Pediatric Emergencies: Part 2

Evidence-based Recommendations for Challenging Cases
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Part II: Recommendations for Difficult Cases

- Pyelonephritis in Infants <2
  - Interpreting urinalysis
  - How to collect urine
- Otitis Media
  - New Recommendations
- Bronchiolitis
  - Diagnostic approach
  - Management
- Imaging After Minor Head Trauma
Case Presentation #5

- Cherimoya is our 5 month old, uncircumcised male infant with no source for his fever, who has received 2 doses of PCV-7.
- Based on his well appearance, good follow up, and vaccine status, you have decided to hold off on a CBC.
- Questions:
  - Should he be tested for UTI?
  - How should urine be obtained for testing?
Background: Pyelonephritis in Children <2yrs

- Most common bacterial infection in infants with FWS
- Infants with FWS <3 months of age: HIGH RISK
  - Overall =10% (uncirc boys =19%, girls=13%) (Newman et al)
  - Febrile UTI often accompanied by bacteremia (10-20%)
- Infants with FWS 3 mo to 2 years (T>39)
  - Girls:
    - Prevalence around 5-10%
  - Boys:
    - **Circumcision** is the most important risk factor
    - Prevalence LOW among circ males => 0.2%
    - Uncirc boys 5-20 times higher
  - Other considerations: length of fever, height of fever, viral source
Recommendations: Who To Test

- Consider pyelonephritis in all infants and children <24 mo with FWS
- Estimate prior probability based on age, gender, circumcision
- Test for UTI in when probability >5%
  - All infants <3 months of age with FWS (T>38.5)
  - Infants 3-24 months with FWS (T>39):
    - All girls
    - Boys:
      - Uncircumcised boys < 6-12 mo of age
      - Circumcised boys < 3-6 mo of age
Background: Collection of Urine

- Urine is collected for
  - Screening UA
  - Culture
- Cath urine accurate but invasive
- Bag may be helpful in selected patients
Evidence: Screening UA in Infants

- Good sensitivity is most important characteristic of a screening test
- Leuk esterase
  - The *most sensitive* single test
  - Sens ~ 80-90%, Spec ~ 75-85%
- Nitrites
  - Higher spec (90-100%) but low sensitivity
- Sens/spec DO NOT vary depending on age, but *predictive value does!*
“Predictive value” refers to the posterior probability of disease, given a positive or negative test.

Depends on sensitivity, specificity, and prior probability.

Example: For a UA positive for LE only:

<table>
<thead>
<tr>
<th>Prior prob</th>
<th>PPV</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>5%</td>
<td>20%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>10%</td>
<td>33%</td>
<td>1%</td>
</tr>
<tr>
<td>20%</td>
<td>53%</td>
<td>3%</td>
</tr>
</tbody>
</table>

Which patients are most likely to be impacted?
Interpretation of UA: Depends on Prior Probability!

- In LOW PRIOR PROB (<5%) populations:
  - A negative UA has good predictive value to RULE OUT UTI
  - Positive results should be confirmed with culture

- In HIGH PRIOR PROB (>10%) populations:
  - PPV is high, may impact management
  - NPV poor, send culture anyway to confirm
Evidence: Can a bag specimen be used for UA?

- **Bottom line:** *No published data* compares sensitivity and specificity of UA collected by bag vs other methods!

- **Sensitivity of bag UA should be as high as cath:**
  - A negative bag UA just as helpful as negative cath UA
  - *Most helpful in low prior prob patients*

- **May have slightly decreased specificity (higher false positive rate) compared to cath specimen**
  - If this will impact management, consider getting a cath instead
Evidence: Can a bag specimen be sent for culture?

- Since the culture is our “gold standard” we need to minimize both false positives \textit{and} false negatives

- False positives with bag culture
  - Depend on the population, technique, and + threshold
    - Very low in circumcised boys
    - As high as 20% in other populations
    - Minimized when + threshold $= >100,000$ orgs

- False negatives
  - Depend on the threshold chosen for positive test…
  - For $>100,000$ org: sens and spec $\sim 85\%$
Predictive value of bag culture

- Usual + threshold is >100,000 orgs (to minimize false positives)
- At this threshold, sens and spec are both ~85%
- Example:

<table>
<thead>
<tr>
<th>Prior prob</th>
<th>PPV</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>5%</td>
<td>23%</td>
<td>1%</td>
</tr>
<tr>
<td>10%</td>
<td>40%</td>
<td>2%</td>
</tr>
<tr>
<td>20%</td>
<td>60%</td>
<td>4%</td>
</tr>
</tbody>
</table>

