Stridor, Stertor, and Babies that Squeak: Evaluation of Noisy Breathing in Infants

Jeffrey P. Simons, MD, FAAP, FACS

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Associate Professor
Division of Pediatric Otolaryngology
Department of Otolaryngology
Children's Hospital of Pittsburgh of UPMC
University of Pittsburgh School of Medicine

Disclosures

- none

Learning objectives

- Characterize various pediatric airway sounds and recognize their potential etiology.
- Describe the indications for flexible laryngoscopy in the office and complete upper aerodigestive tract endoscopy in the operating room.
- Develop a practical approach to the diagnosis and management of infants with noisy breathing.

"Noisy Breathing"

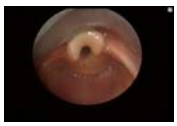
- Common pediatric complaint
- Implies perturbation of airflow
- Many different potential sites
- Variety of potential noises
- Goal:
  - To determine exact site and treat appropriately

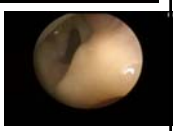
"Noisy Breathing"

- Which children need endoscopic airway evaluation?
- How is pediatric airway endoscopy performed?
- What are some common endoscopic airway findings, and how are they managed?

Pediatric Airway Evaluation

- Differs greatly from that of adults:
  - Smaller diameter: minimal edema can lead to critical airway distress
    - Neonatal subglottis: 4-5mm
  - More pliable airway cartilage: "malacia" more common
  - Developmental issues related to feeding and swallowing may contribute to airway symptoms
  - Congenital anomalies and hemangiomas more likely than malignancy and autoimmune diseases
  - Patients can't describe their symptoms





Definitions

- Snoring:
  - Produced by soft palate and uvula vibrating against posterior naso- and oropharyngeal wall
- Stertor:
  - Produced by base of tongue, hypopharynx
  - Harsh, rattling sound from pharynx
  - Typically heard during sleep
    - Decreased pharyngeal muscle tone and gravity
  - Typically heard during inspiration
    - Bernoulli effect

Definitions

- Stridor:
  - Harsh, musical sound produced by turbulent airflow through upper airway (larynx, trachea)
  - Can be inspiratory, expiratory, or both
- Wheezing:
  - Continuous sound made by walls of narrowed airway vibrating against each other
  - Usually expiratory

Pathophysiology

- Bernoulli's law:
  - As velocity increases through a constant area, pressure on wall of lumen decreases
  - In an area with anatomic narrowing due to collapse:
    - This area will collapse further with increased airflow: e.g. stridor

Pathophysiology

- Neonatal subglottis: 4 to 5 mm (coronal plane)
- Premature newborn subglottis: 3.5 mm
- Adult subglottis: 12 mm
- Airflow through subglottis governed by Poiseuille's law:
  - Resistance related to inverse of radius to 4th power
  - Airflow resistance increases exponentially as subglottic diamater narrows
- Narrowing of infant subglottic diameter by 1 mm:
  - Decreases cross-sectional area by 75%
  - Increases airway resistance 16-fold
- Narrowing of adult subglottic diameter by 1 mm:
  - Decreases cross-sectional area by 30%
  - Increases airway resistance 2-fold

History & Physical Examination

- Can the site of airway obstruction be localized by the sound quality?
  - Snoring: nasopharynx, palate
  - Stertor: base of tongue, tonsils, hypopharynx
  - Stridor: larynx, trachea
  - Wheeze: peripheral lower airway

History & Physical Examination

- Can the site of airway obstruction be localized by the phase of respiration?
  - Inspiratory noise: glottis and above (extra-thoracic)
    - Snoring/stertor: pharyngeal soft tissue
    - Stridor: supraglottis/glottis
  - Expiratory noise (or grunting):
    - Tracheobronchial disorder (intra-thoracic)
  - Biphasic noise:
    - Fixed lesion (usually subglottic stenosis)

Diagnostic Dilemma

- Children under age 2 frequently have congenital large airway disease (tracheobronchomalacia) that masquerades as small airway disease (asthma)
- How can you tell these sources of "wheezing" apart?

Large vs. Small Lower Airway Disease

- Large (central) airway disease (e.g. tracheomalacia):
  - Presents 1st 6 mos. of life
  - Often congenital
  - Chronic "congestion"
  - Usually no hypoxemia
  - Palpable fremitus
  - Normal diaphragm pos.
  - No response to Abx
  - No response to bronchodilator
- Small (peripheral) airway disease (e.g asthma):
  - Presents later in life
  - Often acquired
  - Produced by trigger
  - Hypoxemia
  - No palpable fremitus
  - Depressed diaphragm
  - No response to Abx
  - Good response to bronchodilator

Initial Airway Assessment

- History:
  - Birth history, age of symptom onset, duration and severity of symptoms, associated feeding/voice problems
- Physical examination:
  - Observe child breathing, phonating, feeding
  - Auscultate over nose, mouth, neck and chest
  - Examine nasal cavities, oral cavity, oropharynx, neck
  - Observe for neck/chest retractions; assess urgency of situation
- Radiography:
  - May be helpful, but rarely gives definitive upper airway diagnosis
- When is endoscopy indicated?
  - Whenever the diagnosis is in question, or during emergencies

History and Physical Exam

- Immediate assessment of urgency of situation
- Careful inspection of patient:
  - Respiratory rate, degree of distress
  - Tachypnea, fatigue
  - Nasal alar flaring, accessory neck/chest muscle use
  - Cyanosis, air hunger:
    - Patient may hyperextend neck
    - If unstable, bring immediately to O.R.

