Pediatric Potpourri
WAPA Spring Conference

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Most Common Pediatric Complaints

- Respiratory Distress
- Gastrointestinal Illness
- Fever
Chief Complaint – Respiratory Distress

- Upper airway obstruction
- Lower airway obstruction
- Parenchymal/Lung tissue disease
- Disordered control of breathing
- Compensation for metabolic acidosis
Upper Airway Obstruction

- Mouth/nose to thoracic inlet
- More prominent on inspiration
- “Pullers”
- Disease processes
  - Croup
  - Epiglottitis
  - Foreign body
Upper Airway Obstruction – Croup

- Infectious vs. Spasmodic
- Epidemiology
  - Parainfluenza 1 & 2
  - Late Fall
- Age ranges
  - 6 months to 5 years
- Presentation & natural history
  - URI prodrome
  - Waxing & waning, worse at night
  - 3-4 days
Croup - Workup

- No x-rays generally indicated
- No lab tests routinely indicated
Croup – Treatment

- Cool mist
  - No evidence of benefit in acute care setting

- Steroids
  - Dexamethasone 0.6 mg/kg PO once
  - IM/IV generally not necessary

- Racemic Epinephrine
  - Indication: stridor AND distress at rest
  - Observe 2-3 hours

- Decision to admit or transfer
Upper Airway Obstruction - DDx

- **Epiglottitis**
  - Clinical diagnosis: toxic, rapid onset
  - Don’t mess with them
  - Airway must be controlled by most experienced clinician available in most controlled setting

- **Bacterial tracheitis**
  - Sudden onset, high fever

- **Foreign body**
  - History is important
  - Consider if no improvement after racemic epi
Lower Airway Obstruction

- Bronchi to bronchioles
- More prominent work during expiration
- “Pushers”
- Disease processes
  - Bronchiolitis
  - Asthma
Bronchiolitis vs. Asthma

- Bronchiolitis more likely
  - First time wheezer
  - Bronchiolitis season (Nov-May)
  - Lots of secretions
  - Less than 2 years of age

- Asthma more likely
  - History of bronchodilator-responsive wheeze in the past
  - Only wheeze
  - Older than 5
  - Strong family history
Lower Airway – Bronchiolitis

- **Virology**
  - Respiratory Syncytial Virus
  - Human *Metapneumovirus*
  - Rhinovirus
  - *Parainfluenza* (especially 3 & 4)

- **Clinical Diagnosis**
  - Children less than 2 years of age
  - Upper respiratory congestion
  - Lower respiratory wheeze and rhonchi
Bronchiolitis

- **Seasonality**
  - November – May
  - Peaks in Feb/March

- **Highest risk patients**
  - First two months of life
  - Cardiac patients
  - Former premature infants
9 month old with classic bronchiolitis, RR 65, wheezing, SaO2 89%, T 38.2 – What test would you choose first?

a) CBC with differential
b) Chest x-ray
c) RSV viral testing
d) Nothing
Don’t Just Do Something – Stand There!

- **Workup**
  - Viral testing or blood testing not indicated
  - Imaging not indicated

- **Treatment**
  - Suctioning
  - Supportive care
  - No medications shown to be reliably effective

- **Disposition decision**
  - Need for supportive care
  - Risk for apnea
Lower Airway - Asthma

- Asthma vs. bronchiolitis
- Acute treatment
  - Steroids for all children with visible distress
    - Dexamethasone 0.6 mg/kg PO x 2 days or
    - Prednisone/Prednisolone 2 mg/kg PO x 5 days
  - Bronchodilators
    - Mild disease – Albuterol MDI puffs
    - Moderate-severe
      - Ipratropium
      - Albuterol 20 mg over one hour
Asthma

- **Workup**
  - Chest x-rays not generally indicated
  - Labs not generally indicated

- **Admission decision**
  - Failure to improve despite an hour of intensive therapy
  - Hypoxemia
Parenchymal/Lung Tissue Disease

- Alveolar or interstitial disease
- No predominant inspiratory or expiratory effort
- Tachypnea – fast and shallow
- Disease processes – Blood, pus, cells or water
  - Pneumonia
  - Pneumonitis
  - Pulmonary edema/ARDS
Parenchymal Disease – Pneumonia

