilepsy (postictal state)
  - d. Hypothermia/hyperthermia
  - e. Diabetic ketoacidosis

**Suggestions for Learning Activities:**

- Have the students obtain a Glasgow Coma Scale and then assess the patient's airway, breathing, and circulation. They can then decide on appropriate interventions (e.g. the need for intubation).
- With each item on the list of possible toxins in this case, discuss other physical exam findings that can be expected with each toxin (review toxic syndromes).
- When appropriate, review specific antidotes or other treatments that would be helpful for each of these toxins (e.g. atropine and pralidoxime for organophosphate poisoning).

**Other Resources:**

- Rudolph's Fundamentals of Pediatrics, chapter entitled Injuries & Emergencies, section entitled "Coma." Similar chapters in standard pediatric textbooks will also cover this.

## **Poisoning, Case #4**

Written by David Eldridge, M.D.

You receive a phone call from the mother of a 12 kg two year-old child who was found eating her mother's prenatal vitamins that contain iron. Each tablet contains 60 mg of elemental iron. She thinks he may have swallowed 16 tablets. What amount of elemental iron ingestion is potentially toxic for a child? What additional information do you need from the mother? What advice would you give the mother?

### **Definitions for Specific Terms:**

**Iron toxicity-** This type of poisoning typically occurs from the ingestion of iron supplements (e.g. prenatal vitamins). The amount of elemental iron ingested determines the risk that a child will develop iron toxicity. The preparation of iron involved must be considered when calculating the amount of elemental iron ingested. The amount of elemental iron, by percent weight, for some common iron preparation includes: ferrous gluconate (12%), ferrous lactate (19%), ferrous sulfate (20%), ferrous chloride (28%), and ferrous fumarate (33%).

**Toxic dose of elemental iron-** Once the amount of elemental iron potentially ingested is known, the risk of toxicity can be predicted based on the weight of the child. Children may become symptomatic at 20-40 mg/kg of elemental iron. Ingested amounts of elemental iron exceeding 40 mg/kg place a child at risk for serious toxicity. Those exceeding 60 mg/kg must be considered at risk for life-threatening toxicity. Because iron toxicity is such a potentially dangerous ingestion, it is always best to be cautious and have the child clinically evaluated immediately if the amount of iron ingested is unclear.

### **Review of Important Concepts:**

#### **Historical points**

- What kind of iron supplement was ingested?
- Amount taken (how many tablets)?
- How long ago did the ingestion occur (timeline)?
- How much does the child weigh?
- Is the child displaying concerning gastrointestinal symptoms that are the hallmark of early iron toxicity?
  - Change in mental status (e.g. lethargy or coma)
  - Vomiting
  - Diarrhea
  - Abdominal pain
  - Hematemesis
  - Hematochezia
  - Melena

## Physical Exam Findings

1. Assess airway, breathing, and circulation (ABC's) with particular attention to circulation, as shock is the most common cause of mortality from iron poisoning and can be seen early in the course of this ingestion.
2. Careful assessment of peripheral perfusion and vital signs is essential.
3. Concerning findings include:
  - a. Tachycardia
  - b. Hypotension
  - c. Pallor
  - d. Delayed capillary refill
  - e. Depressed mental status may be present with shock.
  - f. Abdominal tenderness on palpation.

## Clinical Reasoning

1. Does this child need to be referred to the emergency department?
  - a. Iron poisoning is a potential life-threatening ingestion. The decision to have a child referred for clinical evaluation can be made based on the amount ingested and the presence of symptoms. If the amount of iron ingested can be reliably determined, the total dose ingested can be helpful. Generally, if a child has potentially ingested  $>40\text{mg/kg}$ , they are at risk for severe toxicity and require medical evaluation. However, even at lower doses, a child must receive similar, emergent care if they are symptomatic (typically gastrointestinal symptoms).
  - b. If a total dose cannot be determined by this child's mother, the presence of symptoms alone justifies immediate medical evaluation.
2. What is the role of home gastrointestinal decontamination in this patient?
  - a. The use of syrup of ipecac, as means to induce emesis and attempt to evacuate pills from the stomach, is no longer recommended for gastrointestinal decontamination.
  - b. The use of activated charcoal (AC) at home has received some attention as a potential replacement of ipecac, but the evidence regarding its efficacy is unclear. However, ingested AC does not bind to iron and therefore has no role with this ingestion. If iron poisoning is a concern, referral to a medical facility is the main intervention.
3. Is there a role for gastrointestinal decontamination at a hospital?

