Stridor, Stertor and Snoring: Common Pediatric Airway Problems

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Pediatric Airway Problems

- Stridor
- Stertor
- Snoring
Stridor

• Definition
  – sound produced by turbulent airflow from obstruction in the upper aerodigestive tract
    • laryngeal
    • tracheobronchial
  – sound and pitch dependent on air flow dynamics
Stridor

- Timing in respiratory cycle determines anatomic location of airway lesion
  - Inspiratory
  - Biphasic
  - Expiratory
Inspiratory Stridor

- Partial supraglottic airway obstruction
- Other aerodigestive tract symptoms
  - suprasternal and intercostal retractions
  - feeding difficulties
  - muffled cry
Biphasic Stridor

- Partial obstruction at the level of the glottis
- Primarily inspiratory stridor
- Other aerodigestive tract symptoms
  - hoarseness
  - aphonia
  - nasal flaring
  - retractions
Expiratory Stridor

- Partial obstruction at the level of the subglottis or proximal trachea
- Other aerodigestive tract symptoms
  - xiphoid retractions
  - barking cough
  - nasal flaring
Stridor

• Congenital
  – 85%
  – anatomical anomalies
  – present by 4 months of age
• Acquired
  – 15%
Stridor: Diagnosis

- History
- Flexible fiberoptic laryngoscopy
- Direct laryngoscopy with rigid bronchoscopy
- Barium esophagram
- CT neck and chest
Congenital Stridor

#1 Laryngomalacia
#2 Bilateral True Vocal Fold (Cord) Paralysis
#3 Laryngotracheal Stenosis (Subglottic Stenosis)

- Laryngeal webs
- Laryngotracheal esophageal clefts
- Tracheoesophageal fistulae
- Laryngeal and subglottic cysts
- Subglottic hemangioma
- Tracheomalacia
- Tracheal stenosis
- Tracheal compression
- Complete vascular rings
- Anomalous innominate artery
- Pulmonary artery sling
Laryngomalacia

- #1 cause of newborn stridor
- 58% congenital laryngeal anomalies
- males 2:1
- inspiratory stridor
- presents shortly after birth
- worsens by 6-8 weeks of age
- “omega-shaped” epiglottis
- usually self-limited
  - resolves by 12-15 months of age
Laryngomalacia

• Symptoms:
  – stridor with:
    • agitation
    • feeding
    • supine position
  – feeding difficulties
    • failure to thrive
  – rare:
    • cyanosis
    • pectus excavatum
Laryngomalacia

- Etiology
Laryngomalacia

Type 1
prolapse of mucosa overlying the arytenoid cartilages

Type 2
foreshortened aryepiglottic folds

Type 3
posterior displacement of the epiglottis

Olney: Laryngoscope, 109(11) Nov 1999
Laryngomalacia

Management of Laryngomalacia

**SEVERITY ASSESSMENT**

**MILD:**
No associated feeding problems
Not progressive

- Observation
- Reassurance

**MODERATE:**
Progressive noisy breathing
Feeding symptoms without failure to thrive

- Apnea monitor
- Observation
- Reassurance

**SEVERE:**
Cyanotic episodes
Failure to thrive

- Surgery: Supraglottoplasty Tracheostomy
- NG Tube Feedings
Laryngomalacia

Supragliototomy
True Vocal Fold Paralysis

- #2 Etiology of newborn stridor
- 10% all congenital laryngeal lesions
- no gender predilection
- biphasic stridor
- 58% present within first 12 hours of birth
- unilateral or bilateral
  - unilateral: left > right
True Vocal Fold Paralysis

- Idiopathic
- Anatomic
- Neurologic
  - congenital
  - acquired
True Vocal Fold Paralysis

- Congenital
  - CNS
    - Arnold-Chiari malformation I & II
    - Leukodystrophy
    - Encephalocele
    - Hydrocephalus
    - Cerebral or nuclear dysgenesis
    - Perinatal asphyxia
True Vocal Fold Paralysis

• Acquired
  – Thoracic surgery
    • PDA ligation
  – ETT trauma
    • Recurrent laryngeal nerve compression
  – LMA
    • Arytenoid dislocation
    • Recurrent laryngeal nerve compression
True Vocal Fold Paralysis

Signs and Symptoms

• Bilateral
  – biphasic stridor
  – apnea
  – cyanosis
  – aspiration
  – dysphagia
  – ineffective cough

