Management of Pediatric Tracheostomy

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Definitions

- **Tracheotomy:**
  - The making of an incision in the trachea
  - The name of the operation

- **Tracheostomy:**
  - The opening in the trachea that results from the operation
  - Synonymous with “tracheostoma”
  - Can be used as an adjective (e.g. “tracheostomy” tube)
Children with Tracheostomy

- Traditionally, 2-3 times greater complications than adults (Wetmore 1982)
- Concerns in children, especially newborns and infants:
  - Apprehension regarding management
  - High incidence of complications and mortality
- Has become safer:
  - More defined indications
  - Introduction of endotracheal intubation
  - Safer endotracheal tubes: allows longer duration
  - Vaccines for diphtheria, polio, HiB
  - Improved routine care
Pediatric Tracheotomy: Indications

- Two major groups:
  - Relief of airway obstruction:
    - 72% to 76% (Donnelly 1996, Midwinter 2002)
  - Positive pressure ventilation/pulmonary toilet
    - 24% to 28% (Donnelly 1996, Midwinter 2002)

- Congenital anomalies: 65% of overall cases:
  - Laryngotracheal anomaly
  - Cardiovascular anomaly
  - Pulmonary anomaly
Pediatric Tracheotomy: Indications

- Changes in indications over past 30 years:
  - Premature birth: increased 28% to 58%
  - Congenital anomalies: increased 6% to 23%
  - Acquired subglottic stenosis: increased 2% to 23%
  - Neuromuscular disease: increased 9% to 23%
  - Infectious diseases: decreased 50% to 3%
    - Intubation has all but eliminated tracheotomy for acute inflammatory/infectious disease
    - Study:
      - 44% congenital, 28% prematurity, 12% acquired SGS, 8% infectious disease, 8% emergencies

- Kremer et al. 2002
Pediatric Tracheotomy

- Tracheotomy might be avoided by long-term intubation
- Long-term intubation itself has become an indication for tracheotomy
- One option: weekly fiberoptic examination of intubated neonates (to find developing subglottic and tracheal stenosis) (Kremer et al. 2002)
Pediatric Tracheotomy

- Long-term effects:
  - Delays in expressive and receptive speech development after infant tracheotomy (Kaslon and Stein 1985, Hill and Singer 1990)

- Successful decannulation possible in 78% (Donnelly 1996)
  - Average 2.1 years with tube (Donnelly 1996)
Subglottic Stenosis
Pediatric Tracheostomy: Complications

- Frequency of pediatric complications has been decreasing since 1970s
- Two categories:
  - Early (1st postoperative week, or until first tube change)
  - Late
- Overall complication rate: 5% to 41% (Donnelly 1996, Alladi 2004)
- Some (but not all) studies have found higher complication rates in younger children
Complications

- Early complications: 3% to 14% (Donnelly 1996, Alladi 2004)
  - #1 accidental decannulation
  - Bleeding
  - Pneumothorax
  - Pneumomediastinum
  - Subcutaneous emphysema
  - Obstruction of tube
  - Tracheal tear
  - Tracheoesophageal fistula
  - Cervical abscess
Complications

- Late complications: 24% to 34% (Donnelly 1996, Alladi 2004)
  - #1 lower respiratory tract infections
  - Granulation tissue
  - Bleeding
  - Infection
  - Tracheal stenosis
  - Tracheomalacia
  - Tracheocutaneous fistula
- Children under 1 year old:
  - 64% complication rate (32% early, 32% late) (Donnelly 1996)
  - 0% complication rate (Alladi 2004)
Complications

  - Most commonly due to accidental decannulation or tube obstruction
  - Higher rate in younger children (smaller tube diameter, shorter tube)
  - Overall mortality rate: 7% (Dutton 1995, Kremer 2002)
Complications