Many will recommend the use of whole bowel irrigation (WBI) with large amounts of polyethylene glycol electrolyte solution in an attempt to flush out iron supplements from the gut. Some recommend this intervention for toxic doses of iron or if large amounts of pills are seen on an abdominal radiograph. The use of WBI should be carefully scrutinized. If a patient has an active gastrointestinal bleed or obstruction or if they are in shock, WBI is contraindicated. Discussion regarding the use of WBI with a regional poison control center may be helpful.
4. What is the antidote for iron poisoning and how does it work?

Intravenous deferoxamine chelates iron and is the antidote of choice for iron poisoning.

**Diagnosis:**

1. Will obtaining a serum iron level be helpful in the management of iron poisoning?
  - a. The diagnosis of iron poisoning and the decision to refer for medical evaluation should be based on the estimated amount of iron ingested and the presence of symptoms. An iron level obtained during the period of peak absorption (typically 2-6 hours after ingestion) is helpful. Peak levels less than 300 µg/dL are not generally associated with toxicity while levels of 500 µg/dL and above are associated with serious toxicity. Iron concentrations between these ranges may be associated with toxicity.
  - b. It is vital to interpret iron levels in the context of a patient's history, symptoms, and clinical status. Serial iron levels should be considered, especially if a timeline of the ingestion is unclear.
2. What is the role of abdominal radiography in the diagnosis of iron poisoning?
  - a. Depending on the content of elemental iron and type of preparation, some iron supplements are radiopaque. Therefore, radiography may be helpful in confirming the presence of iron supplements, and even quantifying their number, in the gastrointestinal tract.
  - b. If iron tablets are present on a radiograph, the use of WBI is more easily justified. However, the absence of visible tablets does not rule out iron poisoning as some supplements are not radiopaque or may have dissolved prior to obtaining radiography.
3. Are there any other diagnostic tests that may be helpful in making the diagnosis of iron toxicity? Leukocytosis, hyperglycemia, and a wide anion gap metabolic acidosis may all be seen with iron poisoning. However, these laboratory findings are not specific.

**Suggestions for Learning Activities:**

- Provide the students with the case scenario and ask them the questions under the clinical reasoning section.
- This case provides an opportunity to role play a phone triage situation. The instructor can discuss the challenges of gathering clinical data by phone and of make use of other sources of information (e.g. electronic medical record) in order to make decisions.
- Ask the students to calculate how many mg/kg that this child may have ingested based on the iron formulation ingested, the suspected number of pills involved, and the child's weight.

**Other Resources:**

- Pediatric Toxicology: Diagnosis and Management of the Poisoned Child, Erickson, TB, et al. (Eds.), Chapter 68. Iron.

## PREVENTION

### **Prevention, Case #2**

Written by Ragini Miryala, M.D.

A sixteen-year-old girl presents for a routine health care supervision visit. She has had two sexual partners and has used birth control inconsistently. What advice would you give to help prevent a sexually transmitted disease or pregnancy?

### **Definitions for Specific Terms:**

Define the different types of contraception:

**Barrier Methods**- Condoms, diaphragm, cervical cap, female condom

**Hormonal Methods**- Oral contraceptive pill or patch, Depo Provera shot, hormonal ring

**Chemical Methods**- Spermicides

**Surgical**- Tubal ligation, vasectomy

**Devices**- Intrauterine device

**Abstinence**- Intimacy and sexual expression with low risk of disease transmission and/or pregnancy (ie. mutual masturbation, frottage, oral sex)

Define which sexually transmitted infections (STIs) teens are most at risk for contracting?  
Gonorrhea, Chlamydia (most common), HIV, Syphilis, HPV

### **Review of Important Concepts:**

### **Historical Points**

- Important Social/Sexual History:
  - Last Menstrual Period
  - Number of partners and sexual practices
  - Forms of contraception used in the past, reasoning behind the decision, and experience with that choice
  - Past STI or pregnancy and outcome
  - Use of drugs or alcohol (puts teens at risk)
  - A helpful mnemonic is the 5 P's of a sexual history: partners, practices, protection against pregnancy, protection against STIs, past history (including history of sexual abuse).
- Obtaining a sexual history is a subject that needs to be approached in a non-judgmental manner while letting the teenager know that unless she is at risk of being hurt or harming others, you can keep the information confidential. (i.e.: "The things we talk about will be private. I will only share this information with others if I'm concerned about your safety or safety of others. I will

always tell you before sharing information if I ever decide it's necessary so we can decide together how to do it.”)