History and Physical Exam

- If child stable:
  - Auscultation:
    - Listen over nose, mouth, neck, chest
    - Observe respiratory cycle, and relationship of any stridor to phase of respiration
    - Supraglottic and glottic obstruction: prolonged inspiration
    - Bronchial obstruction: prolonged expiration
  - Place child prone: should relieve stridor from laryngomalacia, macroglossia, micrognathia, vascular compression

Respiratory Distress

- Respiratory distress with feeding:
  - Congenital nasal obstruction
  - TE fistula
  - VC paralysis
  - Laryngeal cleft
  - GERD
  - Cricopharyngeal achalasia
- Respiratory distress after surgical procedure:
  - Subglottic edema from ETT

Types of Airway Endoscopy

- Flexible nasolaryngoscopy

- Rigid laryngotracheoscopy/bronchoscopy

Pediatric Endoscopy

- The choice of which type of endoscopy to perform depends upon nature of child's noisy breathing
  - Snoring, stertor, inspiratory stridor, concerns regarding vocal cord paralysis:
    - Flexible endoscopy
  - Expiratory stridor, suspected intubation injury, complex symptoms/patients:
    - Rigid endoscopy
- These different techniques are often complementary

Flexible Nasolaryngoscopy

- Benefits:
  - Can be performed in office, or at bedside
  - No general anesthesia needed
  - Immediate diagnosis (don't have to wait to schedule a procedure)
  - Allows assessment of pharynx
  - Accurate assessment of laryngeal dynamic function (true vocal cord mobility, laryngomalacia)
- Drawbacks:
  - Cannot assess subglottis or trachea
  - Less magnified image
  - Accuracy may be compromised by patient struggling
  - Rare chance of precipitating laryngospasm in uncontrolled environment

Rigid Endoscopy

- **Benefits:**
  - **Magnified, clear view of airway**
  - **"Leisurely" inspection of airway with airway protected and child ventilated**
  - **Thorough inspection of entire airway (including subglottis and trachea)**
  - **Other potential interventions immediately available (e.g. lasers, optical forceps, etc.)**
- **Drawbacks:**
  - **May delay diagnosis (case often has to be scheduled)**
  - **Requires general anesthesia**
  - **Sedation and anesthesia may inadvertently suppress pharyngeal muscle tone and vocal fold mobility**

Flexible Nasolaryngoscopy

- **Anterior nasal cavity:**
  - **Piriform aperture stenosis**
  - **Nasolacrimal duct cyst**
  - **Inferior and middle turbinate hypertrophy**
  - **Nasal septal deviation**
  - **Nasal polyps**
  - **Nasal foreign body**
- **Posterior nasal cavity:**
  - **Choanal atresia/stenosis**
- **Nasopharynx:**
  - **Adenoid hypertrophy, other mass lesions**

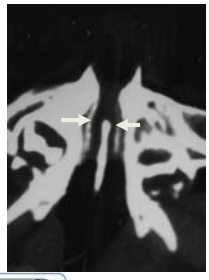
Flexible Nasolaryngoscopy

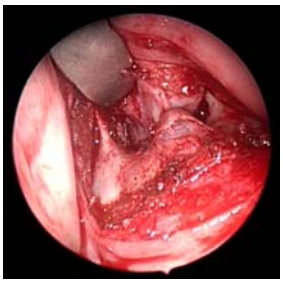
- Oropharynx:
  - Tonsillar hypertrophy
- Hypopharynx
  - Tongue base collapse
- Larynx:
  - Laryngomalacia
  - Vocal fold paralysis/immobility
  - Laryngeal web

Piriform Aperture Stenosis

- Congenital narrowing of piriform aperture:
  - Anterior nasal cavity stenosis
- Symptoms:
  - Respiratory distress, cyanosis, feeding difficulties in newborn
- Diagnosis:
  - Endoscopy: narrow nasal vestibule
  - CT: narrowing of piriform aperture <11mm; <5mm: usually requires surgery
- Management:
  - Observation for mild cases (5-11mm)
  - Surgical intervention for severe cases (<5mm)

Pyriform Aperture Stenosis

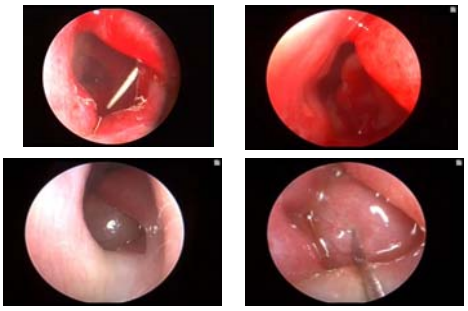




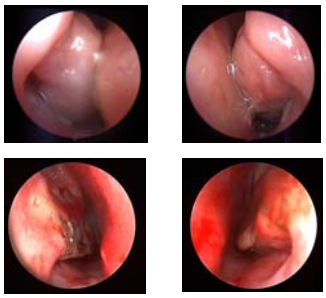
Nasolacrimal Duct Cyst (Dacryocystocele)

- Cystic dilatation beneath inferior turbinate
- Etiology:
  - Congenital obstruction of distal (Hasner) and proximal (Rosenmuller) lacrimal duct valves
- Can be unilateral or bilateral
  - Bilateral cases can be life-threatening
- Treatment: intranasal excision of cyst with lacrimal duct stenting
- Differential diagnosis: glioma, encephalocele, rhabdomyosarcoma, dermoid cyst
  - Obtain pre-op CT

Nasolacrimal Duct Cyst



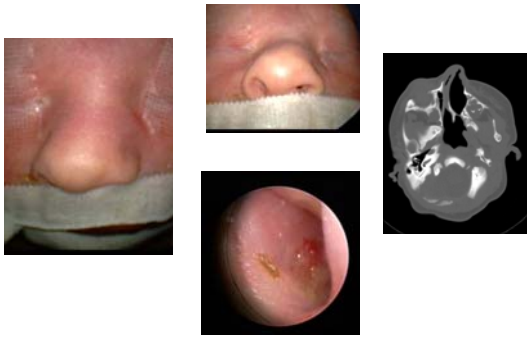
Inferior Turbinate Hypertrophy



Neonatal Nasal Septal Deviation

- Occurs in approx. 1% of all births
  - Much greater incidence in vaginal births vs. C-section
- Etiology:
  - Most likely birth trauma
  - ? Pressure against nose in utero
- Can cause life-threatening airway obstruction
- Management:
  - If mild symptoms: observe
  - If severe symptoms:
    - Manipulate septum back onto maxillary crest (within 3 days)
    - May require nasal stenting

