Respiratory Distress: An Evidence-Based Approach
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CROUP

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<th>Mild</th>
<th>Mod</th>
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<tr>
<td>Barking</td>
<td>Stridor</td>
<td>Stridor at Rest</td>
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<td>Steroid?</td>
<td>Yes</td>
<td>Yes</td>
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<td>Racemic Epi?</td>
<td>No</td>
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<td>Admit</td>
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Basics
- Ages: 6mos – 6yrs (peak at 2yrs)
- Parainfluenza is the most common etiology, but it can be any virus really

Presentation
- Typically have 1-3 days of URI symptoms and then develop Harsh, Barking cough
- With or without stridor
- Diagnosis is clinical (another positive of this condition!)

Management
- Croup Scores
  1. Useful in research to ensure comparability…
  2. I'm not smart enough to remember them… so I prefer the following:
     1. **MILD CROUP**—Barky Cough, No Stridor
        1. Decadron (0.6mg/kg po once, 0.15mg/kg has also shown benefit)
        2. The steroid will NOT necessary improve the condition, but can prevent it from progressing – so be very clear with the family to manage expectations.
     2. **MODERATE CROUP**—Barky Cough, Stridor with agitation/excitement
        1. Decadron – can decrease symptoms and improve stridor.
        2. Observation – this is to define whether the stridor is ever at rest… when you first evaluate the child, he/she is likely not at rest as you either excite or agitate them (maybe that’s just me). So reassess the patient at rest. No stridor at rest? No Racemic Epi needed.
        3. Inform family that cough will last for even several weeks and that the stridor may recur during episodes of agitation/excitement.
     3. **SEVERE CROUP**—Barky cough, Stridor AT REST!
        1. Decadron
2. Racemic Epinephrine – will work faster than the steroids, but has short half-life.
3. Ideally, one dose of Racemic Epi will improve patient long enough for steroids to start to work and both alleviate Stridor at Rest.
4. Requires Observation to determine duration of efficacy. If patient does not require any more Racemic Epi after 2 hours, then the patient can be safely discharged home.
5. If the patient requires more Racemic Epi, then admission for further management is warranted.

- OTHER THERAPIES
  1. Cool Mist – never proven to be effective (but little downside)
  2. Heliox – helps alleviate the turbulent airflow created by the supraglottic edema and, thus, improves stridor and decreases work of breathing.
  3. BiPap – anytime that you are dealing with increased work of breathing, consider BiPap. This hasn’t been specifically proven to work for severe croup… but it still may help.
  4. Intubation – there will be some that require an ETT… anticipate a difficult airway (have all of your back-up plans) and use 1-1.5 smaller size ETT than normal.

Consider:
- If the patient is not responding like you thought he/she should have, then it is time to readdress the diagnosis and consider others like:
  1. Bacterial Tracheitis (see separate Morsel on this!)
  2. Foreign Body Aspiration
  3. Epiglottitis (may present atypically now with HiB vaccination)

Admit
- Stridor at rest despite racemic Epi
- Persistent respiratory distress
- Dehydration
- Poor social situation.

Croup vs Recurrent Croup
- Viral Croup is does not usually occur more than once (or twice) in a year in a otherwise healthy child.
- Croup like symptoms that occur more frequently (>2 a year) have been called “Recurrent Croup.”
- Essentially, recurrent croup is not due to a viral etiology and should be considered a RED FLAG for another condition.
- Recurrent croup can be the presentation of underlying intrinsic or extrinsic airway narrowing.

- Croup
  - Usually 1-2 episodes per year
  - Ages: 6 mos – 3 years with peak at 2 years
  - Usually short in duration (1-2 days)
  - Standard therapy usually treats the symptoms

- Recurrent Croup
  - > 2 episodes per year
  - Any age. Be suspicious of croup in a child < 6 months or > 3 years of age.
  - Relapsing and remitting course. Can persist over weeks.
  - Some or no response to standard therapy for croup.

Recurrent Croup – Some Causes to Consider
- Airway
- **Subglottic stenosis**
  - Congenital
  - Traumatic – from prior intubation
- **Subglottic cysts**
- **Subglottic hemangioma**
  - Look for hemangiomas on the child’s face, particularly the beard distribution.
- **Recurrent respiratory papillomatosis**
- **Vocal cord paralysis**
- **Tracheoesophageal fistula**
- **Tracheomalacia**

- **Others**
  - Foreign Bodies
  - Congenital cardiovascular abnormality
  - Gastroesophageal reflux
  - Asthma / Allergy
  - Mediastinal mass

**Timing of Stridor**

- Not everything works as planned… but listening to the timing of the stridor can help point toward potential cause.

