Noisy Breathing in Children
New Mexico Medical Society
Aug 17, 2023

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Outline

● Anatomy - pediatric and adult
● Ddx of noisy breathing in infants - children/adolescents
● Work up - fine tuning your exam and history
● Management
● When to refer to ENT
Anatomy

- Narrow nostrils, newborn obligate nose breather
- Occiput rounded
- Tongue relatively large for mouth
- Epiglottis omega-shaped and floppy
- Larynx higher in neck
- Vocal cords slant anteriorly
- Neck short
- Cricoid ring: narrowest diameter
Anatomy

8-12 years of age

Anterior

Posterior

**Normal**

- Infant: 4 mm
  - Resistance: \( R \sim \frac{1}{\text{radius}^4} \)
  - X-sect area
  - Increase: 16x
  - Decrease: 75%

- Adult: 8 mm
  - Increase: 3x
  - Decrease: 44%

**Child**

**Narrowest point**

**Cricoid**

**Adult**
Levels of the Airway and Noisy Breathing

Stertor

Nasopharynx
Oropharynx
Hypopharynx
Larynx

Stridor

Nasal cavity
Oral cavity
Esophagus
Trachea
Levels of the Airway and Noisy Breathing
Levels of the airway and stridor

- **Inspiratory**
  - Extrathoracic
  - Supraglottic
  - Glottic
  - Upper Trachea

- **Expiratory**
  - Intrathoracic
  - Expiratory Stridor $\approx$ Wheeze

- **Biphasic**
  - Fixed
  - Glottis or below
Flexible Nasolaryngoscopy
Microlaryngoscopy with Rigid Bronchoscopy
Infants - Stertor - Nasal Cavity/Nasopharynx

- Common - inflammation
  - Reflux/CMA - worsens during/after feeds, when supine.
  - Infectious - fever or other signs up upper/lower respiratory disease
  - Neonatal rhinitis - NOS

- Rare - CONSTANT
  - Midface hypoplasia (syndromic)*
  - Choanal atresia (UL/BL*)
  - Pyriform aperture stenosis*
  - Congenital masses*
    - NLDC
    - Glioma/Meningioma/Encephalocele

* Diagnosed at birth
Infants - Stertor - Oral Cavity/Oropharynx

- Micrognathia
  - Alveolar ridge

- Cleft palate (submucus)

- Vallecular cyst

- Ankyloglossia*
  - Aerophagia/feeding difficulties

- Poor tone
  - Other neurologic signs?
  - Poor feeding
Infant - Stertor - Common things being common

- Thorough history and exam
- Consider managing reflux medically
- Medical management of rhinitis
  - Saline/suction
  - Neosynephrine: 2 drops BID x 3 days*
  - Dexamethasone ophth: 2 drops TID until improvement (4-6 weeks)

Need to refer

- Consistent unilateral nasal obstruction
- Epistaxis (after ruling out nasal aspirator abuse)
- Difficulty feeding/gaining weight (can frequently start with an SLP referral)
- Failure of conservative management/never clears with saline/suction
- Associated obstructive apneas (generally will be with feeding/supine)
- True signs of respiratory distress (with or without feeding difficulty/failure to thrive) should go to ED/urgent care
UNM Pediatric Speech Language Pathology

- In clinic with pediatric otolaryngology faculty
- Clinical feeding exam
- Flexible laryngoscopy
- FEES (Fiberoptic endoscopic evaluation of swallowing)
Infants - Stridor - Inspiratory

- Supraglottic
  - Laryngomalacia**
  - Papillomatosis (HPV)

- Glottic^
  - Paradoxical vocal fold mobility*
  - Vocal cord paralysis
    - Bilateral vs unilateral
  - Laryngeal web/congenital cyst
  - Papillomatosis (HPV)

- Subglottic
  - Stenosis (congenital or acquired)
  - Cyst
  - Hemangioma
  - Papillomatosis (HPV)
Laryngomalacia

- **History**
  - Inspiratory stridor within 2 weeks of life
  - Sounds a bit more “wet”
  - Generally intermittent
  - Difficulty feeding/aspiration
  - **Resolves between 6-18 months of age**

- **Cause**
  - Neuromuscular hypotonia / sensorimotor integration

- **Work up**
  - Rule out other causes of stridor*
  - Feeding assessment

- **Management**
  - Time
  - Reflux?
  - Surgery

*https://youtu.be/IYHg--J1iKw
Supraglottoplasty

- Red flag symptoms
  - Poor weight gain
    - Difficulty feeding/aspiration
    - Increased caloric expenditure
  - Apneas - cyanosis/desaturations
  - Not “happy noisy”

- Overnight stay in hospital

- Stridor will often persist!