Neonatal Nasal Septal Deviation

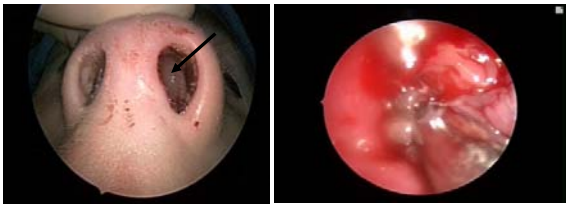


Sinonasal Polyposis

- Rare condition
- Cystic fibrosis accounts for 70% of cases
  - Asthma associated for 11% of cases
- Cystic fibrosis:
  - Disorder of mucosal Cl^- secretion: dry respiratory mucosa; impaired mucociliary clearance
    - Infectious sinusitis, hyperplastic mucosal changes: polyps
  - Approx. 50% have sinonasal polyps
  - 22% undergo sinus surgery (avg. age: 9-11 years)
  - Medical therapy: steroids (topical, injected); antibiotics (systemic, nebulized)
  - Endoscopic sinus surgery
    - 50% change of needing surgery again prior to 24 months
    - Unrealistic to expect cure of polyposis in CF

Rowe-Jones et al 1996; Triglia and Nicollas 1997

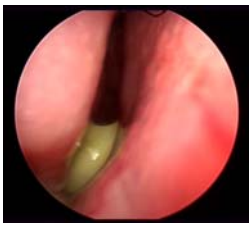
Nasal Polyps

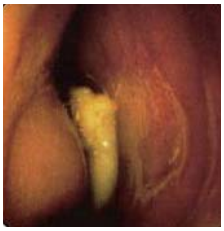


Intranasal Foreign Bodies

- Most common in young and developmentally delayed children
- Symptoms: unilateral fetid nasal discharge
- Most common location: below inferior turbinate, or immediately anterior to middle turbinate
- Can remain present for years
- Vegetable matter and button batteries most dangerous
- Can be inadvertently aspirated
- General anesthesia may be required for removal in some children

Nasal Foreign Body

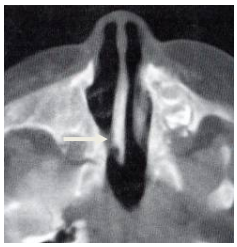


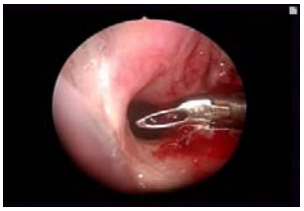


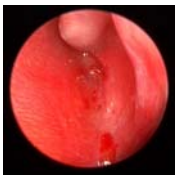
Choanal Atresia

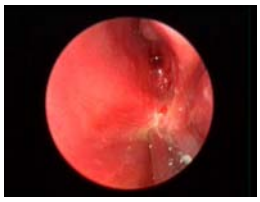
- Neonates are obligate nasal breathers for 1st 6-8 weeks of life
- Nasal obstruction can be life-threatening
- Choanal atresia: failure of choana to open
  - Between posterior nasal cavity and nasopharynx
  - 1:5,000 to 7,000 live births; F>M
- 45% bilateral:
  - Respiratory distress requiring urgent intervention; can temporize with Montgomery nipple
- 55% unilateral:
  - Not life-threatening; unilateral nasal congestion, mucoid rhinorrhea
- Types: bony, membranous (rare), mixed (#1)
- Surgical repair: transpalatal vs. transnasal (endoscopic)
- Post-operative care:
  - Removal granulation; dilatation to prevent re-stenosis
- Can be associated with CHARGE syndrome

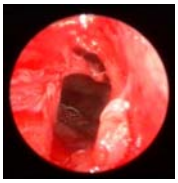
Choanal Atresia

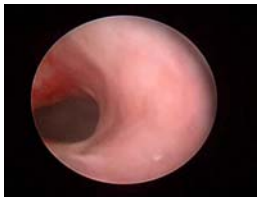




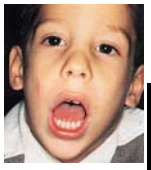


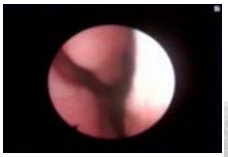


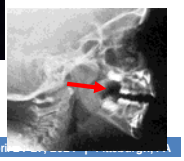




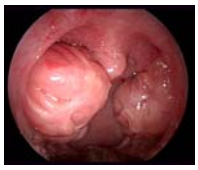
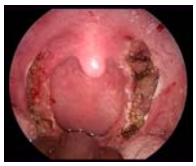
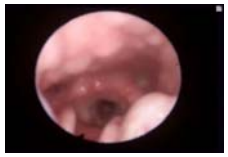
Adenoid Hypertrophy





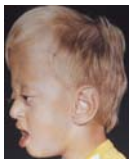
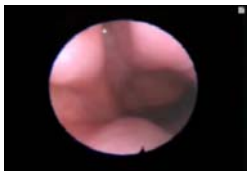


Tonsil Hypertrophy

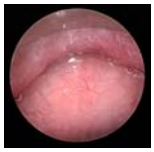
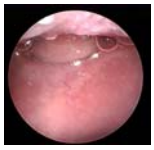
Midface Hypoplasia

- Midface hypoplasia:
  - Leads to soft palate collapse
- Examples:
  - Crouzon's syndrome
  - Treacher Collins
  - Pfieffer's
  - Apert's

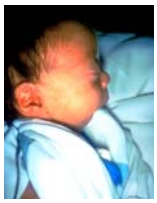
Micrognathia

- Leads to glossoptosis (base of tongue collapse)
- Pierre Robin sequence
- Syndromes:
  - Cornelia de Lange
  - Nager's
  - Stickler's