- Alladi et al. 2004 (10 large series; 1,123 children):
  - Granuloma: 13% (0-31%)
  - Accidental decannulation: 4.7% (0-24%)
  - Tracheo-cutaneous fistula: 3.8% (0-35%)
  - Hemorrhage: 3.5% (0-25%)
  - Tube obstruction: 2.8% (0-8%)
  - Pneumothorax: 2.6% (0-9%)
  - Tracheal stenosis: 1.8% (0-12%)
  - SubQ emphysema: 1.6% (0-9%)
  - Pneumomediastinum: 1.6% (0-6%)
  - Stomal infection: 1.2% (0-6%)
  - Tracheomalacia: 2.0% (0-10%)
Accidental Decannulation

- Prevalence: 3.3% to 5.6% (Wetmore et al. 1999, Tantinikorn et al. 2003)
- Early or late complication
- More frequent as child develops manual dexterity
- Constant supervision at home
- Tracheostomy ties must be secure (no more than one finger)
- Caregivers have dislodgement plan
Accidental Decannulation

- What was original indication for tracheotomy?
  - Airway obstruction (subglottic stenosis):
    - May not be able to intubate from above
  - Pulmonary disease:
    - May be able to intubate from above

- How old is tracheostomy?
  - The longer it’s been in, the more mature the tract, the less likely to create false passage
  - If “fresh” tracheostomy (few weeks): be careful
False Passage
Pneumothorax
Pneumothorax
Accidental Decannulation

- Don’t panic
- Often child can breathe comfortably through open stoma
- Monitor $O_2$ saturation
- Try calm, controlled reinsertion
  - Position properly:
    - Shoulder roll, neck extension
    - Get lots of holding help
    - Good lighting (headlight preferred)
- If hurried:
  - False passage (anterior neck, esophagus)
Accidental Decannulation

- Enter airway from the side
- If tube won’t go, try a size down
- If smaller tube not available, try small ETT
- Soft clear suction catheter
  - Thread trach tube over it
- Confirm that you’re in the airway:
  - Suction: secretions
  - Hear and feel air through tube
  - Check breath sounds (bilateral)
  - \( \text{CO}_2 \) monitor
- OR, rigid tracheoscopy, stomal revision
Bleeding

- Approximately 3.5% of all pediatric tracheostomy patients (Alladi 2004)
- Early or late (usually late)
- Etiologies:
  - Tracheitis
  - Suction trauma
  - Granulation tissue:
    - Peristomal (external)
    - Intratracheal
  - Tracheal erosion (innominate fistula)
Bleeding from Tracheostomy

History:
- When did it begin?
- How much?
- Around the tube or in the lumen?
- Previous history of bleeding from trach?
- History of recurrent tracheitis?
- Any recent change in trach tube size or brand?
- Are trach changes going well?
- Any history of bleeding disorder?
Bleeding from Tracheostomy

- Associated symptoms:
  - Airway obstruction
  - Hypoxia
  - Increased tracheal secretions
  - Increased ventilator settings
  - Hematemesis, epistaxis
Peristomal Granulation Tissue

- **Prevalence:**
  - So common that some don’t consider it a complication
  - Peristomal granulation: 6% to 10% (Wetmore et al. 1999, Tantinikorn et al. 2003)
  - Peristomal infection/ulceration: 0.6%

- **Diagnosis:** look underneath trach tube
  - Preferable to examine entire airway
  - Sometimes it’s very obvious

- **Treatment:**
  - Topical AgNO₃, antibiotic ointment, dressing care
  - Surgical excision
  - If recurrent, consider formalizing trach stoma
Stomal Granulation
Stomal Granuloma
Wound Complication
Suprastomal Tracheal Granuloma

- Granulation tissue within the lumen of the trachea
  - Immediately superior to the stoma
- Prevalence:
  - 39% to 41% (Wetmore et al. 1999, Tantinikorn et al. 2003)
- Can bleed:
  - Infection
  - Excessive neck movement
  - GERD
- Can obstruct airway
  - Totally-obstructing suprastomal granuloma
  - Dangerous trach tube changes
  - Loss of voice
Tracheostomy Tube Placement
Suprastomal Tracheal Complications

- **Diagnosis:**
  - Best view is from above with bronchoscope
  - Difficult to visualize via stoma