- The sexual history should be taken with the parent outside of the room. As the physician, you should take the responsibility of asking the parent to step outside and not place the burden on the teenager to do so. An appropriate way to address this with the parent may be to say, “We routinely ask parents to leave the room so that we can speak to teenagers by themselves. This helps them to transition to adulthood by learning to take responsibility for their own health. It also allows us to educate them on topics they may otherwise be embarrassed to address and establish trust with us as their provider.”

## Physical Exam Findings

1. Assess if the student knows what findings to look for on a well woman exam or genital exam that would make her suspicious for a STI.  
One way to think about assessing and documenting findings on a well woman exam is to think of the exam as going from the outside inwards. Start with inspection of the labia majora and perianal regions, followed by the labia minora and hymen, the vaginal vault, and finally the cervix and adnexa (seen via speculum exam and felt on bimanual exam). Look for ulcers or warts, discharge, blood, yeast, foreign bodies (e.g. tampons), masses, and cervical friability. Normal variations such as skin tags may be noted and Tanner stage should also be documented.
2. Assess if the student know that many STIs are asymptomatic and the patient may not even be aware she is affected.  
Many teenagers feel that they will know if they have an STI because they will have discharge, fever, or feel ill. In fact, many STIs are spread among multiple partners because they do not present with any such symptoms and yet are colonizing the patient's body. (This is why physicians test for common STI's such as Gonorrhea and Chlamydia, Syphilis, and HIV on routine exams for sexually active teens at increased risk of infection, with the patient's consent.) The US Preventive Services Task Force recommends that all sexually active females younger than 25yo be considered at increased risk for Chlamydia and gonorrhea and be screened accordingly.

## Clinical Reasoning

1. What clinical reasoning goes into choice of birth control method for a teenager?
  - a. Understand that teenagers may have many personal reasons for choosing a certain kind of contraception but their decision may be based on misconceptions. Teenagers often get advice and information from their peers instead of trained healthcare professionals and it is important to dispel any myths about contraception. For example, many young women are afraid of starting oral contraceptive pills (OCPs) for fear of gaining weight. Studies have shown that OCPs are in fact not responsible for any detectable weight gain and that it is a teenager's diet and lack of activity that causes weight gain.
  - b. When counseling a teenager about contraception, go through the options listed above and describe each one with some of the advantages and disadvantages of each method.
  - c. Side effects and contraindications should also be touched upon. Some teenagers will find it difficult to remember to take a pill daily while others may be afraid of needles. These personal preferences will help to guide you in what manner of contraception is best for each individual and also determine the focus of counseling in future visits.

2. What are the guidelines for maintaining patient confidentiality in cases where a minor is pregnant or has an STI?
  - a. Most states allow minors to consent for treatment of STDs, to receive drug and alcohol treatment, to receive prenatal care and care surrounding delivery of a child, and to receive treatment for mental illness such as depression. In most states physicians are not required to tell a parent about the minor's condition or treatment although confidentiality is sometimes breached due to billing.
  - b. What resources other than a doctor's office are available to teenagers to receive contraception?
  - c. The ability of a teenager to have access to doctor's visits to get shots or prescriptions may be limited. Teen health clinics located in local area schools are valuable places for teenagers to get contraception and be treated for STDs and sometimes even to receive prenatal care. Planned parenthood offices, locations, and hours may be available online.

**Diagnosis:**

What kinds of lab tests are available to diagnose common sexually transmitted diseases?

- a. Syphilis RPR
- b. HIV antibody
- c. GC/Chlamydia Nucleic Acid Amplification Test

**Suggestions for Learning Activities:**

- Role Play – have the student role play counseling a patient about contraception. The student would have to ask the parent to leave the room, obtain a sexual history and then educate the patient on options for birth control and STI prevention.
- Role Play – have the student role play “breaking bad news” that a patient has a STI
- Discuss what you would do if your patient is using their contraception intermittently. What would you do next?

**Other Resources:**

- Ziemann M, Hatcher RA et. al. A Pocket Guide to Managing Contraception. Tiger, Georgia: Bridging Gap Foundation, 2010.
- Meyers, et al. USPSTF Recommendations for STI Screening. American Family Physician. 2008 Mar 15, 77(6): 819-824



**Prevention, Case #9**

Written by Ragini Miryala, M.D.

The parents of a newborn are concerned about Sudden Infant Death Syndrome and have purchased a baby alarm. What advice would you give them to help prevent SIDS in their infant?