  - **Inspiratory**
    - Supraglottic problem
    - Laryngomalacia is an example.

  - **Expiratory**
    - Tracheal pathology
    - Ex, compression from aberrant vascular structure.

  - **Biphasic**
    - Glottic or Subglottic problem
    - Subglottic stenosis or vocal cord paralysis are examples.

**Croup and Negative Pressure Pulmonary Edema**

- Also referred to as “Post-Obstructive Pulmonary Edema”
- Can be caused from **severe, sudden upper airway obstruction** (Type I)
  - Cases reported due to laryngospasm, epiglottis, croup, aspirated FB’s, and angioedema. [Chen, 2010]
  - Even seen in agitated patient after **biting down on endotracheal tube**. [Bhattacharya, 2016]
  - Can also develop after surgery (especially ENT T&A surgery) for **upper airway obstruction**. (Type II) [Sonsuwan, 2014; Mehta, 2006]

- **Forced inspiration against a closed or obstructed glottis** generates excessive negative intrathoracic pressures [Bhattacharya, 2016]
  - Known as **Muller Maneuver**.
  - -140 cm H2O compared to baseline of -4 cm H2O
  - This increases venous return to right heart and **increases pulmonary venous pressures**.
  - Additionally, low cardiac output leads to **increased high afterload pressures**.
  - These combine to cause **increased hydrostatic pressures** $\rightarrow$ fluid moves from pulmonary vasculature to the interstitial space $\rightarrow$ **Pulmonary Edema $\rightarrow$ Hypoxia**
  - Acute airway obstruction can also lead to hypoxia, which further causes pulmonary vasoconstriction, pulmonary hypertension, and right heart failure.
  - Usually occurs **within minutes of airway obstruction**; often resolves within 12-24 hours. [Bhattacharya, 2016; Chen, 2010]
Presentation of Negative Pressure Pulmonary Edema

- May present with obvious **signs of upper airway obstruction** (stridor, increased work of breathing/retractions, hoarseness, drooling).
  - May also present after the episode of obstruction resolved (so, perhaps you took appropriate actions to fix the problem with positioning, medications, or intubation).
- Signs of Pulmonary Edema [Chen, 2010]
  - Hypoxemia
  - Frothy sputum in nonintubated patient or **edema fluid** in endotracheal tube.
  - Bilateral infiltrates on CXR

Treatment of Negative Pressure Pulmonary Edema

- **Early recognition** is important (remember, hypoxia in a patient with “croup” is odd).
- **Beta-agonists** may help improve fluid clearance. [Bhattacharya, 2016]
- **Supplemental oxygenation**
  - May need high flow nasal cannula
  - May need intubation — may need to even consider **delayed sequence intubation**
- May need **Positive Pressure Ventilation**
  - Use lung protective ventilation strategies
  - Low tidal volume (6 mL/kg) and plateau pressures less than 30 cm H2O.
- **Use of diuretics**
  - Still controversial [Chen, 2010]
  - May be beneficial, if patient is not hypotensive. [Bhattacharya, 2016]
- May require Prone Positioning or even **ECMO**.

TRACHEITIS

Tracheitis in Children: Basics

- **Tracheitis is an inflammatory process of the trachea!**
  - That inflammation can be due to:
    - **Bacterial infection**
    - **Viral infection**
      - **HSV** has even been found to be a culprit. [O’Niel, 2013]
      - Coinfection, particularly with **Influenza** can be seen. [Hopkins, 2006]
    - **Chemical irritation**
    - **Thermal irritation**
  - It is **Dangerous!**
    - It can be a **true medical emergency**.
    - While rare, it has emerged as the **most common potentially life-threatening upper airway infections in children**. [Hopkins, 2006]
    - Traditionally, described as leading to critically ill and toxic appearing patients.
      - Thick exudative plaques can obstruct the airway!
    - **Epidemiology has been shown to be changing**, though, and can present with **less severe disease**. [Casazza, 2018]
  - **It’s All Connected!**
    - Ok, this is obvious, but we often think of conditions as being isolated… pneumonia is in the lungs, croup is the trachea, pharyngitis is in the pharynx…
    - But, those **processes can overlap adjacent regions**.
    - **Isolated Tracheitis is rare**. [Blot, 2017]
      - Inflammation usually affects continuous structures also.
      - **Larngotracheitis, tracheobronchitis, laryngotracheobronchitis** (which also refers to croup)
Pediatric Bacterial Tracheitis:
- Should be considered when there is a toxic appearance or poor/no response to therapies (ex, steroids, racemic epi). [Blot, 2017]
- Now most likely due to S. Aureus, often MSSA. [Casazza, 2018; Tebruegge, 2009; Hopkins, 2006]
- H. influenzae was once most common, but now reduced frequency due to HiB vaccine (although still ~16% of cases).
- Viral Coinfection can be seen in ~30% of cases. [Casazza, 2018; Blot, 2017; Tebruegge, 2009]
  - Typically will have had a “viral prodrome.”
  - May have even begun as viral Croup or “the Flu.”