• Unilateral
  – stridor
  – hoarseness
  – abnormal cry
  – aspiration
  – dysphagia
  – ineffective cough
True Vocal Fold Paralysis Management - Airway

- Respiratory distress
  - Endotracheal intubation
  - Laryngoscopy
    - Direct
  - Tracheostomy
  - Posterior cordotomy
  - Swallowing evaluation

- Stable
  - Flexible fiberoptic laryngoscopy
  - Swallowing evaluation
True Vocal Fold Paralysis Management - Feeding

- Normal MBSS
  - Oral feeding

- Aspiration
  - NG tube feeding for 6 weeks
  - Repeat MBSS
    - Normal
      - Oral feeding
    - Aspiration
      - G-tube
Subglottic Stenosis

- #3 most common congenital laryngeal anomaly
- no gender predilection
- congenital or acquired
Subglottic Stenosis

• Definition
  – narrowed airway 2-3mm below true vocal folds
  – subglottic diameter of 4mm or less in a full-term neonate
Subglottic Stenosis

• Symptoms
  – stridor
  – may be biphasic
  – dyspnea
  – cough
    • brassy or barky
  – hoarseness
  – weak or unusual cry
Subglottic Stenosis

- Congenital
  - Definition
    - stenosis in the absence of prior intubation, laryngeal trauma, or extrinsic compression
  - Presentation
    - after upper respiratory infection
    - “recurrent croup”
    - age
      - birth to few months
Subglottic Stenosis

• Congenital
  – Etiology
    • failure to recannalize the lumen of the larynx at 9 weeks gestation
      – atresia
      – webs
      – stenosis
Subglottic Stenosis

• Acquired
  – More common than congenital subglottic stenosis
    • after 1965
      – McDonald and Stocks (1965)
        » prolonged nasotracheal intubation in children
Subglottic Stenosis

• Acquired
  – Presentation
    • failed extubation
    • recurrent croup after extubation
  – Age at presentation
    • 2wks - 10 yrs
    • majority < 1yo
Subglottic Stenosis

• Acquired
  – Etiology
    • trauma to the subglottic structures
      – endotracheal intubation
      – foreign body
      – infection
      – thermal burns
      – chemical irritation
Subglottic Stenosis

- Radiographic findings
  - long segment of subglottic narrowing
Subglottic Stenosis

Meyer-Cotton Grading System
- most frequently used system
- grade correlates with prognosis

Myer, et al. (1994)
Subglottic Stenosis Grading

Endoscopic view of laryngeal stenosis with endotracheal tube in place for the purpose of sizing.
Subglottic Stenosis
Grading

Grade 1

Grade 2
Subglottic Stenosis
Grading

Grade 3

Grade 3
Subglottic Stenosis - Management of suspected SGS

• Stable airway
  – History
  – Flexible fiberoptic laryngoscopy
  – Direct laryngoscopy with rigid bronchoscopy

• Unstable/unsafe airway
  – Intubation or tracheostomy
  – History
  – Direct laryngoscopy with rigid bronchoscopy
Subglottic Stenosis - Surgical Management

• Evaluate overall medical condition
  – BPD, poor neurologic status, LBW
• Tracheostomy
• Airway reconstruction
  – Open surgical management
    • LTR- laryngeal tracheal reconstruction
      – Single or double stage
  – Endoscopic surgical management
    • Balloon dilation
Subglottic Stenosis
Laryngeal tracheal reconstruction

Posterior cricoidotomy

Anterior costal cartilage graft
Posterior cricoidotomy

Four quadrant cartilage division

Anterior costal cartilage graft

Posterior costal cartilage graft

Anterior and posterior cartilage grafts

Willging and Cotton (1995)
Subglottic Stenosis
Endoscopic management

• Balloon Dilation
Laryngeal Web

• Glottic lesion
  – variable thickness
  – failure of laryngeal recannalization

• Hoarseness or aphonia

• Potential respiratory distress at birth

• Presentation
  – 0-6 months of age
Laryngeal Web

- Management
  - Dilatation
  - Endoscopic division
  - Tracheostomy
  - LTR
Posterior Laryngeal Clefts

• Uncommon
• Presentation
  – aspiration
    • recurrent pneumonia
  – stridor
  – weak cry
• May be associated with other anomalies
• 4 Types
Laryngeal Clefts