- The only clinically meaningful use of the bag culture is to rule OUT UTI in the low prior probability patient
Summary: Bag specimen

- Sensitivity of bag UA is just as good as cath
  - UA most useful to **rule out UTI in low probability patients**
    - If + may initiate treatment in high risk patient
- Bag culture
  - For low-risk patients: negative results helpful
  - For high-risk patients: both false positive AND false negative results are a significant risk
  - **Must weigh the implications of false pos/false neg for the patient, against the discomfort of a cath**
Recommendations for Collection of Urine: High PP Patient

- High risk =
  - <3 mo infant
  - Uncircumcised boy < 6mo
  - Sick enough to require IV antibiotics

- Obtain *cath specimen*!
  - Begin empiric therapy if UA positive
  - Send for culture anyway if negative
Recommendations for Collection of Urine: Low/mod PP Patient

- Collect specimen by most convenient method for screening UA

- Negative UA:
  - NPV is good, so skip the culture!
  - (send anyway if prior prob or risk is MOD)
  - *If you send the bag for culture – consider the clinical implications before you send the test!*

- Positive UA:
  - Nitrites: Start empiric treatment, send culture for ID/sens
  - LE alone: send confirmatory culture (cath or CLEAN bag)
    - Consider empiric treatment if moderate risk
Additional Recommendations: Treatment of Pyelonephritis

- Admit young (<3 months) or sick infants for IV antibiotics
- Outpatient therapy preferred in well-appearing children >3 mo
  - Observe 1st dose of abx
  - Close follow up, should respond in <48h
  - 10-14 days of PO treatment
- Local sensitivities determine treatment of choice
  - Cephalexin best choice in SF Bay Area
- Recommend UT imaging for high risk infants
Lamotrigine and Cherimoya’s vegetarian neighbors heard how great your ED was…

They bring in Quinoa, an 8 mo old boy with 3 d of runny nose, and 2 d of fever to 39 and fussiness.

He is well-hydrated and well-appearing, but on exam the R eardrum is erythematous, bulging and opaque.

Mom says he received amoxicillin for AOM 6 weeks ago
MC question:

In addition to pain and fever control, what is the best initial treatment option for Quinoa?

A. No antibiotics, most ear infections respond spontaneously
B. Amoxicillin 40-50mg/kg/day
C. Amoxicillin 80-90mg/kg/day
D. Augmentin, since he has recurrent/persistent OM
E. Azithromycin, since he has recurrent/persistent OM
Background: Otitis Media and Antibiotics

- Long history of management without antibiotics outside of U.S.
- Potential benefits of observation without antibiotics:
  - Fewer side effects
  - Reduce bacterial resistance
- Potential downsides:
  - Longer duration of illness
  - More complications
Overall, the majority of children with AOM do well, *whether or not they are treated with antibiotics*. However, antibiotics *improve rates* of clinical cure.

- **Randomized trial in UK:**
  - 70% vs 86% improved at 3 days
- **AHRQ meta-analysis:**
  - 12.3% *lower clinical failure* with antibiotics (NNT=8)
  - 1 day *shorter symptoms* in 5-14% of children (NNT 7-20)

Greatest difference improvement found in children with *more severe illness and younger age*. 
Evidence: Complications

- Rates have decreased in the post-antibiotic era
- Rates higher in countries which do not treat with antibiotics
- HOWEVER: AHRQ pooled data from 8 trials
  - Comparable rates of mastoiditis (0.6 vs 0.2%) in children treated with/without antibiotics
  - Children closely followed, some trials excluded young/sick
- Little evidence for lower rates with antibiotics
  - Estimated 36-87% of cases treated with prior antibiotics
Recommendations: Recent Clinical Guidelines

Recent AAP/AAFP guidelines based on review of available evidence

1. Consider diagnostic certainty in management
2. Assess and treat pain in all children
3. Consider observation without antibiotics in selected children
4. Specific antibiotics for initial/resistant infection
5. Reduction of risk factors
## Recommendations: Initial Management of AOM