**Definitions for Specific Terms:**

**Sudden Infant Death Syndrome**- Defining SIDS is still a dilemma because pathognomonic postmortem findings have yet to be identified. It remains a diagnosis of exclusion but there have been dramatic developments in understanding its epidemiology and pathology. An expert panel of experienced forensic pathologists has proposed the following definition in 2004: “the sudden and unexpected death of an infant under 1 year of age, with onset of the fatal episode apparently occurring during sleep, that remains unexplained after a thorough investigation including performance of a complete autopsy, and review of the circumstances of death and the clinical history.

**The epidemiology of SIDS**- The SIDS rate in 2004 was 0.54/1000 live births compared with 2-3 times that before the early 1990's. However, SIDS is still the most common cause of infant death in the post-neonatal period accounting for 23% of all deaths in this group.

**Review of Important Concepts:****Historical Points**

These historical points are significant given the risk factors for SIDS:

- Birth History
- Sleep History
- Smoking History

**Physical Exam Findings**

Recognize that documentation of any physical exam findings of injury or trauma to the child is important in suspected SIDS deaths. Bruises, especially those with characteristic patterns of handprints or household objects, cigarette burns, and fractures may reveal other causes of death.

**Clinical Reasoning**

1. What are the risk factors for SIDS?
  - a. Premature birth, low birth weight, lower socioeconomic class, young maternal age, and short inter-gestational interval.
  - b. Cigarette smoke exposure is an important and modifiable risk factor.
2. What advice is given to the parents of newborns to prevent SIDS?
  - a. Explain to parents that 90% of SIDS deaths primarily occur by the sixth month of life. For anxious parents, knowing this may help give them a timeline after which they can feel more comfortable discontinuing the use of the baby alarm. Advise parents that the following measures have shown a considerable decline in SIDS deaths:

- b. Supine placement of infants to sleep, i.e. “back to sleep”. The “Back to Sleep” campaign and other public educational programs have led to dramatic declines in SIDS rates.
  - Use of a firm sleep surface
  - Avoidance of excessive wrapping or bundling
  - Avoidance of prenatal and postnatal exposure to cigarette smoke
  - Bed-sharing (sometimes equated with co-sleeping which can mean sleeping in the same room as opposed to sleeping in the same bed) remains controversial as a risk factor for SIDS but the American Academy of Pediatrics recommends that the infant is safest when sleeping alone.

### 3. Do baby alarms prevent SIDS?

Although baby alarms may provide comfort and reassurance, they have not been proven to reduce the risk of SIDS nor can they prevent SIDS. In addition, they may alarm even when the child is not in distress and create unnecessary worry or loss of sleep.

### Diagnosis:

How is the diagnosis of SIDS reached and what is on the differential?

- a. Understand that the diagnosis of SIDS is a forensic diagnosis that involves a pathologist to help exclude other causes of death.
- b. Many infant deaths remain unclassified due to lack of autopsy or when the circumstances surrounding the death are equivocal.
- c. Infant death may result from natural disease, accidental or inflicted injuries, or asphyxia.

### Suggestions for Learning Activities:

Role Play – Have a student counsel a parent about SIDS

### Other Resources:

- [www.cdc.gov/SIDS](http://www.cdc.gov/SIDS)
- Krous, HF, Beckwith JB, Byard RW, et al. Sudden Infant Death Syndrome and unclassified sudden infant deaths: a definitional and diagnostic approach. *Pediatrics*. 2004; 114:234-238.
- Mathews TJ, MacDorman MF: Infant Mortality Statistics from the 2004 period linked birth/infant death data set. *Natl Vital Stat Rep* 2007; 55:1:1-32
- “Sudden Infant Death Syndrome and Fatal Child Abuse” Krous, Henry F; Byard, Roger W.; Reese, Robert; Christian, Cindy editors; *Child Abuse Medical Diagnosis and Management* 3<sup>rd</sup> edition, American Academy of Pediatrics 2009.
- Krous, Henry; Byard, Roger; “Sudden Infant Death Syndrome or Asphyxia?”; Jenny, Carole editor. *Child Abuse and Neglect: Diagnosis, Treatment and Evidence*, Saunders 2010.

## THERAPUTICS

### Therapeutics, Case #1

Written by Rebecca Chasnovitz, M.D.

A three-year-old has acute otitis media. She is not allergic to any medications. Which if any antibiotics would you prescribe and why?