Tracheitis in Children: Presentation

- It’s Challenging to Diagnosis!
  - With the overlapping conditions and the more common entities presenting similarly, it can be difficult to pick up on.
  - Standard imaging does not reliably diagnosis it.
  - It can present dramatically or subtly.
  - Requires high index of suspicion for subtle cases.

Presentation:
- May look similar to: [Blot, 2017]
  - Epiglottitis
  - Tracheal Foreign Body
  - Retropharyngeal Abscess
  - Tracheal Edema (ex, anaphylaxis)
  - Diphtheria
- Symptoms similar to other causes of airway obstruction. [Blot, 2017]
  - Tachypnea
  - Stridor
  - Hoarse voice
  - Cough (may be productive or may have coughing fits — hmmm, like pertussis)
  - Dyspnea and agitation
  - Fever
    - Fever is not always seen with viral croup…
    - More frequently seen with bacterial tracheitis, although not necessary.
- Nosocomial / healthcare associated tracheitis presents differently. [Blot, 2017]
  - Patients with tracheostomy may have bacterial colonization of their stoma that then infects their adjacent trachea.
  - Patients with endotracheal tubes can develop ventilator-associated bacterial infection.
  - May present with fever, increased secretions, change in secretions, or increased oxygen requirement.
- Community Acquired Bacterial Tracheitis – It’s a Spectrum
  - May present with Toxic Appearance.
    - Once taught to be the primary form.
    - Recent study had only 17% presenting with Toxic Appearance. [Casazza, 2018]
  - May actually be a continuum.
    - Mild Upper Respiratory Infection -> Severe Bacterial Tracheitis
    - “Exudative Tracheitis” is used to describe cases with exudate, but without systemic toxicity. [Casazza, 2018]

Tracheitis in Children: Management

- Toxic appearing?
  - Treat similarly to what you would with Epiglottitis.
- Keep patient calm.
- Have patient taken to the OR for rigid bronchoscopy and, likely, intubation.

### Not exactly Toxic appearing, but not quite right?

#### Have High Index of Suspicion!

- Patients with **atypical course** or who **don’t respond to therapies** are waving the **red flag** at you!
  - *Just diagnosed last week with Croup and now with recurrent stridor?*
  - *Seemed like croup, but Racial Epinephrine and Dexamethasone has made no difference?*
- Bacterial Tracheitis should be considered with:
  - **Worsening stridor**
  - **Respiratory distress**
  - **High fever**
  - **Orthopnea**
  - **Dysphagia**

#### Plain Films may help.

- PA and Lateral neck films and Chest Xray are often discussed. [Blot, 2017]
- CXR can show concomitant pneumonia (which would support bacterial tracheitis)
- PA/Lat neck films may show Steeple sign and an **uneven/ragged tracheal wall** concerning for intraluminal tracheal membranes.

#### Flexible endoscopes can help! [Blot, 2017; Shargorodsky, 2010]

- Calling your **ENT consultants early**.
- Bedside scope or scope in the OR to evaluate the supraglottic structures is helpful:
  - May show **mucosal edema, pseudomembranes, ulcerations, microabscesses**, and **purulent secretions** that don’t clear.
  - Can **rule-out epiglottis**.
- If scope is abnormal, then would need full bronchoscopy.

### Treat the Patient!

- Look for signs of **SHOCK** and treat with **Fluids and Pressors** as needed.
- **Ampicillin-clavulanic acid and a 3rd generation cephalosporin** are typically selected to treat bacterial tracheitis. [Blot, 2017; Tebruegge, 2009]

### EPIGLOTTITIS

#### Epiglottitis: Basics

- Potentially **life-threatening condition** due to acute airway compromise.
- **Epiglottitis = inflammation of the epiglottis and surrounding tissues.**
- Can lead to airway obstruction and subsequent respiratory arrest.