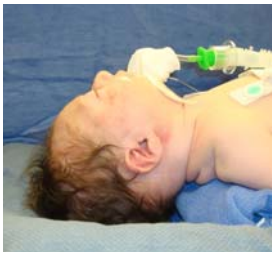




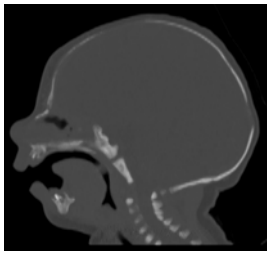
Micrognathia

- Usually managed conservatively in mild cases.
- Severe cases may need surgery
  - Tongue lip adhesion
  - Mandibular distraction
  - Tracheotomy

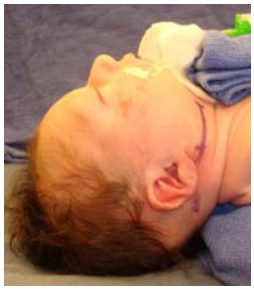


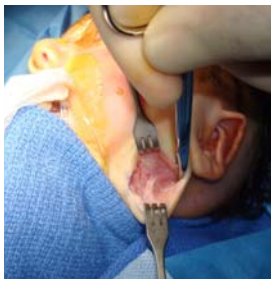
Micrognathia



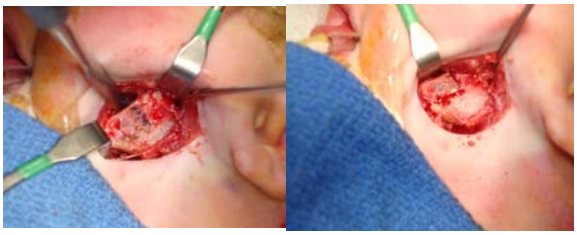


External Approach

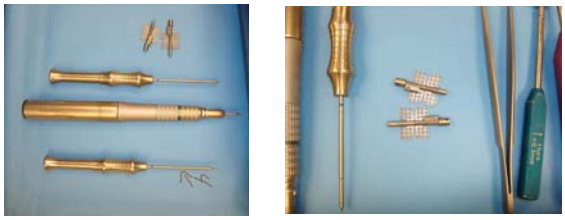




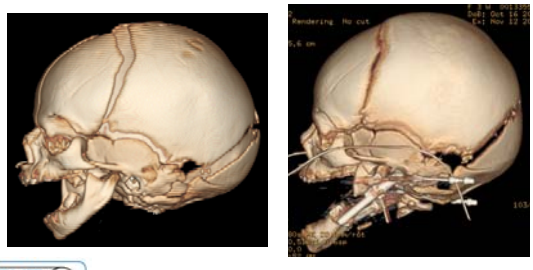
Osteotomy



Distraction Device



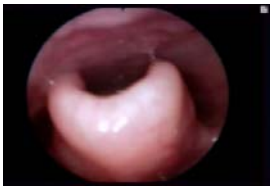
Skeletal Imaging



Pharyngeal Soft Tissue Obstruction

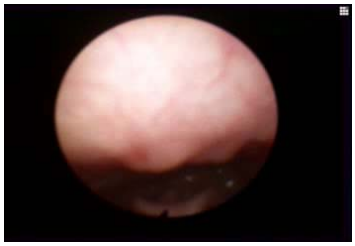
- **Trisomy 21:**
  - **Small pharynx**
  - **Pharyngeal hypotonia**
- **Cerebral palsy:**
  - **Decreased pharyngeal muscle tone**
- **Hunter and Hurler's syndrome:**
  - **Mucopolysaccharide storage in pharynx causes pharyngeal obstruction**

Epiglottis Collapse (Grade 1)



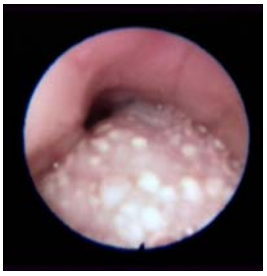
Cerebral Palsy

Epiglottis and Tongue Base Prolapse (Grade 2)



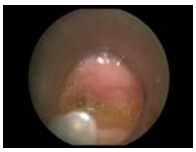
Cornelia de Lange Syndrome

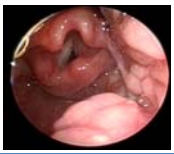
Tongue Base Collapse (Grade 3)



Laryngopharyngeal Reflux (LPR)

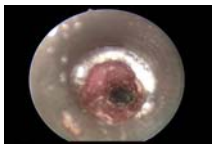
- Symptoms associated with LPR/GERD:
  - Intermittent stertor, cyanotic spells, frequent emesis, failure to thrive, choking/gagging, nasal congestion
    - All of these symptoms significantly more common < 2 years
    - Empiric treatment with upright position, thickened feeds, reflux medication:
      - Reasonable 1st step with mild symptoms
      - Recommended if endoscopy is negative but symptoms persist





Eosinophilic Esophagitis

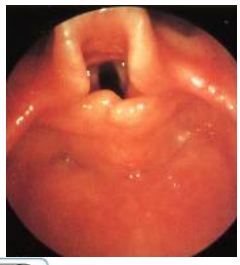
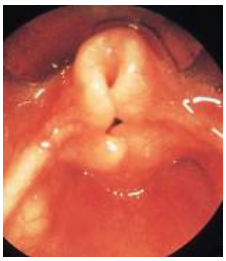
- Eosinophilia of esophageal mucosa
- Normal pH probe
- Lack of response to PPI
- Pediatric symptoms:
  - Dysphagia, regurgitation, abdominal pain, failure to thrive
  - Strong association with asthma, AR, eczema
  - Associated with laryngeal inflammation; LTR failure; hoarseness, cough, stridor
- Diagnosis: Esophagoscopy with biopsy (>15 eosinophils/HPF)
- Treatment:
  - Dietary therapy (milk, eggs, wheat, soy, peanuts, shellfish); amino acid (elemental)
  - Ingested fluticasone (MDI without spacer, x 6-8 weeks)