- Type I: Supraglottic, interarytenoid cleft
- Type II: Partial cricoid cleft
- Type III: Complete cricoid cleft with or without extension into part of the tracheal esophageal wall
- Type IV: Laryngotracheal esophageal cleft
Laryngeal Clefts

• Management
  – Diagnosis
    • Endoscopy
  – Treatment
    • Endoscopic repair
    • Open Laryngotracheo-oesophageal Reconstruction
    • Tracheostomy
Tracheoesophageal Fistula

- Incomplete development of the tracheoesophageal septum
- Presentation – after birth
  - cyanosis with feedings
- Diagnosis
  - Esophagram
  - Bronchoscopy
- Management
  - surgical closure
Tracheoesophageal Fistula
Laryngeal and Subglottic Cysts

- Arise from saccule
- Filled with mucoid secretions
- Do not communicate with larynx

Presentation
- Biphasic stridor
- Airway obstruction

Management
- Endoscopic marsupialization
- Emergent
  - Intubation
  - Tracheostomy
Subglottic Hemangioma

- Progressively worsening stridor
- 2:1 female
- Cutaneous hemangiomas – 50%
- Rapid growth up until 12 to 18 months of age
- Presentation
  - cough
  - cyanosis
  - hoarseness
  - dysphagia
  - hemoptysis
Subglottic Hemangioma - Management

• Diagnosis
  – Endoscopic
    • Flexible laryngoscopy
    • Direct laryngoscopy
  – Radiographic
    • Airway fluoroscopy
Subglottic Hemangioma - Management

- **Treatment**
  - Observation
    - Spontaneous resolution by age 5
  - Medical
    - Propanolol
  - Endoscopic
    - Laser ablation
  - Open excision
  - Tracheostomy
Tracheomalacia

- Abnormal flaccidity of trachea
  - collapse on expiration
- Intrinsic
  - primary tracheomalacia
  - weakness of cartilaginous rings
- Extrinsic
  - secondary tracheomalacia
  - extrinsic compression
- Presentation
  - asymptomatic to severe distress
- Management
  - observation to tracheostomy
Vascular Tracheal Compression

- Vascular rings
  - double aortic arch
  - right aortic arch

- Vascular slings
  - innominate artery compression
Vascular Tracheal Compression

• Presentation
  – expiratory stridor
  – recurrent cough
  – apnea
  – recurrent bronchopulmonary infection
  – reflex apnea or dying spells
    • innominate artery compression
Vascular Tracheal Compression - Management

• Diagnosis
  – Direct laryngoscopy with rigid bronchoscopy
  – Flexible bronchoscopy
Vascular Tracheal Compression - Management

- **Diagnosis**
  - CT chest
  - MRI chest
Tracheal Vascular Compression
Management

• Innominate Artery Compression
• Vascular Ring (Double Aortic Arch)
• Pulmonary Sling
Tracheal Vascular Compression - Management

- Innominate Artery Compression
  - Sleep study
    - Normal - observation
    - Apnea - Arteriopexy
  - Feeding evaluation - MBSS
    - Normal - observation
    - Feeding problems - Arteriopexy
Tracheal Vascular Compression Management

• Vascular Ring (Double Aortic Arch)
  – Thoracotomy
  – Vascular repair
Tracheal Vascular Compression Management

• Pulmonary Sling
  – Bronchoscopy
    • Complete tracheal rings present
      – Median sternotomy
      – Vascular repair
      – Tracheoplasty
    • Complete tracheal rings not present
      – Thoracotomy
      – Vascular repair
Tracheal Stenosis

• **Types**
  – tracheal hypoplasia
  – funnel-like stenosis
  – short segmental stenosis

• **May have complete tracheal rings**
  – no posterior membranous tracheal wall

• **Presentation**
  – biphasic or expiratory stridor
  – wheezing
  – cyanosis
  – FTT
  – “recurrent croup”
Tracheal Stenosis

• Management
  – Diagnosis
    • Airway fluoroscopy
    • Bronchoscopy
    • CT/MRI
  – Treatment
    • Observation
    • Tracheal resection
    • Tracheal grafts
Acquired Stridor

- Croup
  - Laryngeal tracheitis
- Epiglottitis
- Foreign body
- Laryngeal papilloma
Laryngotracheobronchitis - Croup