#### Epiglottitis: Causes of the Swelling

Anything that causes edema of the epiglottis can lead to the condition. [Richards, 2016]

- **Infection**
  - *Haemophilus influenzae* type B
    - Was the most common cause prior to initiation of Hib vaccinations
    - Now it accounts for ~1 case per 100,000 kids. (**YEAH IMMUNIZATIONS!**)
  - Group A and F *Streptococci* [Faden, 2006]
  - *Strep pneumonia*
  - *Klebsiella sp*
  - *Staphylococcus aureus* (including MRSA)
- **Thermal Burn**
  - Can be due to inhaled hot steam. [Kudchadkar, 2014]
  - Heat-carrying capacity of steam is 4000 times that of heated air. [Kudchadkar, 2014]
  - Quickly can overcome the cooling effects of the upper airways. [Kudchadkar, 2014]
Leads to mucosal edema that develops over time.

- Trauma
- Caustic Ingestions

Epiglottitis: Presentation

- With the location of the epiglottis, symptoms are classically:
  - Sore Throat
  - Dysphagia and subsequent Drooling
  - Muffled Voice
  - Stridor
    - Progressive Respiratory distress
    - Tripod positioning
  - Anxiety *(I'd also be anxious if I couldn't breath)*
  - Fever and Toxic appearance
- Similar presentation can be seen with bacterial Tracheitis.
- Classically, epiglottis that is caused by infections has an abrupt onset.
- Other causes, like thermal burns from steam, can lead to a gradual onset of symptoms.

Epiglottitis: Management

- Make every effort to keep child comfortable.
  - Anxiety will worsen stridor
    - More turbulent airflow will occur
    - Increased work of breathing
    - Delay IV attempts or IM injections
    - Do not use tongue depressor as this may worsen agitation.
- Call your friends
  - You know… your surgeons, your anesthesiologists, and your ENT docs.
  - Direct visualization of the epiglottis is the only way to confirm or rule-out the condition.
  - This should be done in an area where the child can be kept comfortable and where an emergent surgical airway can be performed.
    - Classically, this is an operating room.
- Images?
  - Again, the only way to truly rule in or rule out the condition is via direct visualization, but…
  - Plain films may be helpful to evaluate for foreign bodies.
  - Plain film may also show a “thumbprint” sign – swollen epiglottis.
- Intubation?
  - Hopefully can be avoided, but may be necessary.
  - Expect to use smaller ETT size than age would predict.
  - Be prepared for circothyrotomy and transtracheal needle ventilation.
- Medications?
  - No proven benefit (or harm) of steroids.
  - No proven benefit of racemic epinephrine (although it may further agitate the child).

ASPIRATED FOREIGN BODY

Severe vs Subtle

- In 2001, ~ 17,537 children < 14 yrs were treated in EDs for choking-related episodes.
- Rates highest for infants (<1 yr) and decreased with age.
- Candy/gum – 19%
- Coins – 12.7%
- In 2000, **160 children < 14 yrs died** from aspirated foreign bodies.
  - Food substances were involved in 41% of cases.
- Severe symptoms often develop acutely and more commonly have a suspicious history for a aspirated foreign body.
  - Cough, stridor, difficulty breathing
  - Stupor, cyanosis, respiratory arrest.
- The history, however, may not be helpful in more subtle cases, particularly if the episode was not witnessed or the patient is not able to clearly communicate what happened (ex, infant, debilitated patient, or reluctant / embarrassed teenager).
- The classic presentation of **cough, wheeze, and diminished breath sounds are only seen in 40%** of patients with aspirated foreign bodies… and when present, can be misconstrued as other conditions like reactive airway disease, URI, or bronchitis.
- Sometimes aspirated foreign bodies can be completely asymptomatic initially and present later with complications of retained foreign body.
  - Chronic Cough
  - Recurrent pneumonia
  - Recurrent / persistent “croup”
  - Poorly controlled “asthma”
  - Lung abscess
  - Hemothysis
  - Progressive respiratory distress
  - Death
  
  *If you are considering the diagnosis of chronic cough or recurrent pneumonia, high on your potential DDx should be undiagnosed retained foreign body.*

**Tracheal vs Bronchial Foreign Body**

- Patients with a tracheal foreign body are more likely to have:
  - **Dyspnea.**
  - Early diagnosis compared to bronchial foreign bodies.
- Patients with a bronchial foreign body are more likely to have:
  - Alternative diagnosis upon first presentation.
  - **Delayed Diagnosis.**
  - Decreased breath sounds.