- Presentation depends on age
  - Infants and toddlers difficult to diagnose clinically
  - Should be worked up based on fever and tachypnea

- Occult pneumonia
  - 0-6 months RR > 59
  - 6-12 months RR > 52
  - 12-24 months RR > 42
  - PPV = 20%
  - NPV = 95%
Parenchymal Disease – Pneumonia

- **Treatment**
  - High dose amoxicillin
  - IV ampicillin
  - Macrolides only if suspected atypical and not recommended as monotherapy

- **Admission**
  - Toxic or hypoxemic
  - Significant respiratory distress
  - Unable to tolerate PO antibiotics and hydration
Disordered Control of Breathing

- Seizure/Medication overdose
- Increased ICP – Cheyne-Stokes
Compensation for Metabolic Acidosis

- Kussmaul respirations
- DKA
- Severe lactic acidosis
Chief Complaint – GI Illness

- Vomiting and diarrhea
- Vomiting alone
- Abdominal pain
Vomiting Alone

• Important questions to ask and document
  – Bilious?
    • Bilious emesis in an infant is malrotation and volvulus until proved otherwise
  – Bloody?
    • Most often non-worrisome (Mallory-Weiss tears)
    • NG tube if persistent
  – Projectile?
    • Pyloric stenosis 2 weeks – 2 years of age
    • Only emergency is dehydration and metabolic derangement
Vomiting Alone

• Important questions to ask and document
  – Pain?
    • Intussusception
    • Appendicitis
  – Chronic?
    • Worrisome: increased intracranial pressure
    • Non-worrisome: GERD
    • Non-worrisome: Constipation
  – Dysuria or foul-smelling urine?
    • Pyelonephritis/UTI
Diarrhea

• Important questions to ask and document
  – Blood/Melena?
    • Bacterial enteritis
    • Intussusception
    • Meckel’s Diverticulum
Vomiting/Diarrhea

- Once you are reassured that it isn’t serious
  - Most pediatric vomiting is viral and infectious
    - Diarrhea often lags behind vomiting
    - Pitfalls of gastroenteritis diagnosis

- Testing
  - Glucose if decreased energy
  - Electrolytes only for severe dehydration
  - Stool cultures for blood
  - X-rays if concerned about obstruction
*Ondansetron*

- For significant vomiting
  - < 15 kg: 0.2 mg/kg of oral solution x 1 dose
  - 15 - 30 kg: 4 mg oral disintegrating tablet (ODT) or oral solution x 1 dose
  - > 30 kg: 8 mg oral disintegrating tablet (ODT) x 1 dose

- Decreases likelihood of needing IVF in ED setting
- Return rate unchanged
Vomiting/Diarrhea - Treatment

- **Lactobacillus**
  - For significant diarrhea
    - Lactobacillus rhamnosus GG
    - Decreases duration of viral AGE diarrhea by one day
    - 0.5 capsule/packet twice daily for children < 12 kg
    - 1 capsule/packet BID for children > 12 kg
    - Studied down to 6 months of age
Abdominal pain is a frequent complaint in acute care settings

- As many as 20% of children presenting to an ED have serious or surgical disease
  - Percentage may be much lower in other settings
  - Most other causes are self-limited

Abdominal pain is one of the highest risk, common chief complaints in pediatrics
Volvulus

- Malrotation puts a child at risk for volvulus
- Volvulus leads to intestinal ischemia
  - Risk of needing bowel resection
  - Risk of overwhelming sepsis and death
  - Peritonitis is a late finding in infants
- Volvulus is a surgical emergency
- Workup can start with plain films, but you need an upper-GI to determine malrotation
- The ligament of Treitz should be to the left of midline
Malrotation

Normal anatomy

Malrotation
Volvulus

- Bilious emesis in an infant is malrotation and volvulus (and therefore a surgical emergency) until you prove otherwise
  - 60% of volvulus happen in the first month of life
  - Most of the rest happen by age 12 months
  - Consider low grade malrotation in any child with chronic intermittent pain and vomiting
Intussusception