• Most common cause of upper airway obstruction
  – 6 months to 6 years of age
  – Most commonly 1-2 years of age
  – Barky cough
  – Biphasic stridor
  – Viral prodrome
Laryngotracheobronchitis-Croup

• Causes
  – Parainfluenza
  – Influenza

• Diagnosis
  – History
  – AP and lateral neck x-rays
    • Steeple sign
  – DLB
Laryngotracheobronchitis - Croup

- **Management**
  - Oral corticosteroids
  - Inhaled racemic epinephrine
  - Possible intubation
Epiglottitis

• Causes
  – *Hemophilus influenza* type B
    • Blood cultures

• Diagnosis
  – History
  – Lateral neck x-ray
    • Thumb print sign
Epiglottitis- Supraglottitis

• Management
  – Intubation in the OR
  – PICU
    • 24-72 hours
  – Ceftriaxone, cefuroxime or cefotaxime
Laryngeal Foreign Body

- Biphasic stridor
- Flexible laryngoscopy
- Direct laryngoscopy with removal
Esophageal Foreign Body

- Drooling
- Stridor
- X-ray
  - AP chest
Esophageal Foreign Body

• Endoscopic esophagoscopy for removal
Laryngeal papilloma-
Juvenile Recurrent Respiratory Papillomas

- JRRP
- HPV
  - Types 6,11
- 2-5 years of age
  - Most commonly diagnosed by age 5
- Inspiratory stridor
- Hoarseness
- Diagnosis
  - Flexible laryngoscopy
JRRP

• Management
  – Surgical
    • Microlaryngoscopy
      – CO2 laser
      – Microdebrider
      – Intraliesional cidofovir
JRRP

- Management
  - Medical
    - Alfa-interferon
    - Indole-3-carbinol
    - Proton pump inhibitors
    - Beta mannan
    - Celebrex-celecoxib
Stertor

- Airway obstruction above the level of the larynx
- Snoring-like noise from nasopharyngeal or oropharyngeal obstruction
- Awake patient
Stertor

• Congenital
  – Choanal atresia
  – Congenital pyriform aperture stenosis
  – Nasal lacrimal duct cyst(s)
  – Juvenile nasopharyngeal angiofibroma
  – Craniofacial abnormalities
    • Pierre Robin Syndrome
    • Down Syndrome
    • Treacher Collins Syndrome
    • Crouzon Syndrome
Choanal Atresia

- Persistence of the buccopharyngaeal membrane
- 1 in 5000-8000 live births
- Respiratory distress at birth relieved by crying
  - Paradoxical cyanosis
- Feeding difficulties
- Unilateral > bilateral
- 29% bony
- 71% mixed bony and membranous
- Males < females
Choanal Atresia

• CHARGE Syndrome
  – C  Coloboma of eye
  – H  Heart abnormality
  – A  Atresia of choanae
  – R  Retarded growth/development
  – G  Genital hypoplasia
  – E  Ear anomalies/deafness
Choanal atresia

- Management
  - Nasal endoscopy
  - CT
  - Surgery
    - Transpalatal
      - Maldevelopment of dental arch and cross-bite
    - Endoscopic
      - Mitomycin-C
Congenital Pyriform Aperture Stenosis

- Bony overgrowth of the nasal process of the maxilla at occurs at 4 months gestation
- Pyriform aperture with <11mm
- Newborn with respiratory distress, poor feeding, FTT and recurrent cycles of cyanosis and apnea
Congenital Pyriform Aperture Stenosis

- Associates abnormalities
  - Holoprosencephaly
  - Midline nasal cavity defects
  - Microcephaly
  - Cleft lip/palate
  - Hypopituitarism
  - Hypotelorism
  - Esophageal or duodenal atresia
Congenital Pyriform Aperture Stenosis

- Management
  - Nasal endoscopy
  - CT
  - Medical
    - Steroid drops and topical decongestants
Congenital Pyriform Aperture Stenosis

• Management
  – Surgical
    • Bony removal floor of nose-sublabial approach with nasal stents
Nasolacrimal Duct Cysts

- Distal nasolacrimal duct obstruction
  - Incomplete canalization
  - Obstruction of the valves of Hasner

