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](http://www.hawaii.edu/medicine/pediatrics/pemxray/v1c02.html)
  b. Meniscus sign on plain film
     [http://www.hawaii.edu/medicine/pediatrics/pemxray/v1c02.html](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:

- 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 (≥38 degrees Celsius in infants < 3 months; ≥ 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.
Clinical Reasoning

1. 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.

   a. Viral gastroenteritis—Acute non-bloody diarrhea with or without vomiting and fever are the typical clinical features.
   b. Bacterial gastroenteritis—Usually bloody diarrhea that may last > 14 days
   c. 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.
   d. Appendicitis—Abdominal pain is usually the most prominent feature, along with fever and vomiting. Diarrhea is usually not present.
   e. Inflammatory bowel disease—This process presents chronically or insidiously, and does not usually have a sudden onset like the case patient’s symptoms.

2. How would you assess this patient’s hydration status? (See table from NICE guidelines)
   a. 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:


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/mm3 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/mm³, 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:

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 pass 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:

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/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/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/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/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/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 know 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 who go on to develop an autoimmune disorder or leukemia.

Other Resources:

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 ≥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, 10th ed. 2008), rhonchi are lower-pitched, continuous and have a “snoring” quality; they are caused by secretions in large airways. Cracks 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:
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 pneumonia 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](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 dacrocystitis 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

- 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):

<table>
<thead>
<tr>
<th>Age</th>
<th>Respiratory Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn</td>
<td>&gt;60</td>
</tr>
<tr>
<td>2-12 months</td>
<td>&gt;50</td>
</tr>
<tr>
<td>1-5 years</td>
<td>&gt;40</td>
</tr>
<tr>
<td>&gt;5 years</td>
<td>&gt;20</td>
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</tbody>
</table>
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’s 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.

<table>
<thead>
<tr>
<th>3 weeks to 3 months</th>
<th>Chlamydia trachomatis</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSV</td>
<td>Parainflueza</td>
</tr>
<tr>
<td>Streptococcus pneumoniae</td>
<td></td>
</tr>
<tr>
<td>Bordetella pertussis</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3 months to 4 years</th>
<th>Viral (RSV, parainfluenza, human metapneumovirus, influenza and rhinovirus)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Streptococcus pneumoniae</td>
<td></td>
</tr>
<tr>
<td>Mycoplasma pneumoniae</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5 years through adolescence</th>
<th>Mycoplasma pneumoniae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlamydia pneumoniae</td>
<td></td>
</tr>
<tr>
<td>Streptococcus pneumoniae</td>
<td></td>
</tr>
<tr>
<td>Mycobacterium tuberculosis</td>
<td></td>
</tr>
</tbody>
</table>
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 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 his 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:
  - 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](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](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](http://www.hawaii.edu/medicine/pediatrics/pemxray/v4c05.html)
  - Cases: D, E, F, H, J and N have infiltrates.
Other Resources:

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):

<table>
<thead>
<tr>
<th>Age</th>
<th>Respiratory Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn</td>
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</tr>
<tr>
<td>&gt;5 years</td>
<td>&gt;20</td>
</tr>
</tbody>
</table>

- **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 is 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 significant 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](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:
  - 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](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](http://www.hawaii.edu/medicine/pediatrics/pemxray/v1c08.html)

**Other Resources:**

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


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?


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 (15,000-50,000 103/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 😎)!
<table>
<thead>
<tr>
<th>Age</th>
<th>Tachypnea (from WHO)</th>
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</thead>
<tbody>
<tr>
<td>Newborn</td>
<td>&gt;60</td>
</tr>
<tr>
<td>2-12mo</td>
<td>&gt;50</td>
</tr>
<tr>
<td>1-5yrs</td>
<td>&gt;40</td>
</tr>
<tr>
<td>&gt;5 yrs</td>
<td>&gt;20</td>
</tr>
</tbody>
</table>

- 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 pertussis
  - 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](http://www.whoopingcough.net/symptoms.htm)
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: bary 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.
   - 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:**

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 peribrochial 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](http://www.nhlbi.nih.gov/guidelines/asthma/asthgdln.htm)
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 lasts 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 (≥38 degrees Celsius in infants < 3 months; ≥ 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
Non-blanching rash may be petechial due to low platelets (seen in HUS).

<table>
<thead>
<tr>
<th>Increasing severity of dehydration</th>
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<tbody>
<tr>
<td>No clinically detectable dehydration</td>
</tr>
<tr>
<td>Appears well</td>
</tr>
<tr>
<td>Alert and responsive</td>
</tr>
<tr>
<td>Normal urine output</td>
</tr>
<tr>
<td>Skin colour unchanged</td>
</tr>
<tr>
<td>Warm extremities</td>
</tr>
<tr>
<td>Alert and responsive</td>
</tr>
<tr>
<td>Skin colour unchanged</td>
</tr>
<tr>
<td>Warm extremities</td>
</tr>
<tr>
<td>Eyes not sunken</td>
</tr>
<tr>
<td>Moist mucous membranes (except after a drink)</td>
</tr>
<tr>
<td>Normal heart rate</td>
</tr>
<tr>
<td>Normal breathing pattern</td>
</tr>
<tr>
<td>Normal peripheral pulses</td>
</tr>
<tr>
<td>Normal capillary refill time</td>
</tr>
<tr>
<td>Normal skin turgor</td>
</tr>
<tr>
<td>Normal blood pressure</td>
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</table>

**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. Bacterial AGE—Acute bloody diarrhea
   b. Viral AGE—Ranked second because viral AGE is not usually bloody
   c. Intussusception—Can cause “currant jelly” stools and irritability but is usually associated with vomiting due to the obstruction.
   d. Ischemic bowel/Other surgical—Also possible, but vomiting and possibly fever would be prominent features. The patient would most likely have a surgical history.