**Plain Radiograph Utility**

- Unfortunately, plain x-rays are not adequate enough to rule-out the presence of a aspirated foreign body.
- One study that compared radiographic findings to endoscopic findings found no abnormalities on x-ray in **24%** of confirmed foreign body cases.
- Their sensitivity and specificity were 68% and 67% respectively.
- As with all testing, your pre-test probability needs to be factored into the interpretation of the results.

*The parents saw the child put a Leggo piece in his/her mouth and now that piece is missing and the kid has a persistent cough: a normal x-ray does not take the possibility of aspirated foreign body off of the DDx.*

**The Evaluation**

- Naturally, based on the above, a high index of suspicion is necessary in many cases of aspirated foreign body that present less acutely.
- For those in acute distress, support oxygenation and ventilation!
- For others, obtain plain films with the understanding of their limitations.
  - Look for focal hyperinflation
    - May need exhalation film (for kid who cooperates)
- May need decubitus film (for younger kid) – the dependent lung **should not** be normal size… if it is, it is hyperinflated.
- Focal atelectasis may also be present.
- CT Scanning may reveal material in the airway and focal airway edema, but comes with cost of radiation, and does not offer therapeutic option if foreign body present. CT may also not show rule out all foreign bodies.
- **Bronchoscopy** is the preferred Diagnostic and Therapeutic plan.
  - Flexible Bronchoscopy may be used to define and detect the foreign body, but removal of the foreign body is often more difficult with the flexible scope.
  - Rigid Bronchoscopy is the preferred procedure for removal of the foreign body.

**Factors Related to Delayed Diagnosis of Aspirated Foreign Body**

- **Younger age**
  - Kids *3 years of age and younger* are more likely to be diagnosed with foreign body in a delayed fashion.
  - These kids are less able to give a reliable history and more at risk (as mentioned above) for aspiration.

- **Negative Chest X-rays**
  - Just because the child’s CXR is negative, doesn’t mean that there is not a foreign body!
    - It just means your job is more difficult.
  - ~50% **of known cases of aspiration will have normal chest x-rays**.
  - Special projection films (decubitus position, exhalation films) can help, but should not be used to completely rule out the condition.
  - **Normal X-rays should not preclude bronchoscopy in a patient that you have concern for an aspirated foreign body.**
    - That is taken from the ENT literature — in case you need some support when dealing with consultants.

- **Care provider negligence**
  - When no one is supervising, badness can happen (says Captain Obvious).
  - One study showed that having **No history of a witnessed aspiration episode** was associated with delayed diagnosis.
  - A lack of a parental report of an aspiration event should not sway you from considering retained foreign body in a child whose clinical picture suggests it.

- **Lack of typical symptoms**
  - With a radio-opaque foreign body, the **diagnosis will depend on the history** (hopefully someone saw something) and the physical exam.
  - Unfortunately, after the initial choking event, the aspirated foreign body may cause little if any symptoms, particularly if it falls to the bronchus.
  - The diagnosis is then delayed until symptoms of complications arise.
  - **Location matters:**
    - Larynx – typically will have symptoms of obstruction, dysphonia, or hoarseness. If blockage is complete, then can have cyanosis and severe distress / arrest.
    - Trachea – similar to larynx in presentation, but can have biphasic stridor, dry cough. Often appear uncomfortable or scared.
    - **Bronchus** – 80-90% of foreign bodies are found in the bronchus. **Only 65% will have triad of cough, wheeze, and decreased breath sounds! Can be asymptomatic!**
    - The absence of symptoms and signs does not rule out the possibility of foreign body if the child has a concerning history of aspiration.
We were not vigilant
- Simply put, we didn’t think about the possibility.
- The diagnosis can be rather difficult, as it may present similar to other conditions:
  - **Recurrent Croup** and **Croup** are commonly diagnosed instead of **Foreign Body**.
  - Asthma, bronchitis, pneumonia, laryngitis, and URI are other common mis-diagnoses.

Believe the Parents
- Multiple studies have shown that, while a variety of clinical signs may be seen with an aspirated foreign body...
- **The most sensitive clinical indicator for an aspiration is there being a “Witnessed Aspiration Episode.”**
- Since the physical exam and radiographs may be unenlightening, the parental report of a choking crisis needs to be taken seriously!