- Endoscopic resection or fenestration
JNA

• Benign vascular tumor
• Arises from pterygopalatine fossa
• Presentation
  – Unilateral epistaxis
  – Nasal obstruction
  – Adolescent male
• Nasal endoscopy for diagnosis
JNA

• Management
  – CT for extent of bony destruction and involvement of adjacent structures
  – MRI size of tumor
JNA

- Management
  - Arterial embolization
  - Open resection
  - Endoscopic resection
  - Radiation therapy
  - Hormone therapy
Pierre Robin Syndrome

• Retrognathia
• Micrognathia
• Glossoptosis
• Management
  – Airway
  – Feeding
  – Surgery
    • Tongue-lip adhesion
    • Mandibular distraction osteogenesis
Down Syndrome

- Midface hypoplasia
- Relative macroglossia
- Hypotonia
- High incidence of OSA
Treacher Collins Syndrome

- Midface abnormalities
  - Maxillary hypoplasia
  - Choanal atresia/stenosis
- Mandibular hypoplasia
- Tongue base abnormalities
Crouzon Syndrome

- Midface hypoplasia
  - Choanal atresia/stenosis
- Tongue base abnormalities
Stertor

• Acquired
  – Swollen turbinates
  – Adenoid hypertrophy
  – Foreign body
  – Nasal polyps
  – Peritonsillar abscess
  – Retropharyngeal abscess
Swollen Turbinates

- Inferior turbinates
  - Allergy
  - Infection

- Treatment
  - Nasal steroids
  - Antihistamines
    - Oral
    - Topical
  - Surgery
    - Usually reserved for adults
Adenoid Hypertrophy

• Nasal obstruction
  – Mouthbreathing
    • Darth Vader
  – Hyponasal speech
Adenoid Hypertrophy

• Evaluation
  – Nasal endoscopy
  – CT - only when evaluating chronic sinusitis
  – Lateral neck x-ray not useful

• Treatment
  – Adenoidectomy
  – Nasal steroids
Nasal Foreign Body

- Persistent unilateral nasal drainage and obstruction
Nasal Polyps

- Cystic fibrosis
- Antrochoanal polyp
- Severe allergic rhinitis
- Sampter’s Triad
Peritonsillar Abscess

- Throat pain
- Dysphagia
- Trismus
- Uvular deviation
- Palatal edema
Peritonsillar Abscess

- Diagnosis
  - Physical exam
  - CT neck
Peritonsillar Abscess

- Management
  - Needle aspiration
  - Incision and drainage
  - IV antibiotics and steroids without surgery if only peritonsillar cellulitis
Retropharyngeal Abscess

- Abscess bulging on one or both sides of midline pharyngeal raphe
- Throat pain
- Dyshagia
- Pain with neck extension
Retropharyngeal Abscess

- **Diagnosis**
  - History
  - Physical Exam
  - Soft tissue neck x-ray
    - Widening of prevertebral space
  - CT neck
Retropharyngeal Abscess

- Management
  - Incision and drainage
    - Danger space 5
  - IV antibiotics
Snoring

- Turbulent airflow through the nasopharynx and oropharynx while sleeping.
Snoring

- Common pediatric causes
  - Adenoid hypertrophy
  - Tonsillar hypertrophy
  - Palatal abnormalities
Adenoid Hypertrophy

- Snoring
- Hyponasal voice
- Mouth breathing
Adenoid Hypertrophy

- Grade 1: free choanal opening
- Grade 2: occlusion of upper half of choanal opening without Eustachian tube obstruction
- Grade 3: occlusion of 75% of choanal opening with partial Eustachian tube obstruction
- Grade 4: complete choanal obstruction
Tonsillar Hypertrophy

- “Kissing tonsils”
- Snoring
- Muffled voice
- Drooling
- Sleep disordered breathing
Tonsillar Hypertrophy

0. Surgically removed tonsils
1. Tonsils hidden within tonsil pillars
2. Tonsils extending to the pillars
3. Tonsils are beyond the pillars
4. Tonsils extend to midline
Tonsillar Hypertrophy

- Acute strep pharyngitis
- Infectious mononucleosis
- Management
  - CPAP
  - Tonsillectomy if persistent upper airway obstruction or recurrent infection
Palatal Abnormalities

- Elongated uvula
- Redundancy of soft palate
- Narrowing of the oropharynx
- Treatment
  - CPAP
  - UP3
Thank you!
Questions?