The Pediatric Difficult Airway

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Goals

- Review normal pediatric airway anatomy
- Review pediatric airway evaluation
- Pictures of abnormal airways
- Formulate a flexible/safe plan
Pediatric Airway Anatomy

- Obligate nasal breathers with narrow nares
- Larynx is cephalad C3 (adults C5)
- Epiglottis narrow, floppy and posteriorly angled
- Cricoid cartilage narrowest part and forms complete ring
- Large tongue, adenoids, and tonsils resulting in difficult ventilation & visualization
Fig. 26-1. Diagram of a coronal section through the airway of an infant. Areas where there are significant differences from adults are highlighted. (From Wetzel RC: Anesthesia for pediatric trauma. In Stene JK, ed: Trauma anesthesia, Baltimore, 1989, Williams & Wilkins.)
Fig. 26-2. Schematic drawing of an adult (A) and infant (B) airway. Note the comparison between the cylindrically shaped airway with uniform diameters in the adult as compared to the conically shaped airway of the child with the narrowest region at the cricoid. P, posterior; A, anterior. (From Cote CJ, Todres ID: The pediatric airway. In Ryan JR, Todres ID, Cote CJ et al, eds: A practice of anesthesia for infants and children, Philadelphia, 1986, WB Saunders.)
Adult Larynx
Infant Larynx
Pre-operative Assessment

History focusing on:
- Prior difficult intubation
- Prior head, neck, or oral surgery
- Airway infection
- Snoring
- Specific Syndromes or diseases
- Congenital Lesions
  - Laryngeal web, neck mass, hemangioma, subglottic stenosis, laryngomalacia
Pre-operative Physical Exam

- Gross abnormalities (the child just doesn’t look right)
- Mouth opening (Mallampati if possible)
- Prior cleft lip or palate
- Tongue size, mandibular size and symmetry
- Neck mobility
- Ability to cooperate
  - Even without developmental delay this can be an exciting proposition
Adult Pre-op Airway Exam

- Length of upper incisors
- Relation of incisors during normal jaw closure
- Ability to bring mandibular incisors anterior to maxillary
- Mouth opening
- Visibility of uvula
- Shape of palate
- Compliance of mandibular space
- Thyromental distance
- Length of neck
- Thickness of neck
- Range of motion of head and neck
Uncooperative Pediatric Pre-op Airway Exam

- Length of upper incisors
- **Relation of incisors during normal jaw closure**
- Ability to bring mandibular incisors anterior to maxillary
- Mouth opening
- Visibility of uvula
- Shape of palate
- Compliance of mandibular space
- **Thyromental distance**
- Length of neck
- Thickness of neck
- Range of motion of head and neck
Mallampati Classification

- **Class I**: Clear view of faucial pillars
- **Class II**: Partial view of faucial pillars
- **Class III**: Only posterior pharyngeal wall visible
- **Class IV**: No view of posterior pharyngeal wall

- **Grade 1**: Clear view of faucial pillars
- **Grade 2**: Partial view of faucial pillars
- **Grade 3**: Only posterior pharyngeal wall visible
- **Grade 4**: No view of posterior pharyngeal wall
Large Tongue (Macroglossia)

- Trisomy 21
- Beckwith-Wiedemann
- Hurlers
- Kocher-Debre-Semel
- Ainge
- Pompe’s
- Grieg’s
Trisomy 21

- Atlanto-axial instability consider in-line traction when intubating
- Subacute subglottic stenosis consider using an ETT one size smaller
- Large tongue
- Small mandible
Assessment of the Difficult Pediatric Airway
Retrognathia (micrognathia)

- Arthrogryposis
- Cornelia de Lange
- Cri du chat
- Dwarfism
- DiGeorge
- Goldenhar
- Klippel-Feil
- Pierre Robin
- Trecher Collins
- Turners
- Trisomy 18,21,22
Klippel-Fiel
Achondroplasia
Crouzon’s
Trisomy 21
Hurler’s Syndrome
Hurler’s Syndrome
Pierre Robin
Pierre Robin
Pierre Robin
Pierre Robin after jaw distractors
Treacher Collins
Hemifacial Microsomia
Hemifacial microsomia
Hemifacial microsomia
Treacher Collins
Treacher Collins
Cystic Hygroma
Cystic Hygroma
Blue Bubble Syndrome
Specific Genetic Diseases at Risk for Sedation/Anesthesia Complications