- **Treatment (if needed):**
  - Removal in OR
    - Hook and knife
    - Optical forceps through bronchoscope
    - KTP laser bronchoscopy
    - Open surgery with revision trachotomy
Totally Obstructing Suprastomal Granuloma (TOSSG)
Suprastomal Cartilage Collapse ("Tracheomalacia")
Suction Trauma

- Prevalence unknown
- History:
  - Has anyone new been suctioning?
  - Do the caregivers know how far to insert suction catheter?
  - Any signs of tracheitis?
  - Any evidence of dry tracheal mucosa?
- Diagnosis: tracheoscopy (can be done in ER)
- Treatment:
  - Trach teaching
  - Treat underlying condition (Abx, humidification)
Tracheoinnominate Artery Fistula

- Tracheostomy tube erodes through tracheal wall into innominate artery
- Often fatal: survival 7% to 50% (Jones et al. 1976)
- Prevalence:
  - 373 pediatric tracheotomies (Wetmore et al. 1999):
    - 2 cases of hemorrhage (0.5%)
  - 181 pediatric tracheotomies (Tantinikorn et al. 2003):
    - 0 cases (0%)
- Etiology:
  - Tracheotomy incision too inferior in neck
  - Aberrantly high-riding innominate artery
  - Excessively long/poor-fitting trach tube; old metal tube
  - Overinflated cuff (ischemic necrosis)
  - Associated factors: tracheitis, excessive steroids (Goltz et al. 1981)
Tracheoinnominate Artery Fistula

- Every child with bleeding from tracheostomy should be evaluated
  - Usually preceded by “sentinel bleed”
- Flex scope through trach tube
  - Slowly withdraw tube and scope together
  - Inspect anterior tracheal wall
  - If recognized:
    - Insert cuffed tube into trachea
    - Apply suprasternal pressure
    - Prepare blood for transfusion
    - Immediate transport to OR
    - Sternotomy and control of innominate artery
Tracheal Erosion

- Trauma from tip of trach tube
  - Whenever new trach size or company placed, placement should be confirmed
  - Look for vascular compression of trachea
  - If signs of erosion:
    - In OR, change size of trach tube
    - Try different material
    - Confirm placement with endoscopy
Extrinsic Tracheal Compression
Tracheal Injury
Tracheal Injury
Tracheal Injury
Late Complications

- Tracheal stenosis
- Tracheo-cutaneous fistula
Acquired Tracheal Stenosis
Acquired Tracheal Stenosis

- Approximately 1.8% of pediatric tracheostomy patients
- May require repair before decannulation
Tracheo-Cutaneous Fistula

- Persistent fistula from trachea to skin
- Approximately 3.8% (Alladi 2004)
- Not emergent situation
- Treatment: surgical closure if doesn’t spontaneously heal
Tracheocutaneous Fistula
Tracheocutaneous Fistula
Subcutaneous Emphysema
Tracheitis/ Bronchitis

- 55% chronic ventilated tracheostomy pts have abnormal flora (Palmer 1998)
- Prevalence:
  - 15% to 33% (Wetmore et al. 1999, Tantinikorn et al. 2003)
- Considered consequence of F.B., injury, poor clearance of secretions from diminished cough, and altered mucociliary transport
- Diagnosis:
  - Increased tracheal secretions
  - Other signs of URI
  - Increased $O_2$ requirement
  - Respiratory distress
Infections can be viral or bacterial
- Is positive culture in colonized trachea indicative of true pathogen or normal flora?
- *P. aeruginosa* (25%) and *S. aureus* (37%) are main potential pathogens
- Treatment: culture-directed Abx; inhaled TOBI

Beware of mucus plugging
- Increased secretions, especially in small child with small tracheostomy tube, can increase risk of mucus plugging/tube obstruction:
  - Saline mist/bullets
  - Frequent tracheostomy suctioning
  - Low threshold for Abx; bronchoscopy
Bronchitis/ Mucus Plugging
Conclusion

- Tracheostomy complications in children are common
- Some complications are more emergent than others
- ENT thanks you for your help!
Acute Exudative ("Bacterial") Tracheitis
Acute Supraglottitis
(“Epiglottitis”)