- Revision rate: 5-40%
  - Higher in infants < 2 months of age or other comorbid conditions

Hoff et al. Supraglottoplasty outcomes in relation to age and comorbid conditions. IJPO. 2010 74(3): 245-249
Paradoxical vocal cord mobility

● “Vocal cord dysfunction” or “ILO - Inducible laryngeal obstruction”
  ○ More commonly refers to adolescents/adults
● Refers to adduction of the vocal cords upon inspiration
● Hallmark history
  ○ Almost always associated with feeding
  ○ Comes and goes quite quickly
  ○ Never really present at rest/sleeping
  ○ Can have associated laryngospasm - short periods of time when cords actually “slam shut” (ILO)
● Work up involves laryngoscopy/FEES
● Supportive care
  ○ More common and worse outcomes for babies with neurologic abnormalities
Vocal cord paralysis/immobility
Vocal cord paralysis/immobility

- History
  - Aspiration
  - Weak cry
  - +/- inspiratory stridor (not likely at rest)

- Cause
  - Acquired (PDA most common)
  - Congenital

- Work up
  - Rule out mass along the nerve
  - MBS

- Management
  - Time
  - Supportive measures for swallowing
  - Surgery
Vocal cord paralysis/immobility

- **History**
  - Inspiratory stridor

- **Cause**
  - Congenital

- **Work up**
  - Rule out brainstem mass/Chiari
  - MBS

- **Management**
  - Time
  - Supportive measures for swallowing/breathing
  - Surgery
Papillomatosis

- **History**
  - Consistent stridor (inspiratory of biphasic); infancy/early childhood but not likely at birth
  - Hoarseness/weak cry
  - Known maternal history

- **Cause**
  - HPV

- **Work up**
  - Flexible laryngoscopy

- **Management**
  - Surgery
  - Adjuvant
    - Vaccine, cidofovir, interferon
Infants - Stridor - Biphasic

- Fixed laryngeal obstruction can cause biphasic stridor
  - Hoarse voice/weak cry
    - HPV
    - Web/cyst

- Subglottic pathology
  - Hemangioma
  - Stenosis
    - Congenital
    - Acquired
Subglottic Hemangioma

- History
  - Onset around 2-6 months of age
  - Improves temporarily with steroids
  - “Beard distribution” or other hemangiomas (50% of the time)

- Cause
  - Vascular malformation (infantile hemangioma)

- Work up
  - Bronchoscopy for diagnosis
  - Assess for associated syndrome

- Management
  - Propanolol
  - ENT/Vascular anomalies clinic
Subglottic Stenosis

- History
  - Biphasic high pitched stridor that is not episodic*
  - Congenital
    - Associated syndromes (T21)
  - Acquired
    - History of intubation

- Cause
  - Congenital - malformed cricoid
  - Acquired - intubation trauma

- Work up
  - Bronchoscopy for diagnosis
  - Assess for associated airway lesions

- Management
  - Time
  - Endoscopic/Open surgical treatment
Subglottic Stenosis

- **History**
  - Biphasic high pitched stridor that is not episodic*
  - Congenital
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- **Cause**
  - Congenital - malformed cricoid
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- **Work up**
  - Bronchoscopy for diagnosis
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- **Management**
  - Time
  - Endoscopic/Open surgical treatment
Laryngotracheal reconstruction
Complete Tracheal Rings
Infant - Stridor - Expiratory

- **Tracheomalacia**
  - Severe can be associated with recurrent PNA (post obstructive)

- **Vascular ring**
  - Can affect swallowing
  - Diagnosed with CTA +/- Echo

- **Intrathoracic mass**

- Associated “barky cough”
- May be worse supine (mass effect)
- Generally constant but quieter when still/calm
- More severe can be biphasic (or when associated with other pathology like laryngomalacia)
Tracheomalacia: Management - time/surgical (depends on the cause)
Need to refer

- Biphasic or expiratory stridor (not wheezing or stertor)
- Inspiratory stridor that is constant or worsening
  - Red flags: Weak cry, failure to thrive/feeding difficulties
- Consider UNM SLP referral if feeding is the bigger concern
  - Occasional or mild stridor but with feeding difficulties: FEES
- Difficulty feeding/gaining weight, FTT
- History of cyanosis/apneas
- Respiratory distress with significant retractions/tachypnea - urgent care/ED
Noisy Breathing in Children
Stridor in Children/Adolescents