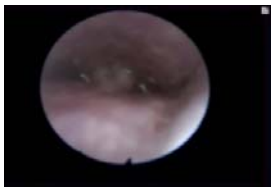
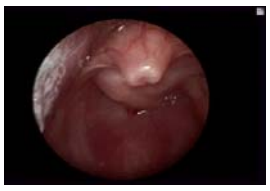
Laryngomalacia

- #1 congenital pediatric laryngeal disorder
  - Immaturity of supraglottic cartilages; decreased lx sensation
- Symptoms: inspiratory stridor, worse supine and during feeds
- Diagnosed with awake flexible endoscopy
- 100% have pharyngeal acid; 66% have esophageal acid exposure on pH probe (Matthews et al. 1999)
- Management:
  - >90% require observation only, most resolve by 18 months
  - Anti-reflux strategies (thickened feeds, medication)
  - Supraglottoplasty: FTT, severe dysphagia, ALTEs
    - Search for synchronous airway lesions

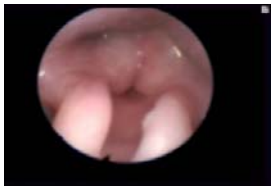
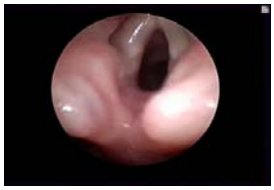
Laryngomalacia

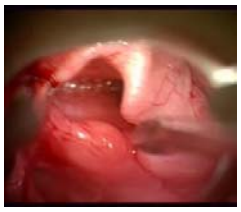
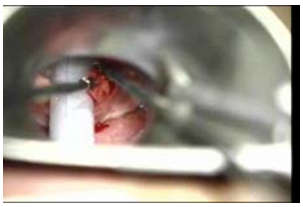
Laryngomalacia

Laryngomalacia

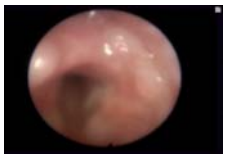
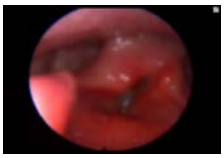
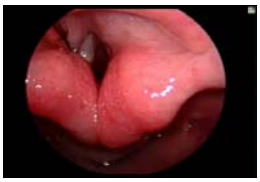
Supraglottoplasty

Vocal Cord Paralysis

- 2nd most common pediatric laryngeal disorder
- Unilateral:bilateral = 50:50
- Unilateral
  - Symptoms: hoarseness, aspiration (occ.)
  - Etiology: cardiac surgery (#1), neck trauma
  - Management: speech tx; injection laryngoplasty, medialization laryngoplasty

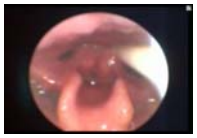
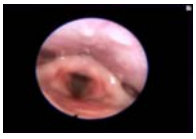
Vocal Cord Paralysis

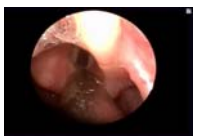
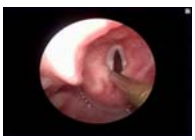
Bilateral Vocal Cord Paralysis

- Symptoms:
  - Biphasic stridor (voice quality can be good)
- Etiology:
  - CNS: Chiari malformation
  - Idiopathic; inflammatory/metabolic
  - Palpate to rule out posterior glottic stenosis
- Management:
  - Observe for spontaneous recovery (12-18 months)
  - Approx. 50% require tracheotomy
  - Surgical options: transverse cordotomy, medial arytenoidectomy, open arytenoidpexy, VF lateralization, posterior graft LTR

Bilateral Vocal Fold Paralysis

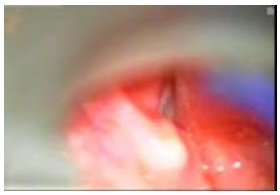
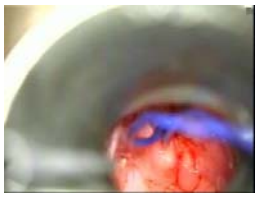



Posterior Glottic Stenosis

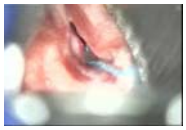
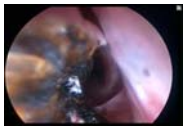



Passive mobility test

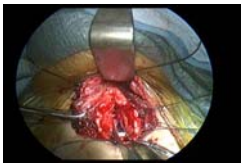
Laryngeal EMG

CO_2 Laser Transverse Cordotomy

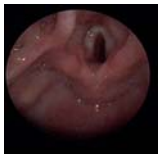
Posterior Cricoid Split with Cartilage Graft



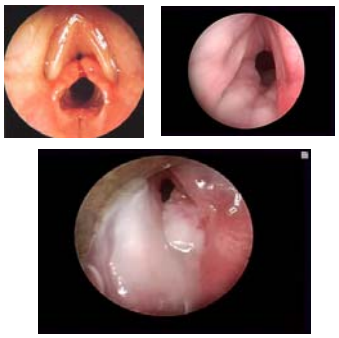
Subglottic Stenosis

- #1 acquired pediatric laryngeal disorder
- #1 pediatric laryngeal disorder requiring tracheotomy
- #3 most common congenital pediatric laryngeal disorder
- 95% acquired; 5% congenital
- Etiology: subglottic injury from ETT
- Presentation: stridor after ETT; recurrent croup; life-threatening respiratory distress; already with tracheostomy
- Management:
  - Observation (mild cases); Tracheotomy (severe cases)
  - Endoscopic techniques for acute stenosis
  - Open surgery (LTR, CTR) for mature significant stenoses

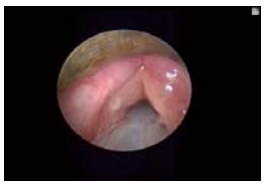
Congenital Subglottic Stenosis

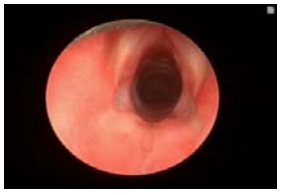


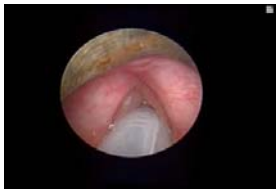
Intubation Injury



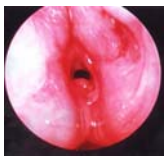
Endoscopic Balloon Dilatation of Acute Subglottic Injury