#### Definitions for Specific Terms:

**Acute otitis media (AOM)**- Must meet all 3 of the following criteria:

- Acute onset
- Presence of a middle ear effusion (see physical exam findings)
- Signs or symptoms of middle ear inflammation (see physical exam findings)

#### Review of Important Concepts:

##### Historical Points

- The time course of symptoms must be acute to meet the definition of acute otitis media.
- The patient's age, severity of symptoms, and reliability for follow-up help determine whether or not to prescribe an antibiotic (see clinical reasoning).
- The patient's past history of ear infections, any underlying medical issues such as cleft lip/palate, and recent antibiotic use may influence the choice of antibiotic.

##### Physical Exam Findings

The best way to diagnose a middle ear effusion is with pneumatic otoscopy demonstrating limited mobility of the tympanic membrane. However, other signs of a middle ear effusion on routine ear exam are bulging of the tympanic membrane, an air fluid level, and otorrhea. Signs of middle ear inflammation include otalgia and tympanic membrane erythema, cloudiness, or opacification.

##### Clinical Reasoning

1. What medications should be used to treat pain in AOM?
  - a. Ibuprofen should be used in all patients to treat symptoms of pain, regardless of one's decision to treat or not to treat with antibiotics.
  - b. Topical benzocaine may also provide pain relief, though evidence is not as strong as that for ibuprofen.
2. What are the complications of AOM?

The more common consequences of AOM are pain and discomfort experienced by the child and loss of parental time at work. However, about 90% of children with AOM will have symptomatic relief of otalgia and fever within 2-3 days regardless of antibiotic use. This improvement may be because many of pathogens in AOM are viruses (20-50%), or because even in cases of confirmed bacterial AOM, the majority of infections resolve without antibiotics. Thus, "watch and wait" is becoming a

more accepted management option for patients initially presenting with AOM if they have reliable follow-up.

3. According to the AAP Clinical Guidelines, when should antibiotics be prescribed in AOM in healthy children?

The AAP recommends antibiotics for:

- a. Children less than 6 months old with suspected AOM,
- b. Children between 6 months and 2 years of age if the physical diagnosis is certain OR, in cases of uncertain diagnosis, if the symptoms are severe, defined as moderate to severe otalgia or fever greater than 39 degrees Celsius,
- c. Children 2 years or older only if the diagnosis is certain AND symptoms are severe,
- d. Children being observed off of antibiotics with no improvement in symptoms after 48-72 hours from start of illness.

4. What is the first-line choice of antibiotic in AOM?

The most common bacterial pathogens in AOM are *Streptococcus pneumoniae* (25-50%), nontypeable *Haemophilus influenzae* (15-30%), and *Moraxella catarrhalis* (3-20%), so the recommended first-choice antibiotic is Amoxicillin 80-90 mg/kg/day. The AAP recommends the standard 10 day course for children less than 6 years old. Studies on shorter courses are limited, but a 5- to 7-day course may be appropriate for older children with less severe symptoms. Symptoms of ear pain and fever usually improve 48-72 hours after initiating treatment. Persistence of a middle ear effusion on ear exam after resolution of acute symptoms is very common and is NOT an indication for a longer treatment course or change in antibiotic therapy.

5. What are the side effects of amoxicillin?

Common side effects of amoxicillin include nausea, vomiting, diarrhea, and rashes. Antibiotics alter normal flora and can increase the risk of yeast infections and resistant organisms. Rare adverse effects of amoxicillin include anaphylaxis, hepatitis, and Stevens-Johnson syndrome.

### Diagnosis:

Acute otitis media

### Suggestions for Learning Activities:

- What is the differential diagnosis for ear pain?
- Why might a patient's symptoms not improve after starting an antibiotic?
- Identify the local resistance patterns for AOM in your region.

### Other Resources:

- AAP Clinical Practice Guidelines: Diagnosis and Management of Acute Otitis Media. *Pediatrics* 2004;113(5):1451-1465.
- Gould JM, Matz PS. Otitis Media. *Pediatrics in Review* 2010;31(3):102-116.

### **Therapeutics, Case #3**

Written by Rebecca Chasnovitz, M.D.

A four-year-old girl has urinary urgency and dysuria. A clean catch urine shows 50-100 white blood cells. How would you manage this child?

#### **Definitions for Specific Terms:**

**Pyuria**- >10 WBC/HPF on unspun urine or >5 WBC/HPF on spun urine

**Urinary tract infection (UTI)**- The diagnosis is confirmed by a positive urine culture from urine collected before the initiation of antibiotics. A significant culture finding is at least 100,000 colonies/ml of a single organism on a clean catch specimen or at least 50,000 colonies/ml on a catheterized specimen (although >10,000 colonies/ml of a single organism on a catheterized specimen in a patient with high pre-test probability may also represent a UTI). There are several ways to classify UTIs, though clinically differentiating between the types can be difficult:

**Lower UTI (cystitis)**- Infection of the bladder and/or urethra

**Upper UTI (pyelonephritis)**- Infection of the kidneys, renal pelvis, and/or ureters

**Complicated UTI**- UTI (upper or lower) in the presence of an underlying condition that increases the chance of therapeutic failure, such as a functional or anatomic abnormality of the urinary tract, an indwelling urinary catheter, recent urinary tract infection, instrumentation, recent antibiotic use, or immunocompromised.