- Invagination of ileum into proximal colon
- Classic triad is rare
  - Obstructive symptoms
  - Colicky abdominal pain
  - Currant jelly stool
- Most common 6-24 months
- Paucity of gas in RLQ
Intussusception

• Suspect when
  – Pain is intermittent
  – Lethargy

• Most children deserve plain films
  – Include left lateral decubitus view

• If low suspicion, cecum filled with air on L lateral decub is reassuring

• Definitive positives are rare with plain films
Intussusception

Target Sign

Crescent Sign
Intussusception

• Give a bolus of isotonic crystalloid
• Confirmatory test: ultrasound
• Definitive test and treatment is air or air/contrast enema
• 90+% reduced non-invasively
• Give cefoxitin when intussusception is confirmed
• Operative reduction if radiographic reduction fails
Appendicitis

• When it comes to possible appendicitis, you can’t trust children

• Children rarely have classic progression of symptoms

• Appendicitis is the most frequently missed serious diagnosis in pediatrics (initial misdiagnosis rate 28-57%)

• Fear of needles is a more potent analgesic than morphine
Appendicitis

- Focal RLQ tenderness is one of the best exam predictors of appendicitis
- Peritoneal signs rare, but also predictive
- Migration to RLQ uncommon, but predictive
- Everything else has a poor positive and negative predictive value
- CBC adds to the predictive algorithm
- Urinalysis for all
Appendicitis – Rules that *don’t* work

“*I’ve never seen a child who had an appy who...*”

- Could jump without pain
- Had a great appetite
- Didn’t have a fever
- Didn’t have focal tenderness
- Had a normal white count
- Had a normal differential
- Had diarrhea
- Had pyuria
9 y/o RLQ pain w/ migration, T 38.3, vomiting, rebound TTP, WBC 15 – what is/are most appropriate next step?

a) CT scan with IV/enteric contrast
b) Limited US
c) Surgical consult
d) A or C
e) B or C
Appendicitis

- Prediction rules can help frame risk
- Children with classic history and findings can go to the OR
- Ultrasound is becoming the radiographic test of choice
- If workup is not pursued or if it is negative, the most important thing is rapid follow-up
## Appendicitis – Pediatric Appendicitis Score

<table>
<thead>
<tr>
<th>Item</th>
<th>Score (point)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anorexia</td>
<td>1</td>
</tr>
<tr>
<td>Nausea or vomiting</td>
<td>1</td>
</tr>
<tr>
<td>Migration of pain</td>
<td>1</td>
</tr>
<tr>
<td>Fever &gt;38°C (100.5°F)</td>
<td>1</td>
</tr>
<tr>
<td>Pain with cough, percussion or hopping</td>
<td>2</td>
</tr>
<tr>
<td>Right lower quadrant tenderness</td>
<td>2</td>
</tr>
<tr>
<td>White blood cell count &gt;10,000 cells/μL</td>
<td>1</td>
</tr>
<tr>
<td>Neutrophils plus band forms &gt;7500 cells/μL</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10 points</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Children (PAS)</th>
<th>Points</th>
<th>LR</th>
<th>20%</th>
<th>33%</th>
<th>40%</th>
<th>50%</th>
<th>60%</th>
<th>66%</th>
<th>75%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low risk</td>
<td>&lt; 4</td>
<td>0.13</td>
<td>3.1%</td>
<td>6.0%</td>
<td>8.0%</td>
<td>11.5%</td>
<td>16%</td>
<td>20%</td>
<td>28%</td>
</tr>
<tr>
<td>High risk</td>
<td>≥ 8</td>
<td>8.1</td>
<td>67%</td>
<td>80%</td>
<td>84%</td>
<td>89%</td>
<td>92%</td>
<td>94%</td>
<td>96%</td>
</tr>
</tbody>
</table>
Appendicitis Algorithm

Source: WSHA
Appendicitis

• Pediatric appendicitis is a very difficult diagnosis to make
  – 30% of children are perforated at time of final diagnosis
  – Focal RLQ tenderness or peritoneal signs deserve a workup
  – Fever and vomiting without diarrhea should prompt consideration of appendicitis
  – Ultrasound is best first imaging test, but is operator dependent
Testicular Torsion