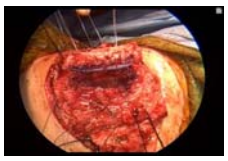


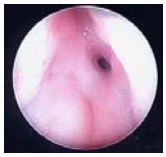


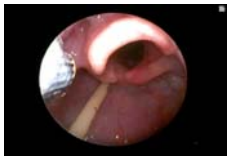


Subglottic Stenosis



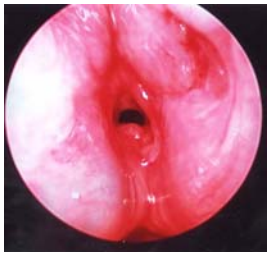






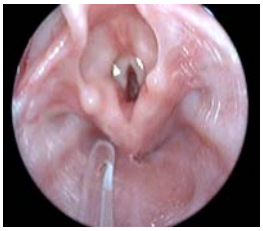
Post Extubation Trauma

- Incidence of acquired subglottic stenosis has been between 0-4 % over last two decades
- Likely because of better ICU care of tube, treatment of GERD, ? decreased period of intubation
- Progression of the initial injury is variable



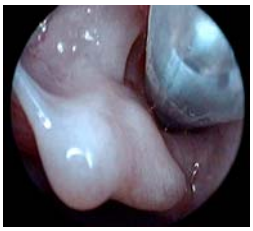
Acute Subglottic Stenosis

- Soft stenosis
- Look for other lesions- posterior glottis
- Treat GERD and/or infection



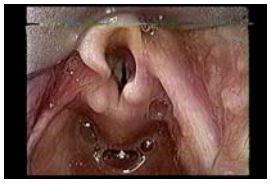
Endoscopic Balloon Dilatation

- Balloons placed endoscopically
- Sizes from 8-14 mm
- Balloon inflated with saline up to recommended burst pressure
- Inflated up to a minute



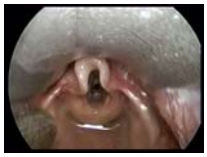
Endoscopic Balloon Dilatation

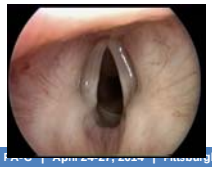
- Can be done weekly for up to 3-4 weeks
- Fairly successful with resolution in about 70% of selected cases (Sobol et al)
- Larger series required



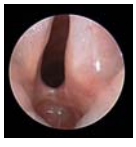
Late Subglottic/Tracheal Stenosis

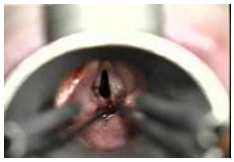
- Soft and thin stenosis can be managed by endoscopic dilatation with laser
- More firm and long stenosis needs open airway reconstruction

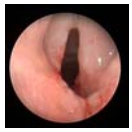




Posterior Glottic Stenosis



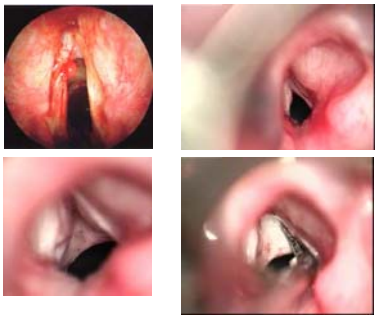




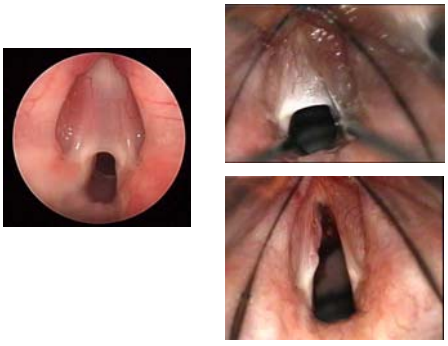
Laryngeal Web

- Failure of embryological recanalization
- Usually glottic; can extend to subglottis
- Symptoms:
  - Mild (<50% glottis): breathy hoarseness
  - Severe (>50% glottis): stridor/obstruction:
    - May need tracheotomy
- Management:
  - Incise with dilatation, mitomycin C
    - May use laryngeal keel, but might require tracheotomy
  - Open vs endoscopic

Acquired Laryngeal Web

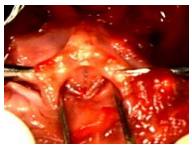


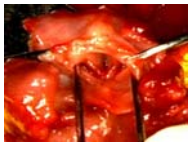
Congenital Laryngeal Web

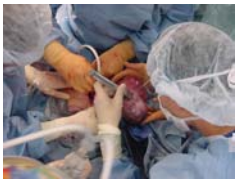


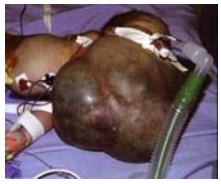
Laryngeal Atresia

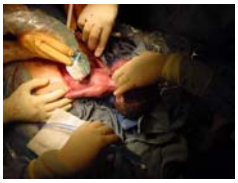
- Associated with CHAOS:
  - Congenital High Airway Obstruction Syndrome
  - Associated with polyhydramnios and fetal hydrops
    - Fetal pulmonary secretions trapped in lungs, which expand and compress venous return to heart
  - Ex-utero intra-partum (EXIT) procedure required