<table>
<thead>
<tr>
<th>Age</th>
<th>Diagnosis: Certain</th>
<th>Diagnosis: Uncertain</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;6 months</td>
<td><strong>Antibiotics</strong></td>
<td><strong>Antibiotics</strong></td>
</tr>
<tr>
<td>6 mo-2 yrs</td>
<td><strong>Antibiotics</strong></td>
<td><em>Severe illness</em>: <strong>Antibiotics</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Non-severe illness</em>: <strong>Observation option</strong></td>
</tr>
<tr>
<td>&gt;2 years</td>
<td><em>Severe illness</em>: <strong>Antibiotics</strong></td>
<td><strong>Observation option</strong></td>
</tr>
<tr>
<td></td>
<td><em>Non-severe illness</em>: <strong>Observation option</strong></td>
<td></td>
</tr>
</tbody>
</table>
Diagnostic Certainty

- Acute onset
- Middle Ear Effusion (MEE)
- Middle Ear Inflammation (MEI)
Other Conditions for Observation Option

- Family/Social
  - Family agrees with plan
  - Able to observe and assess child
  - Communication/transportation available
Case continued

- Now that you’ve decide Quinoa should be managed with initial antibiotic therapy
- *What is the best initial choice for antibiotics?*
Evidence: Microbiology of AOM post - PCV-7

- Incidence of AOM has decreased 7-10%
  - Recurrent OM ↓ 20%
- Microbiology:
  - Decrease in vaccine strains of S. pneumoniae
  - Slight increase in H. influenzae/non-vaccine S. pneumoniae
  - Resistant strains less prevalent
Microbiology of AOM post-PCV-7

- **H. influenza**: 30-50%
- **M. cat**: 3-15%
- **S. pneumo**: 25-35% (30% PRSP)
- **Virus/No growth**: 40-70%
Recommendations: Initial Antibiotic Choice

- High-dose Amoxicillin (80-90 mg/kg/day)
  - Achieves MIC effective against most PRSP (intermediate + most high)
  - Estimated microbiologic cure in ~80% of AOM

- Severe illness: Consider amox/clav

- For PCN-allergic:
  - Cefdinir, cefpodoxime, cefuroxime, ceftriaxone
  - Erythro/sulfa, Azithro, clarithro
You discharge Quinoa from the ED with a prescription for high-dose amoxicillin for 10 days, and ibuprofen for pain and fever.

He returns 3 days later with persistent fever and fussiness. He is non-toxic, and there are no new findings on exam.

You conclude that he has failed initial antibiotic treatment for OM.

**Question:** What should we treat Quinoa with now?
Evidence: Microbiology of Recurrent/Persistent OM

- Persistence of initial organism most likely in early recurrences
  - Only 10% in late recurrences (> 14d)
- H. Influenza most likely pathogen
- 1/3 of S. pneumo recovered is high-level PRSP
Microbiology of Recurrent/Persistent AOM

- **H. influenza** 50%
- **S. pneumo** 30% (30% high PRSP)
- Other/ No growth
Recommendations: Treatment of Recurrent/Persistent OM

- Amox/clav will achieve clinical cure in majority
- Other options
  1. 3 doses of ceftriaxone:
     - Superior to 1 dose for recurrent/persistent disease
  2. Hi-dose azithromycin:
     - Superior to A/C at late follow up, fewer side effects.
  3. Gatifloxacin:
     - Superior to A/C in RCT’s
     - Arthropathy has not been demonstrated
Case Presentation #7

- Kohlrabi’s 3 month old brother, Rutabaga, is brought in mid-January with fever and difficulty breathing.
- VS: T = 38.5, RR 45, O2 sat: 92% on RA.
- Exam: He is alert and awake, with copious rhinorrhea, mild retractions and diffuse coarse wheezes on exam consistent with bronchiolitis.
MC Question: Bronchiolitis

The most appropriate diagnostic test at this time is:

A. Chest Xray
B. Nasal wash for RSV
C. CBC
D. All of the above
E. None of the above
Bronchiolitis: Coming soon to a child near you...

- The most common LRI in children
  - >50% of cases caused by RSV
- Self-limited disease
  - $700 million in hospitalizations annually
- Bronchiolitis vs asthma
  - Subset of patients (15-25%) later develop asthma
  - Certain treatments may be effective for these patients
Evidence-based guidelines for diagnosis and management of bronchiolitis

- Endorsed by AAFP, ACCP, ATS

Highlights for ED physicians:

- Diagnostic testing
- Treatment:
  - Bronchodilators
  - Steroids
- Indications for supplemental O2
AAP Guideline Recommendations: Diagnosis

- Evidence: Systematic review (Bordley, 2004):
  - Routine RSV testing, CXR and CBC have not been shown to reliably affect clinical management or outcomes, or predict severity of disease.