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3 week old male with Pierre Robin sequence presents for placement of mandibular distractors

Examination indicates limited mouth opening and a recessed jaw

**Initial Approach may include:**

- Into OR, monitors placed
- Inhaled induction with O2, N2O, and Sevoflurane
- Peripheral IV placed
- Start propofol infusion at 150 mcg/kg/min
- Decrease Sevoflurane to maintain spontaneous ventilation
- Proceed with oral fiberoptic intubation or place LMA as a conduit for fiberoptic intubation
Insertion of the Laryngeal Mask Airway in Awake Infants With the Robin Sequence

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Airway Devices That Fit Children

- Fiberoptic Bronchoscopes
- Verathon Glidescope Cobalt
- King Systems Airtraq
- Shikani Optical Stylet
- Laryngeal Mask Airways
- Lighted Stylette
- Bullard Laryngoscope
- Exchange catheters and bougies
Airway Devices that Do Not Fit Children

- LMA Fast-Track (sizes 3, 4, 5)
- LMA Ctrach (sizes 3, 4, 5)
- LMA McGrath (Approx Mac 3)
- Verathon Glidescope Ranger
- King Systems LTS-D
- EZC Medical Intubaid Flex
- Combitubes
- Double Lumen ETT
Intubation Techniques

- Laryngoscopy (4 handed technique, BURP)
- LMA
  - Proceed with anesthetic via LMA
  - LMA as conduit for fiberoptic intubation, exchange catheter
- Fiberoptic Bronchoscope
- Video Laryngoscopy (Glidescope)
- Lighted Stylette
- Other
Method in the OR

- IV access or inhaled induction then IV access
- Deepen anesthetic with propofol
- Titrate propofol and inhaled agent to maintain spontaneous ventilation
- Watch for change in ventilation which can be apnea, obstruction, laryngospasm
- Consider atropine (0.01 mg/kg minimum 0.1 mg)
- Consider Lidocaine (1 mg/kg) prior to intubation attempt
Primary Plan

- Maintain spontaneous ventilation
  - Incremental reversible sedation
    - Versed 0.05mg/kg
    - Fentanyl 0.5-1mcg/kg
    - Consider Ketamine
  - Just as dangerous as muscle relaxants
    - Propofol, barbiturates,

- IV lidocaine 1-2 min prior to instrumentation of the airway.
  - The timing of administration
  - Potential toxicity
  - Low potency
Preparation Difficult Pediatric Intubation

Premedication

- **Anticholinergics** (Atropine 10mcg/kg IV or Glyco 10 mcg/kg IV)
- **Antacids** (Ranitidine 1mg/kg IV)
- **Sedatives** (*cautiously approached*)
  - any underlying disorders of ventilation
  - sleep apnea
  - central apnea
  - prematurity
  - age less than 3 mos
Pediatric Difficult Airway Algorithm

Mask Ventilation Difficult

- **Check patients position**
- **Then:**
  - Oropharyngeal airway
  - Nasopharyngeal airway
  - Laryngeal mask airway
- **If this fails**
  - Awaken!
Fig 13. Correct positioning of the child more than 2 years of age for ventilation and tracheal intubation. A. With the patient on a firm surface, secure the tongue with a small ‘T’-shaped device. B. Support the neck by placing a roll under the shoulders. C. Lightly pull the lips apart and insert the stylet into the mouth.
The Unexpected Difficult Pediatric Intubation

Mask Ventilation Possible?