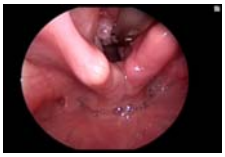


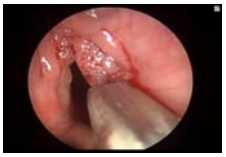
Recurrent Respiratory Papillomatosis

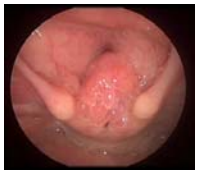
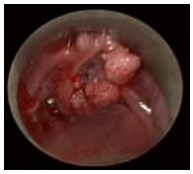
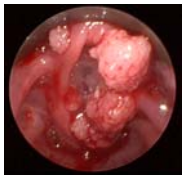
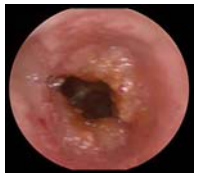
- #1 neoplasm of upper airway in children; likely vertical transmission
- Airway: HPV types 6 and 11; cervical cancer: HPV types 16 and 18
- Prevalence: 4.3/100,000 children in U.S.; median age of diagnosis: 3
- 84%: papillomas restricted to larynx
- Symptoms: hoarseness; airway obstruction (less common)
- Treatment: remove obstructing lesions: microdebrider (52%); CO_2 laser (42%)
  - Mean: 22 surgical treatments/child (4.4/year)
  - 74% stable; 20% regress; 6% progress to distal spread (94/700)
  - Tracheotomy: 11%
  - Adjuvant therapies (21%): local or IV cidofovir injection, INF, indole-3-carbinol
- RRP-related deaths (25/700); 3/700 converted to SCCa
- HPV vaccines: 4-valent vs. 2-valent: ages 9-25

Reeves et al. 2003,
Schraff et al. 2004

Recurrent Respiratory Papillomatosis

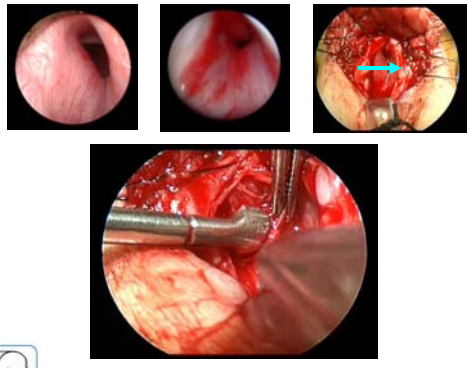




Subglottic Hemangioma

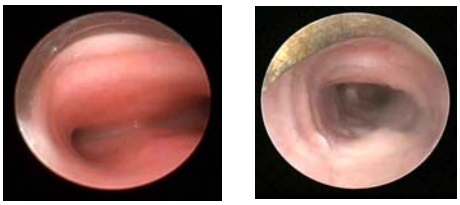
- #1 neoplasm of infant airway:
- Grows rapidly in infancy, then slow regression
- Presentation: progressive biphasic stridor (<6 months); 30-70% mortality if not addressed
- 50% patients have cutaneous hemangioma (usually cervicofacial)
- Diagnosis: endoscopy (biopsy not needed)
  - MRI if suspicion for cervical/intrathoracic extension
- Management: individualized approach
  - Observation
  - Tracheotomy
  - Systemic steroids; injected steroids
  - Laser therapy (CO_2, Nd:YAG, KTP)
  - Open excision with laryngotracheal reconstruction
  - Interferon and vincristine: effective but toxic
  - Propranalol



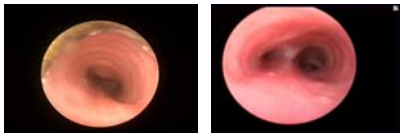
Tracheobronchomalacia

- Flaccidity of tracheal and bronchial cartilage
- Airway collapse on expiration
  - Symptoms: stridor, resp. distress
- Primary tracheobronchomalacia:
  - Cartilage weakness and collapse; usually resolved by 18 months
  - Management: observation; CPAP/BiPAP if severe
- Extrinsic compression: vascular; mediastinal mass
  - Management: observation vs. great vessel pexy
- Can be acquired from tracheostomy
- Management:
  - Endoscopic vs. open repair

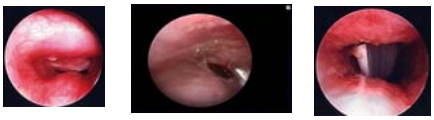
Primary Tracheobronchomalacia



Tracheomalacia
(Extrinsic Vascular Compression)

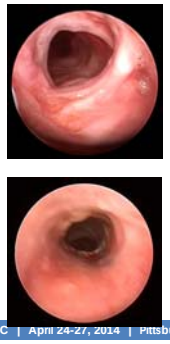


Acquired Tracheomalacia
(Suprastomal Collapse)



Acquired Tracheal Stenosis

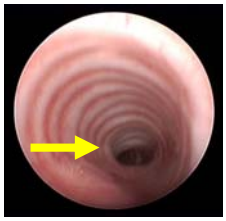
- Usually related to tracheostomy tube or cuff from endotracheal tube
- Treatment:
  - Endoscopy: laser, dilatation
  - Open: cartilage graft; resection and end-to-end anastomosis

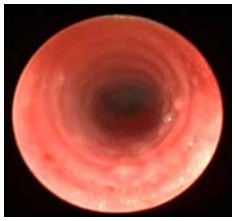


Complete Tracheal Rings

- Normal C-shaped tracheal cartilage fused posteriorly:
  - Often associated with vascular slings
  - Other associations: Down syndrome, Pfeiffer's syndrome, TE fistula, cardiac and esophageal abnormalities
- Long-segment complete rings: presents in newborns; life-threatening
- Management:
  - Observation (if mild)
  - Complete resection with end-to-end anastomosis (<40% trachea)
  - Patch tracheoplasty (pericardium, cartilage)
  - Slide tracheoplasty (for funnel-shaped stenosis)
  - Balloon dilatation

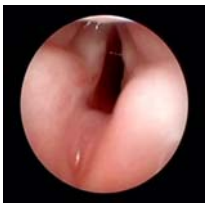
Complete Tracheal Rings





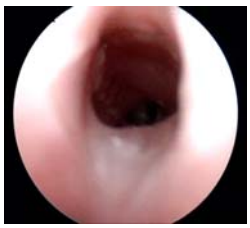
Complete Tracheal Rings

- Neonatal
  - Increasing respiratory distress
  - Stridor and retraction
  - Apnea, cyanosis and occasionally dying spells
  - Noisy "washing machine" breathing
- Childhood
  - Insidious onset exerciseintolerance with biphasic stridor
  - Incidental finding