BRONCHIOLITIS

**Apnea is not the only concern!**
- **Apnea** … certainly that is bad.
  - We have all learned that **RSV** can cause apnea…
  - RSV isn’t the only culprit of bronchiolitis
  - Human Metapneumovirus, Influenza, Parainfluenza, Adenovirus, rhinovirus, etc.
  - So SYNAGIS (monoclonal antibody against RSV) may not prevent Bronchiolitis.
  - RSV does seem to cause more “Severe” disease though.
- **Fatigue** (it is tough to breath 70 times a minute)
- **Hypoxia and cyanosis** (serious VQ mismatch)
- **Dehydration** (tough to drink when you are breathing 70 times a minute)
- **Pneumonia** (actually an uncommon complication)

High Risk Factors for Complications
- **Prematurity**
  - GA < 37 weeks
  - **Post-Conception Age** < 42 weeks
- **Age** < 3 months
- **Chronic Lung Disease** (ex. CLD, requiring Home Oxygen therapy, Cystic Fibrosis)
- **Hemodynamically significant heart disease**
- **Neurological disease** (with hypotonia particularly)
- **Immunocompromised state**
- **Airway Anomalies**

Who needs to stay?
- There are no well-drawn guidelines on this as the disease process of bronchiolitis is so varied, often has overlap with other entities (reactive airway disease), and is relatively difficult to study… but that means your **CLINICAL EXAM is paramount** (I love when that happens).
1. **Unable to maintain adequate hydration**
   1. Working too hard to drink or too ill to care about drinking.
   2. They don’t need to be drinking as much as “normal” – remember that they are normally consuming enough to grow; during times or illness, we don’t care about growing as much as staying hydrated. So assess hydration clinically (see **ORT Morsel**).
2. **Hypoxia**
   1. No single Pox value to help determine admission for everyone.
2. Healthy kids on RA should have Pox >95%
3. Oxyhemoglobin dissociation curve has significant inflection point at ~90%, so we’d like everyone to stay above that. But that curve gets shifted to the right with fever, so I usually aim for >92% on RA.
   1. Important to consider the dynamic nature of the disease and observe child at rest, while active, and while eating.
   2. The alert child with Pox 91% who feeds easily and has no significant work of breathing is better off than the one who cannot feed and has retractions with a Pox of 93%.
3. **Have High Risk Factors** (listed above)
   1. Again, nothing is written in stone… the 2 month old who looks fantastic and is feeding well and not hypoxic does not need to stay just because he is 2 months old.
4. **Consider the disease course**
   1. Typically Bronchiolitis symptoms peak on days 3-5.
   2. If the patient has moderate symptoms on day 2… day 3 will likely be worse.
   3. If the child is doing fairly well on day 3, then the tough part is likely beyond them.
5. **Consider family ability to care for the kid** (subjective I know…)

**Management**

- DEEP NASAL Suctioning!! (no randomized control trials to assess this… but seems to make the most sense!)
- There are numerous studies that continually conflict with each other. Part of the problem is the heterogeneity of the disease makes it difficult to study consistently.
  - What seems to be agreed upon:
    - Steroids alone do not benefit.
    - Ribavirin does not benefit.
    - Supplement oxygen is required if the patient persistently has Pulse Ox below 90%.
      - Supplemental oxygen can be discontinued once the pt is sat’ing above 90%, feeding well, and in no resp distress.
    - Bronchodilators alone do not show significant benefit and shouldn’t be used routinely.
      - A trial can be attempted and if there is a positive response, they can be continued.
      - Some choose albuterol to use as the trial medication.
        - Pro: if there is an improvement, you can send them home with it. Subcommittee recommended its consideration.
        - Con: no consistent evidence to support its use. May confuse family to think there kid has asthma.
      - Some choose racemic epinephrine as the trial medication
        - The most recent studies looking at Racemic Epi plus Decadron do argue for this combination’s use and tout its cost-effectiveness; however, the doses of steroids that they use are high (Decadron 1mg/kg x first dose, then 0.6mg/kg for 5 days [Max dose = 10mg]).
        - Pro: makes you feel fancy when you give it. Many studies support its use (of course others do not).
        - Con: can’t go home with it.
    - The current debate: **Hypertonic saline** (3% or even 5%) plus Epinephrine OR Steroids plus Epinephrine (because if one thing doesn’t work, try two).
      - There are studies that support hypertonic saline as a therapy to reduce length of stay once hospitalized. Mixed results as to whether it is useful to help reduce admissions from the ED.
      - There is evidence that 5% may be better than 3%, but still generates unimpressive statistics to truly support its use.

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