2. What are some complications of bacterial AGE?
   a. HUS
   b. Septicemia

3. 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:**

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:

- 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 ≥ 1,000 cfus of a single species, cath ≥ 10,000 cfus, clean catch ≥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:

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:**

- Centers for Disease Control: Photos of patients with measles.
  
  [http://www.cdc.gov/measles/about/photos.html](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: Heart Murmurs, Case #1

Written by Austin Raunikar, 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 (decrescendo 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 Raunikar, 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
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? quantify 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).
**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 <250mg/24 hours) in a 24 hour-timed urine sample.

**Nephrotic Range Proteinuria** - Proteinuria that is quantitatively severe enough that it could result in the nephritic syndrome. Generally defined as 50mg/kg/24 hours, or alternatively 40mg/m2/24hours. 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.
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
   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:

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:

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:

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/not tender
• 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 by 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:

- McMillan: Oski’s Pediatrics, 4th ed., Chapter 295 - The Spleen and Lymph Nodes
Common Acute Pediatric Illnesses: Otalgia, 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 in is 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](http://www.youtube.com/watch?v=4QDwmNjMeS4)
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

- 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 that 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/](http://dermatlas.med.jhmi.edu/derm/))
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 (i.e. a blister).

Review of Important Concepts:

**Historical Points**

- Predisposing factors: Does the patient have
  - recent trauma to skin?
  - underlying skin condition (e.g. 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**
   - Impetigo can be bullous or nonbullous—nonbullous impetigo accounts for 70% of cases.
   - Almost all bullous impetigo is caused by Staphylococcus aureus.
   - Nonbullous impetigo is classically described as a honey-crusted plaque.

2. **Distribution**
   - Nonbullous impetigo typically occurs on the face and extremities and in areas of trauma.
   - 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)
- 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:

- 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:

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:**

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-α. 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**

<table>
<thead>
<tr>
<th>Type</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comedonal</td>
<td>Benzoyl Peroxide (or topical retinoid)</td>
</tr>
<tr>
<td>Inflammatory</td>
<td>Benzoyl Peroxide (or topical BP/antibiotic)</td>
</tr>
<tr>
<td>Mixed</td>
<td>Benzoyl Peroxide (or topical BP/antibiotic) +/- topical retinoid</td>
</tr>
</tbody>
</table>

   **Moderate Acne**

<table>
<thead>
<tr>
<th>Type</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed</td>
<td>Benzoyl Peroxide or topical BP/antibiotic (or oral abx) AND Topical retinoid</td>
</tr>
</tbody>
</table>

   **Moderately Severe Acne**

<table>
<thead>
<tr>
<th>Type</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed</td>
<td>Oral Antibiotic + Topical Retinoid Consider OCP in female; BP as adjunct</td>
</tr>
</tbody>
</table>

   **Severe Acne**

<table>
<thead>
<tr>
<th>Type</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed</td>
<td>Oral Retinoid + Oral Antibiotic + Topical Retinoid Consider OCP in female; BP as adjunct</td>
</tr>
</tbody>
</table>

   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

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 case 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 papilis 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 polyarthritis, 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:**

- 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
- Pickering, LK Group A streptococcal infections. Red Book AAP 2009 pp616
• Pfofo 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 remain 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](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.)

Posterial cervical lymph nodes- chain of lymph nodes that extends in a line posterior to the sternocleidomastoids but in front of the trapezius

Splenomegal- 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 gonorrhoea: 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)

<table>
<thead>
<tr>
<th>Grade</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Absent</td>
</tr>
<tr>
<td>1</td>
<td>In the tonsillar fossae (between pillars)</td>
</tr>
<tr>
<td>2</td>
<td>Outside tonsillar fossae</td>
</tr>
<tr>
<td>3</td>
<td>Occupying &gt;75% of posterior pharynx</td>
</tr>
<tr>
<td>4</td>
<td>“Kissing” in the midline</td>
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</tbody>
</table>
- 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 labolatory studies (cbc with differential, monospot, EBV titers, CMV titers) in the diagnosis of infectious mononucleosis.

Other Resources:

- Clinical Otolaryngology Online: [http://www.entnet.org/EducationAndResearch/COOL.cfm](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: 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 vasooclusion 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

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?
   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:

- McMillan: Oski’s Pediatrics, 4th ed., Chapter 290 - Hemoglobinopathies and Thalassemias