#### **Review of Important Concepts:**

#### **Historical Points**

- Classic symptoms of acute cystitis include dysuria, urinary frequency, and urinary urgency. However, children are not always able to give you this history and may present with more generalized complaints such as fatigue, irritability, abdominal pain, vomiting, and enuresis (especially new onset). The classic symptoms of pyelonephritis include fever, chills, and flank pain, but again, the only sign in young children may be fever.
- Risk factors for UTI include recent antibiotic use, history of a previous UTI, urine withholding (common in children learning daytime bladder control), chronic constipation (dilated rectum can obstruct outflow) and other causes of incomplete bladder emptying such as a neurogenic bladder or anatomic abnormality, immunocompromise, catheterization, and family history of recurrent UTIs. Uncircumcised male infants have an increased risk of UTI in the first year of life, and in adolescents, sexual activity is also a risk factor. Also ask about chemical irritants such as bath products and spermicides and drug exposures, which can cause non-infectious pyuria.

#### **Physical Exam Findings**

1. Vitals should include a temperature, blood pressure, and review of growth charts (recurrent UTIs can lead to poor weight gain).
2. Abdominal exam should evaluate for suprapubic and costovertebral tenderness.

3. External genital exam should always be performed to look for anatomic abnormalities such as phimosis or labial adhesions, vaginal foreign body, vulvovaginitis, and vaginal or penile discharge.
4. Also inspect the sacrum for dimples, pits, and tufts of hair, which may suggest a neurogenic bladder.

### Clinical Reasoning

1. How do you interpret urine dipstick and microscopy results?  
The presence of nitrite (more specific but less sensitive than LE), leukocyte esterase, pyuria, bacteruria, and/or white blood cell casts are all suggestive of UTI, though a urine culture is necessary to establish the diagnosis. Always ask how the specimen was obtained. Catheterized specimens are the gold standard. In children who are capable, mid-stream clean catch urine can also be used, but the clinician should evaluate for signs of a “dirty” or improperly collected urine, including squamous cells and a mixture of organisms. Bagged specimens are generally not recommended, especially in ill-appearing patients, due to low specificity and poor positive predictive value, although a negative bagged urine culture might be used to exclude UTI in a well-appearing child.
2. What is the differential diagnosis for pyuria?  
WBC in the urine represent inflammation, not necessarily infection. Thus, the differential includes urinary tract infection, chemical cystitis, contaminated urine specimen, vaginal foreign body, vulvovaginitis, drug side effect, appendicitis (secondary to inflammation of the adjacent ureter to the appendix), Kawasaki disease, SLE, and Behcet’s disease.
3. What are the risks and benefits of antibiotic treatment in UTI?  
In the pre-antibiotic era, mortality from UTI was as high as 20%, likely due to urosepsis and secondary bacteremia, and is now very rare. However, the current evidence is unclear on whether antibiotics affect the long-term complications of UTI – recurrent UTIs, renal scarring, hypertension, and renal failure. Prophylactic antibiotics are also now controversial, as they do not clearly prevent recurrent infections and increase the risk of resistant organisms.
4. What is the first-line antibiotic treatment for an uncomplicated UTI?
  - a. Selection of an initial antibiotic should depend on the most prevalent local organisms and resistance patterns, and should be changed as necessary depending on the organism isolated by urine culture and its susceptibility. However in general, the most common pathogen in UTIs is E Coli (~90%). Other pathogens include other gram negative organisms (Klebsiella, Proteus, Enterobacter, Pseudomonas, and Serratia), Enterococcus, Staphylococcus saprophyticus, Chlamydia and Neisseria gonorrhea (in sexually active adolescents), GBS (in infants), Candida (in immunocompromised patients), and adenovirus. Second or third generation cephalosporins have good activity against E Coli and other gram negative organisms, although they are NOT effective against Enterococcus species and Staphylococcus saprophyticus.
  - b. Traditional antibiotic choices for UTI – amoxicillin, amoxicillin-clavulanate (augmentin), nitrofurantoin, first-generation cephalosporins, and TMP-SMZ – show increasing rates of resistance to E Coli but should be used if the isolated organism shows susceptibility.
  - c. Patients should show improvement in symptoms within 24-48 hours of starting antibiotics.
5. When might you hospitalize a patient with UTI?  
Consider hospitalization in patients who are infants (less than 2 months old), ill-appearing, dehydrated, unable to take fluids by mouth, and/or unable to take oral antibiotics.