- Laryngomalacia...what, what?!
  - OSA

- Acquired/secondary subglottic stenosis
  - Granulomatosis Polyangiitis

- Recurrent respiratory papillomatosis

- Vocal cord dysfunction*

- Recurrent croup*

- Airway foreign body*
Vocal cord dysfunction

- Induced laryngeal obstruction or paradoxical vocal cord mobility
- Inspiratory stridor
- 2-12% of patients with diagnosis of “asthma”
- Inducible: exercise, reflux, strong smells, stress, asthma, PND
- Associated behavioral health
- Dx mostly based on history, +/- volume flow loops
- Treatment: Therapeutic breathing maneuvers/vocal cord relaxation
  - SLP referral - pursed lips/straw, belly/diaphragmatic, tongue out/on upper gingiva
  - Botox

Recurrent Croup

Adult vs pediatric airway

Anatomy of adult airway

- Tongue
- Epiglottis (shorter)
- Vocal cords (narrowest)
- Thyroid cartilage
- Cricoid ring
- Trachea
- Posterior
- Anterior

Anatomy of pediatric airway

- Tongue
- Epiglottis (flopper, u-shaped)
- Hyoid bone
- Vocal cords
- Thyroid cartilage
- Cricoid ring (narrowest)
- Trachea (more flexible)
- Posterior
- Anterior

8-12 years of age
Recurrent Croup

- Croup: laryngotracheobronchitis
  - 48 hr - 1 week
  - Viral
- “Spasmodic croup…” VFD?
- > 2-3 episodes or more of croup like episodes
- Associated with asthma, allergies, GERD

Quraishi et al. Recurrent Croup. *Ped Clinic North Amer.* 69(2):319-328
Recurrent croup: systematic review/meta-analysis

- 11 articles: 885 patients who underwent MLB for recurrent croup
- Findings
  - 30.6% had subglottic stenosis (25% of these grade I and 4.1% grade II)
  - 24.6% had reflux changes
  - 4.6% broncho/tracheomalacia
  - 3.7% with vocal cord pathology*
- 8.7% of patients had “clinically significant findings”
  - Alters clinical management: grade II stenosis or higher, surgical intervention or repeat bronch for surveillance
  - Associated with history of intubation, prematurity, age less than 1 and/or less than 3 years*, inpatient consultation*

Recurrence Croup

- Think about VCD

- Identify and treat underlying cause(s)
  - 50% have GERD (hx of GERD is not associated with clinically relevant findings on MLB)
  - Atopy: asthma, allergies, eczema, EoE
    - "Unified airway"
    - Lower expiratory flow loops - predicts asthma?
    - Nasal steroid/antihistamine, oral antihistamine, consider montelukast or allergy referral

- When to refer
  - Any symptoms of chronic cough after above dx have been assessed/treated
  - Stridor between episodes of croup - chronic stridor
  - History of intubation (ask about heart surgery)
  - Age less than 1
  - Consider age less than 3 if no other factors above have been identified
Airway foreign Body

- Inspiratory, expiratory or biphasic stridor/wheezing
- History/X-ray/Exam
- Systematic review/Meta-analysis
  - 1577 patients (1.5-2.6 years)

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<th>Odds Ratio</th>
<th>Sensitivity</th>
<th>Specificity</th>
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<tbody>
<tr>
<td>Radiopaque finding</td>
<td>18.5</td>
<td>7.5%</td>
<td>100%</td>
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<tr>
<td>Focal hyperinflation</td>
<td>8.3</td>
<td>57.5%</td>
<td>84.2%</td>
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<td>Unilateral auscultation findings</td>
<td>4.8</td>
<td>58.1%</td>
<td>69.4%</td>
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<td>Wheezing</td>
<td>2.5</td>
<td>33.1%</td>
<td>77.5%</td>
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<tr>
<td>Witnessed choking</td>
<td>3.1</td>
<td>45.9%</td>
<td>53.1%</td>
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![X-ray images of the chest](image)
2 weeks...cough and then fever
Review/Summary

- **Stertor - Stridor - Wheezing**
  - Infants with stertor often have nasal congestion secondary to inflammation
    - Reflux/feeding difficulties
    - Tongue tie/palate

- **Inspiratory - Expiratory - Biphasic**

- **Laryngomalacia - most common cause of stridor in infants**
  - Intervene when noted to have signs of apneas/feeding difficulties/poor weight gain
  - 18 months

- Reassurance when baby is growing and thriving

- Think about SLP referral for babies with concerns directly related to feeding

- Vocal cord dysfunction - SLP

- Recurrent croup - treat possible underlying conditions, >8-12 years of age
Thank you!

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