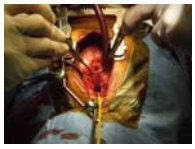
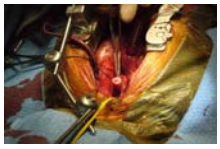
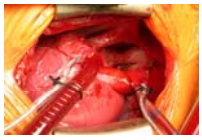
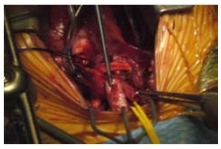


Complete Tracheal Rings

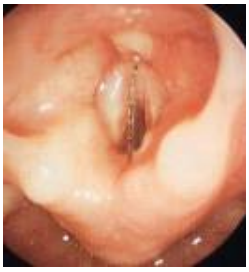
- Slide tracheoplasty has become the treatment of choice as it has dramatically reduced the morbidity and mortality in these patients



Complete Tracheal Rings

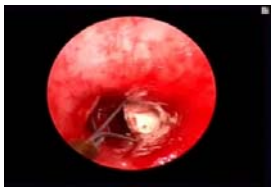
Foreign Body Aspiration



Aspirated Foreign Bodies

- Common in 1-3 year olds (put objects in mouth)
- Accounts for 7% lethal accidents in 1-3 year olds
- Acute symptoms:
  - Coughing, choking, dyspnea
  - Can subside rapidly and spontaneously
- Long-term symptoms:
  - Persistent cough, wheezing, bronchiectasis, pneumonia
  - Inflammation/granulation develop
- Diagnosis:
  - Witnessed aspiration is most predictive
  - In absence of witnessed event, need high index of suspicion
  - CXR: may show atelectasis (25%), air trapping, consolidation (6%); FB only seen in 15%
    - Most aspirated material in kids: food (not radio-opaque)
- Treatment: rigid bronchoscopic removal

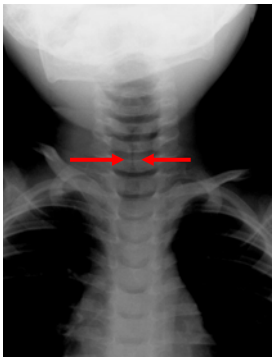
Bronchial Foreign Body

Infectious Causes of Noisy Breathing

Laryngotracheobronchitis (Croup)

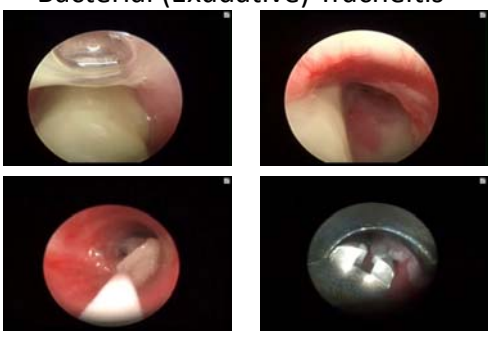
- Peak ages: 1-2 years old
- Usually viral (#1: parainfluenza type I)
- Clinical diagnosis (doesn't require endoscopy): low-grade fever, barky cough, biphasic stridor
- Therapy (usually outpatient; <10% hospitalized):
  - Humidified air with supplemental O_2
  - Oral steroids (outpatient)
  - Racemic epinephrine; IV corticosteroids
- Recurrent croup (Waki et al. 1995) :
  - 50% associated with LPR; 25% associated with SGS or LM



Bacterial (Exudative) Tracheitis

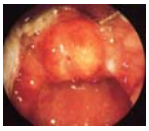
- Initially described as rare, rapidly-progressive, life-threatening infection
  - Thick, membranous tracheal secretions obstruct airway
  - Average age: 4-6 years
  - Diagnosis: prompt endoscopy in O.R.
  - S. aureus: 65% cases
  - Management: suction secretions (endoscopy); IV Abx; intubation (90%)
- Recent reports describe decreasing severity
- May be part of continuum with croup

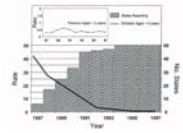
Bacterial (Exudative) Tracheitis

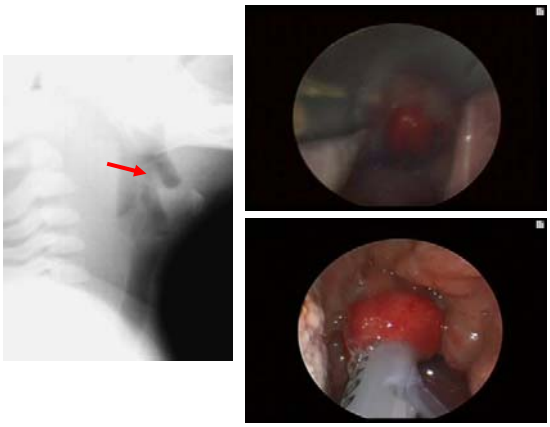


Acute Epiglottitis (Supraglottitis)

- Rapid onset inflammation of supraglottis
- True airway emergency
- Management: direct trip to O.R.; attempt intubation; IV Abx
- *H. influenzae* type B
- 1987: Conjugate HiB vaccine in U.S.: dramatic reduction in incidence (3,400/yr to 125/yr)
- Adult cases less severe; only 10-20% caused by HiB
- Effect of vaccine:
  - Avg. age went from 5 to 14 years
  - Overall less severe







Conclusions

- Variety of causes of noisy breathing in infants
- Important to identify type of noisy breathing
- Diagnosis based upon:
  - History and physical examination
  - Flexible and rigid aerodigestive endoscopy
- Management options:
  - Based upon severity of symptoms, diagnosis, and general health of child
  - Still searching for optimal treatment for many pediatric upper airway disorders