- Clinicians should diagnose bronchiolitis and assess disease severity on the basis of history and physical examination.

- Clinicians should not routinely order laboratory and radiologic studies for diagnosis.
Treatment of Bronchiolitis: Recent Evidence

- **Albuterol**
  - 2 meta-analyses: no clinically significant effects
  - Pts with *recurrent wheeze* more likely to benefit

- **Racemic epinephrine**
  - *Short-term improvement*: superior to placebo and B2- agonists in recent meta-analysis (Hartling, 2003) and Cochrane Database review (2004):
    - *Admission rates*: no difference
    - *Length of Stay*: reduced in large RCT
    - "Rebound": not reported in trials
Steroids: Recent Evidence

- Meta-analysis (Garrison et al, 2000):
  - Improved clinical symptom score
  - Reduced DOS-LOS (-0.43 days)
  - Effect greatest with recurrent wheezers, sicker pts

  - Found differences in symptom scores and LOS but insignificant.
AAP Guideline Recommendations: Treatment

- Mainstays of treatment are supportive
  - Oxygen, fluids and nasal/airway clearance.
- “Bronchodilators [and corticosteroids] should not be used routinely in the management of bronchiolitis”
  - “A carefully monitored trial of α-adrenergic or β-adrenergic medication is an option…should be continued only if there is a documented positive clinical response”
Additional Considerations:

- **Steroids**
  - Most likely to benefit sicker patients, and asthmatics
  - Consider dexamethasone

- **Hypertonic saline**
  - Small RCT: Improved short-term response to albuterol/epi when administered with 3% saline
  - Should NOT be used without bronchodilator!
Case Continued

- Rutabaga shows no response to a trial dose of albuterol
- He remains smiley and is tolerating po’s well
- However, his O2 sat is noted to intermittently drop to 89% on RA
- *Is hospitalization for supplemental oxygen recommended for this infant?*
AAP Guideline Recommendations for Supplemental Oxygen

- “Supplemental oxygen is indicated if SpO2 falls persistently below 90% in previously healthy infants”
  - Based on expert opinion and reasoning (eg: O2 dissociation curve)
New Evidence: Home O2 for Bronchiolitis

- Hypoxia is a frequent indicator for admission for bronchiolitis
  - Also prolongs 25% of admissions
- RCT in Colorado (Bajaj, 2006)
  - After randomization, the infants were observed for 8 hours in the ED:
    - Those discharged home on O2 did well
    - Of greater interest: 21% of patients changed disposition during observation period
      - 10% discharged home without O2
      - 10% admitted due to increased resp distress
Recommendations: Home O2 for Bronchiolitis

- An observation period is recommended before disposition in infants with bronchiolitis
  - Minimize excess admissions/need for readmission
- Consider home O2, if available, for infants in whom persistent hypoxia is the only indication for admission
Rocketship is a 9 month old boy brought in by his babysitter immediately after he is knocked over in his high chair by the family dog.

- She had turned her back, heard a crash and found him on the tile floor crying, with the dog looking on.

On exam the infant is somewhat fussy but consolable, he drinks from a bottle, has a non-focal neuro exam and a 2X2 cm red mark on his R occiput.
Multiple Choice Question

What would be your next step in management?
A. CT scan
B. Plain skull films
C. Head Ultrasound
D. Observation for 4-6 hours
E. Discharge if caregiver is reliable
Background: Imaging after Minor Head Trauma in Young Infants

- Intracranial injury (ICI) occurs in ~3%-6% of young infants and children with apparently minor minor HT

- Selective imaging:
  - Identify those with *clinically significant ICI*
  - Minimize unnecessary radiographs, sedation and admissions
Background: Imaging After Minor Head Trauma in Young Infants

- Head imaging guidelines often recommend a “lower threshold” for imaging children <2
  - Clinical assessment challenging
  - ICI may be asymptomatic
  - Higher risk for skull fractures
  - Higher risk for non-accidental trauma

- However, important to minimize unnecessary CT scans in these infants because:
  - More likely to require sedation
  - May be more vulnerable to effect radiation
Evidence: Predictors of ICI in Infants < 2

- Risk factors for significant ICI in infants <2:
  - Altered mental status
  - Focal neurologic findings
  - Skull fracture (SF)
  - Scalp swelling
  - Younger age (<6 mo)
  - Inflicted injury, or head injury without history of trauma