6. Is UTI an indication for imaging?

The latest report from the AAP no longer recommends imaging as a necessary part of follow-up for UTI in children. This recent change was based on a meta-analysis of data from recent, randomized-control trials that do not support antimicrobial prophylaxis to prevent future febrile UTIs, and thus, reflux identified on VCUG would not change management. Consider ultrasound in a child who fails to improve with appropriate antibiotic treatment to evaluate for perirenal abscess and pyonephrosis.

**Diagnosis:**

Culture grew >100,000 colonies/ml of E Coli.

**Suggestions for Learning Activities:**

- Identify a bacteriogram for UTI and resistance patterns of E Coli in your region.
- If the patient were a 1-month-old male infant, how would that change your management?
- If the patient were a 16-year-old female, how would that change your management?
- How might patients with a neurogenic bladder and UTI present differently?

**Other Resources:**

- Zork, Kiddoo, & Shaw. Diagnosis and management of pediatric urinary tract infections. Clin Microbiol Rev. 2005 April; 18(2): 417–422.
- Raszka & Khan. Pyelonephritis. Pediatr Rev, Oct 2005; 26: 364 – 370.
- Finnell, Carroll, & Downs. Diagnosis and management of an initial UTI in febrile infants and young children. Pediatrics, Sept 2011; 128(3): e749-e770.

## **Therapeutics, Case #8**

Written by Rebecca Chasnovitz, M.D.

A two-year-old presents with a persistent pruritic rash on his arms and legs. He has patches of erythema with obvious excoriations on the extensor surfaces of his arms and legs and also in the antecubital fossae. How would you treat this condition?

### **Definitions for Specific Terms:**

**Macule**- Flat, less than 0.5 cm area of skin with a different color than the surrounding skin

**Patch**- Flat, greater than 0.5 cm area of skin with a different color than the surrounding skin

**Papule**- Raised, less than 0.5 cm area of skin

**Plaque**- Raised, greater than 0.5 cm area of skin

**Excoriation**- Punctate or linear break in the skin produced by mechanical means, usually scratching

**Lichenification**- Thickened skin with prominent skin markings usually due to chronic scratching

**Scale**- Flakes or layers of excess stratum corneum, usually white or grey in color

**Crust**- Flakes or layers of dried serum, blood, or purulent exudates, color varies but often red or yellow

**Ointment**- The thickest moisturizer, with the highest oil content

**Cream**- Medium thickness moisturizer, with more water than oil

**Lotion**- The thinnest moisturizer, with more water content than a cream

### **Review of Important Concepts:**

#### **Historical Points**

- Aggravating factors- Triggers for atopic dermatitis (commonly known as eczema) can include fragrant soaps, shampoos, and detergents, abrasive fabrics, nickel, synthetics, dyes, rubber, temperature changes from hot to cold, sweating, dust, animal dander, pollen, and food allergies. However, many of these may also trigger contact dermatitis.
- Exposures- Family members or classmates with similar recent onset skin findings could indicate an infectious condition, such as scabies. Elicit a medication history as well, as drug reactions can cause a wide variety of rashes.
- Past medical history- A chronic, relapsing history of pruritic rash is more supportive of atopic dermatitis. Children with a history of asthma, allergies, or atopic dermatitis are three times as likely to develop a second component of the atopic triad; so patients presenting with one component should always be screened for symptoms of the other disorders. A history of



recurrent skin or sinopulmonary infections suggests a possible associated immune deficiency such as Wiscott-Aldrich or Job syndrome.

- Family history- Children with a first-degree family member (parents, siblings) with a history of asthma, allergies, or atopic dermatitis are more likely to develop atopic dermatitis.

### Physical Exam Findings

The patient's presentation with pruritic, erythematous patches and overlying excoriations is most consistent with atopic dermatitis. Flexor more often than extensor surfaces of the extremities and the atecubital fossae are classic locations for eczema in this age group. However in practice, flares can occur on any part of the body and can present with patches, papules, plaques, scale, dry skin, and lichenification. Oozing, weeping, and crust may indicate a secondary bacterial infection. Central clearing with peripheral papules suggests possible tinea infection.