• Always do a testicular exam

• Why?
  – You can’t trust teenage boys
  – Testicles are embarrassing
  – Pain can be referred from hemi-scrotum to lower quadrant
  – But mostly, who wants to talk about their testicle?
Testicular Torsion

- Lower quadrant pain should always prompt a gonadal exam
  - You don’t need to do testicular ultrasounds on all of these kids
  - Just examine for (and document absence of) testicular tenderness or swelling
Ovarian Torsion

- Usually sudden-onset, severe, unilateral pain
- Often associated with nausea and vomiting
- Most often in post-menarchal females, usually in association with ovarian cyst
- Ultrasound is best test but problematic
Adolescent Females

- Always ask a sexual history
- Always get an HCG
- Obtain dirty, then clean-catch urine
  - *Chlamydia*
  - *N. gonorrhea*
- www.cdc.gov/std
• 20% of ED/Urgent Care visits
• Definition – Rectal temperature ≥ 38°C or 100.4°F
• Fever vs. Hyperthermia
• Concern in fever without source – Occult bacteremia
Fever - Causes

• Infectious
  – Most fevers will be viral in origin
  – Serious bacterial infection
  – Non-serious bacterial infection
    • Otitis media
    • Streptococcal pharyngitis

• Inflammatory disease
  – Appendicitis
  – Kawasaki’s disease
  – Rheumatologic disease
Age-based Approach

- Children are not little adults
- And infants are not little children
- 0-30 days
- 31-60 days
- 60-90 days
- 3-36 months
Neonatal Fever - Principles

• Susceptible to generally harmless organisms (GBS, *Listeria*)

• Tend to disseminate infection

• Do not reliably show localizing signs

• Observation scores not reliable in infants
  – Experienced pediatricians 47-74% sensitivity

• Meningismus not reliable until 12 months of age
Neonatal Fever - Principles

• As many as 15% of children < 2 months of age may have a serious bacterial infection

• Most data from academic referral centers

• Your prevalence may be different
Referral Hospital – Fever 0-30 Days

- No safety evidence for outpatient management in this age group
- Ceftriaxone (once daily dosing) relatively contraindicated
- *Enterococcus* and *Listeria* not covered by ceftriaxone
Referral Hospital – Fever 0-30 Days

• Full workup for all
  – CBC/diff & blood culture
  – UA & urine culture
  – LP & CSF culture

• Admit all

• Treat all
  – Ampicillin for all
  – Gentamicin (no evidence of meningitis)
  – Cefotaxime (evidence of meningitis/traumatic tap)
Referral Hospital – Fever 30-60 Days

• Philadelphia Protocol (modified)
  – WBC > 5000 & < 15,000
  – Band:Neutrophil ratio < 1:4
  – Spun UA < 10 WBC/hpf, no bacteria

• Follow cultures
• No antibiotics
• Reassessment in 24 hours
• Negative predictive value = 100%
• If low risk labs, no LP needed
• If bronchiolitis, only UA needed

Baker et al. 1993 & 1999
9 month old immunized female with temperature of 105 at home; now non-focal exam, well-appearing – what single test would you choose?

a) CBC with differential
b) Catheterized UA + culture if indicated
c) Chest x-ray
d) Serum procalcitonin level
Fever – 2-36 months

- General approach for healthy children
  - Bacterial infections identified by exam
    - Otitis media
    - Cellulitis/Abscess/Lymphangitis
    - Lymphadenitis
    - Septic arthritis
    - Some cases of meningitis
  - Bacterial infections identified by history
    - Acute sinusitis
- Most will be viral
Fever – 3-36 months

• Special cases
  – Children with immunodeficiencies
  – Children receiving chemotherapy
  – Technology dependent children
  – Neurologically impaired children
  – Children with sickle-cell disease
  – Children with central-lines
Occult Serious Bacterial Infection

- Occult Bacteremia
- Urinary Tract Infection
- Occult Pneumonia
Occult Bacteremia

• Why do we care?
  – 40% of *S. pneumoniae* bacteremia resolves spontaneously, but…
  – Bacteremia can lead to sepsis or focal infection
    • Bone & joint infections
    • Endocarditis
    • Meningitis

• Historically vs. Post-immunization era
  – *Hemophilus influenza* B
  – *Strep. pneumoniae*
What Has Changed?