- Loss of consciousness (LOC) and vomiting have NOT been shown to be independent predictors of ICI
Evidence: Asymptomatic (Occult) ICI

- More prevalent in younger aged children
  - <3 to 6 mo
- Occurred 19% of 101 infants with minor head trauma studied by Greenes et al (1998)
  - All ICI occurred in infants < 1 year
  - 95% also had skull fractures
Evidence: Skull Fracture and ICI

- Incidence of SF: 6-30%
  - Highest in younger age group
- SF is a better predictor for ICI in young infants than clinical symptoms
  - Positive predictive value 15-30%
  - Sensitivity best in young infants (60-100%)
    - Sensitivity may be as low as 50% in older infants
- Scalp hematoma:
  - 80-100% sensitive for associated SF
  - Most sensitive in older infants
Recommendations: Imaging After Minor Head Trauma in Children <2

- Use clinical and historical findings to stratify into High, Intermediate or Low Risk

- High Risk (symptomatic)
  - Obtain CT scan

- Intermediate Risk
  - Potential indicators of ICI OR Risk Factors
  - Imaging or observation for 4-6 hours
  - Occult ICI most likely in those <6 mo of age, scalp hematoma, skull fracture, higher force mechanisms, unwitnessed

- Low Risk
  - Asymptomatic AND no risk factors May be discharged without imaging
Child <2 yrs with apparent minor head trauma

**Is the child HIGH RISK for ICI?**
- Depressed mental status
- Focal neurologic findings
- Prolonged seizure
- Irritability
- Acute skull fracture
- Bulging fontanelle
- Vomiting >5 times or >6 hrs
- Loss of consciousness >1 minute

  **Yes**
  - CT scan
  - Neurosurgical consultation

  **No**

**Is the child INTERMEDIATE RISK (potential indicators of ICI)?**
- Vomiting 3-4 times
- Loss of consciousness < 1 min
- History of lethargy/irritability, but now resolved
- Caretaker concerned that behavior is not at baseline
- Non acute skull fracture (>24h)

  **Yes**
  - Decision to obtain CT?

  **Yes**
  - CT scan (go to A)

  **No**
  - Consider DC if meets criteria

  **No**

**Is the child INTERMEDIATE RISK (additional risk factors)?**
- Higher force mechanism
- Hematoma, Fall onto hard surface
- Unwitnessed, possible significant trauma
- Signs/sx of head trauma, no hx

  **Yes**
  - Decision to image?

  **Yes**
  - CT or skull Xray?
    - Consider:
      - Clinical scenario
      - Availability
      - Need for sedation
      - Radiology expertise

  **No**
  - Observation (go to B)

  **No**

**Is child LOW RISK for ICI?**
- Low energy mechanism (<3ft)
- No signs/sx >2 h post-injury
- Older age more reassuring
  (*6mo)

  **Yes**
  - Discharge if meets criteria

  **No**

**CT scan**

**Decision to obtain CT?**

**Observe.**
- Asymptomatic 4-6 h post head trauma?

  **Yes**
  - Observation (go to B)

  **No**
  - CT scan (go to A)

**CT scan (go to A)**

**Consider DC if meets criteria**

**Discharge if meets criteria**

*Discharge Criteria*
Key Points: Pyelonephritis

- High risk: Cath urine for UA and culture
  - Send culture even if UA is negative
- Low/mod risk: Bag urine OK to screen
  - Send culture if only if UA positive
  - False pos/neg BOTH a risk of bag culture!
- Treatment: Outpatient OK in most patients
Key Points: Otitis Media

- Observation without antibiotics an option for certain patients, with good follow-up
- High-dose amox is first-line antibiotic for uncomplicated AOM requiring treatment
- For recurrent/resistant disease (<14 days) H. influenza most likely pathogen
Key Points: Bronchiolitis

- Diagnosis is clinical
- Mainstays of treatment are supportive
  - Consider trial of albuterol/epi,
  - *Pts with asthma more likely to benefit from bronchodilators, steroids*
- Supplemental O2 recommended when O2 sats persistently < 90%
- Observation in the ED may lead to more selective disposition of patients
Key Points: Imaging After Minor Head Trauma for Infants < 2

- Young infants at higher risk for skull fracture and occult ICI
- Those who are asymptomatic, but with risk factors, should be imaged or observed before discharge
Thank You!

Don’t forget to eat your vegetables!