**SUCCEED**
Non emergency Pathway

**FAIL**
Emergency Pathway

If mask ventilation becomes inadequate

**PURSUE OTHER INTUBATION OPTIONS**
- Change Head Position
- Different Intubation Technique
- LMA as intubation guide
- Light Wand Retrograde

Different Technique with Rigid Laryngoscope (Limit attempts to avoid trauma)
- Fiberoptic
- OELM
- Stylets
- Retromolar Approach

**CALL FOR HELP**
- Awaken Patient

**PURSUE EMERGENCY OXYGENATION / VENTILATION OPTIONS**
- Two Person Mask Ventilation
- Percutaneous Cricothyrotomy
- Rigid Bronchoscopy
- LMA

**SUCCEED**
General Anesthesia by Mask
- General Anesthesia by LMA
- Awaken Patient

- Establish Definitive Airway
- Surgical Airway

**FAIL**
Surgical Airway

- Awake Intubation Techniques
- Abort and Regroup

- Surgical Airway
Pediatric Difficult Airway Summary

- Difficulty with mask ventilation
  - Reposition and attempt mask ventilation
- Move to 100% oxygen and call for help
- Obstruction
  - Reposition
  - Oral Airway
  - LMA
  - Awaken if possible
- Pursue emergency options
  - Two Person mask ventilation
  - Percutaneous Cricothyrotomy
  - Surgical Airway
Intubation options
The Parsons Laryngoscope
Intubation options
The Parsons Laryngoscope

- Miller Blade
- Parsons Blade
Intubation Options
The Bullard Laryngoscope
Intubation Options
Laryngeal Mask

- Airway during induction
- Route for fiberscope, forgery, lightwand, exchange catheter
- Airway during recovery
- Emergency Airway
  - Can’t intubate
  - Can’t ventilate
Intubation through the LMA

- Sedate/Topicalize/ (Paralyze) the airway according to the algorithm
- Insert the LMA
- Mount ETT onto bronchoscope
- Pass bronchoscope to the carina
- Remove LMA
- Advance tube over the bronchoscope
LMA as a fiberoptic conduit

- Size 1  infants (>5 kg)  3.5 ETT
- Size 1.5  6mos-2yrs (5-10kg)  4.0 ETT
- Size 2  2-6yrs (10-20kg)  4.5 ETT
- Size 2.5  6-10yrs (20-30kg)  5.5 ETT
Obstructed LMA view
(if it was fool-proof it wouldn’t be difficult)

- 10-20% of time
- Non-obstructed air entry
- Reposition the LMA
- Try a size smaller
- Blindly attempt to pass ETT
Intubation Options Blind Nasal
In-line cervical stabilization
Intubation Options
Lightwand
Lightwand
LMA fast track for Kids

- Secure the airway with LMA
- Topicalize with lidocaine
- Only comes in LMA sizes 3, 4, 5
- ETT are then 6, 7, 8
Optical Assistance -- Karl Storz
Optical Assistance - King Systems

A simple solution for visually guided intubation

Effective for routine and complex airway use

Optional clip-on video system
Cricothyroidotomy
Emergency options
Trans-tracheal jet ventilation

- High risk of:
  - Pneumothorax
  - Pneumomediastinum
  - Tracheal dissection

- Ensure controlled Peak inspiratory pressure
- Allow for long expiratory intervals
- Expect moderate to severe hypercarbia
Difficult Airway issues in the ICU
Airway exchange catheters

- Facilitate extubation
- Exchange an ETT (require cuffed ETT)
- Measure length to end of ETT
- Topicalize the airway with lidocaine down the ETT
- Place an additional 2-5 cm
- Suction the pharynx
- Verify ETCO2
- Withdraw the ETT while advancing the catheter
- Advance the new tube over the device no resistance
Difficult Airway issues in the ICU
Airway exchange catheters

- Resistance to advancement DDX
  - Acute hypopharyngeal-tracheal angle
    - Spin the ETT while advancing
    - Head extension/jaw thrust
    - Macintosh laryngoscopy
    - Tongue retraction
  - Laryngospasm
  - ETT too large
  - Catheter displaced/misplaced
Difficult Airway issues in the ICU
Airway exchange catheters
Extubation

- Patient wide awake
- No airway swelling noted
- Consider extubation over an airway exchange catheter
- Lidocaine spray to the pharynx/trachea
- Remove ETT
- Remove airway exchange catheter after convincing observation