• *Hemophilus influenza* B vaccine introduced late 1980’s
  – In the 1970’s, accounted for 20,000 cases of invasive disease/year in the US

• Conjugated pneumococcal vaccine (PCV7) licensed 2000
  – Before introduction, 20,000 cases of pneumococcal bacteremia/year in the US

• PCV13 replaced PCV7 in 2010
  – Accounts for 62% of remaining IPD
FIGURE 1. Rate* of vaccine-type (VT) invasive pneumococcal disease (IPD) before and after introduction of pneumococcal conjugate vaccine (PCV7), by age group and year — Active Bacterial Core surveillance, United States, 1998–2003

* Per 100,000 population.
† For each age group, the decrease in VT IPD rate for 2003 compared with the 1998–1999 baseline is statistically significant (p<0.05).

MMWR, 2005
Fever - CBC

• Historically…
  – Increased risk of occult bacteremia if
    • WBC > 15,000
    • ANC > 10,000
    • Absolute band count > 1,500
    • T > 39
  – In the setting of PCV7
    • ??? (but significantly lower)
  – In the setting of PCV13
    • ???????
Occult Bacteremia (2-36 months)

- 84% reduction in S. pneumo bacteremia
- 67% reduction in overall bacteremia
- WBC > 15,000 is a poor predictor in the setting of an immunized population
  - Specificity 54.5%
  - Positive Predictive Value 1.5%
CBCs do not provide useful information in the workup of fever without source in otherwise healthy, immunized children.

If you choose to get a CBC:
- Decide what your threshold for treatment is *before* you get the test.
- If you order a CBC, *USE IT!*

Send a blood culture only if the CBC is concerning or the patient is high-risk.
When to Get a CBC?

- Appendicitis workup
- Septic hip workup
- Osteomyelitis workup
- Concern for malignancy
- Fever and petechiae
- Immunosuppressed children
- Unvaccinated children with T > 40
- Kids you are worried about
- Children with chronic medical conditions
Occult Serious Bacterial Infection

- Occult Bacteremia
- Urinary Tract Infection
- Occult Pneumonia
Urinary Tract Infections

- Most common SBI in young children
- Risk for renal scarring
- Strongly consider UTI in children with fever without source > 39°C (102.2°F)
  - All girls less than 2 years
  - Uncircumcised boys less than 1 year
  - Circumcised boys less than 6 months
  - Lower threshold for prolonged fever or if accompanied by vomiting
Urinary Tract Infections

- Catheterized or suprapubic sample is best
- Negative bag acceptable
- Positive bag specimen requires catheterized sample
- False negative rate of UA 10-50%
  - Culture all young infants
  - Culture those with history of UTI
UTI Treatment

- Treat 10-14 days for febrile UTI
- 1st line agent – PO cephalexin
- Know your local resistance patterns
Occult Serious Bacterial Infection

- Occult Bacteremia
- Urinary Tract Infection
- Occult Pneumonia
Pneumonia

• Physical Exam is not reliable for diagnosing pneumonia in young children
  – Thin chest walls
  – Acute RAD/bronchiolitis can sound like pneumonia

• Best indications for CXR
  – Fever AND Tachypnea
  – Hypoxemia
  – No clinical bronchiolitis or RAD
  – Prolonged symptoms
Pneumonia

- Indications for CXR
  - Fever > 38°C
  - Tachypnea
    - 0-6 months RR ≥ 59
    - 6-12 months RR ≥ 52
    - 12-24 months RR ≥ 42

- Positive Predictive Value = 20%
- Negative predictive value = 97%

Taylor et al., 1995
A word on S-non-B-I’s

- Influenza

- Current CDC recommendations are to treat patients at high risk for complications empirically with oseltamivir
  - Children less than 2
  - Chronic illness/immunodeficiency

- Clinical diagnosis is challenging in this age range

- Rapid POCT tests have poor sensitivity
Seattle Children’s Clinical Std Work

- Many guidelines available online
- Evidence-based systematic reviews
- Rationale and education embedded in documents
Thank you