### Clinical Reasoning

1. What is the differential diagnosis for a pruritic skin rash?
  - a. The differential diagnosis includes atopic dermatitis (ie eczema), contact dermatitis, seborrheic dermatitis, scabies, tinea, psoriasis, impetigo, drug eruptions, immune deficiency syndromes (Wiscott-Aldrich, Job syndrome), ichthyosis vulgaris, and zinc deficiency.
  - b. Frequent follow-up to monitor response to therapy is important, given the similar presentations of many of these skin disorders.
2. What is the treatment for atopic dermatitis?
  - a. Moisturize and hydrate dry skin- Patients should apply a thick, dye-free, fragrance-free moisturizer such as an ointment or cream at least twice daily. One brand is not recommended more than another. Inexpensive options include petroleum jelly and shea butter. Moisturizers should be applied after application of topical medications and after bathing. Patients should pat skin dry (rubbing can irritate the skin) after bathing in luke warm water to hydrate the skin and then immediately apply the moisturizer. Frequent moisturizing should become a daily routine, even between flares.
  - b. Avoid irritants- In general, switching to fragrant-free bath products and detergents may help prevent flares, as well as avoiding dryer sheets and bubble baths. Patients should be attentive to their personal triggers, such as certain metals, fabrics, or dust, and limit their exposures to a reasonable extent. Finally, patients should be encouraged to scratch as little as possible, as scratching leads to worse itching, which promotes more scratching – a difficult cycle to break.
  - c. Decrease inflammation-
    - Topical steroids- Classic pharmacologic treatment for eczema flares involves a limited course of a topical steroid. Topical steroids are divided into Classes I-VII based on strength. Class I topical steroids (ex. Clobetasone) are about 1800 times more potent than Class VII preparations (ex. Hydrocortisone). Selection of a steroid should be based on the severity of the flare, generally using the lowest strength steroid that achieves remission. There is no evidence-based consensus on length of treatment. Generally, topical steroids should be used until the patient achieves reasonable control of symptoms and then either discontinued between flares or switched to a low-potency long-term treatment. Treatment decisions should involve a discussion of risks and benefits with parents and should include frequent follow-ups to evaluate for improvement. Education on the chronic, relapsing nature of

eczema and specific indications for when to use steroids is important for compliance with and effectiveness of management.

- Topical calcineurin inhibitors- TCIs work by blocking the production and release of proinflammatory cytokines after activation of T cells and mast cells. Tacrolimus and pimecrolimus are FDA approved as second-line agents for short-term therapy of moderate to severe atopic dermatitis in patients 2 years and older. Studies on the long-term safety of these agents are ongoing, but current data do not support an increased association with systemic immunosuppression or skin cancer. TCIs are an appropriate alternative for patients who do not show improvement with topical steroids.
- d. Treat secondary infections- Patients with atopic dermatitis have an increased risk of secondary infection. Pathogens include common skin bacteria (MSSA, MRSA) as well as viral (HSV) and fungal (tinea) infections. Consider bacterial, viral, and fungal culture of the skin in patients who do not respond to typical antibiotics for cellulitis.

### 3. What are the side effects of topical steroids?

- a. Local adverse effects of topical steroids include skin atrophy, striae, telangiectasias, hypopigmentation, rosacea, perioral dermatitis, acne, cataracts, and glaucoma.
- b. Lower potency preparations, shorter courses of therapy, and avoiding application to areas of thin skin (face, neck, groin) decrease the risk of adverse effects.
- c. Many parents are concerned about the systemic side effects of steroids, including hypothalamic-pituitary-adrenal axis suppression, stunted growth, and decreased bone density. However, systemic complications with topical steroids are rare when used properly.

### 4. What can you do about the itching, doctor?

Constant itching can impair sleep and affect school performance, as well as decrease quality of life for the patient and caregiver. Unfortunately, there are no good medications to treat the pruritis associated with atopic dermatitis. First-generation antihistamines are often used at night for their sedating side effects to help with sleep disturbance, but no rigorous trials have evaluated their effectiveness.

## Diagnosis:

Atopic dermatitis

## Suggestions for Learning Activities:

- Identify a reliable patient education resource on atopic dermatitis for children and caregivers.
- List at least one topical steroid in each class.
- List possible causes of treatment failure after 2 weeks of therapy.

## Other Resources:

- Krakowski, Eichenfield, & Dohil. Management of atopic dermatitis in the pediatric population. *Pediatrics* 2008;122(4):812 -824.
- Epps, RE. Atopic dermatitis and ichthyosis. *Pediatr Rev* 2010;31:278-28.