Pediatric Peril: Managing A Child's Airway

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Today's Talk

Goals:

- Identify best practices for positioning and suctioning the conscious child.
- Describe techniques to optimize ventilation of the unconscious child.
- Understand the challenges and risks to pediatric prehospital intubation.

Disclosures

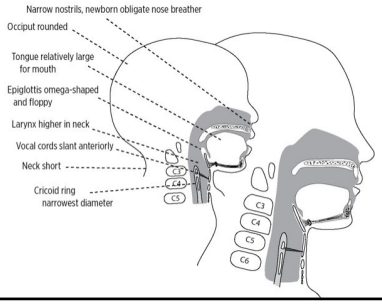
- None

The Pediatric Airway

99% of pediatric airways in the out-of-hospital environment can be managed with:

- Positioning
- Suctioning
- Adjunct Use (OPA/NPA)
- Bag Valve Mask Ventilation

Airway Differences in Kids



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Positioning

Braude, Shocket & Habrat, JEMS 2017

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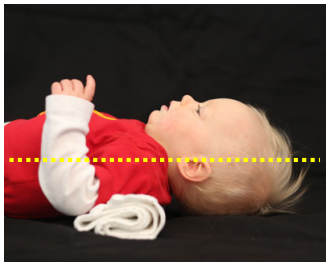
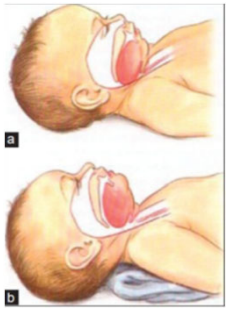


Braude, Shocket & Habrat, JEMS 2017

The Problematic Airway

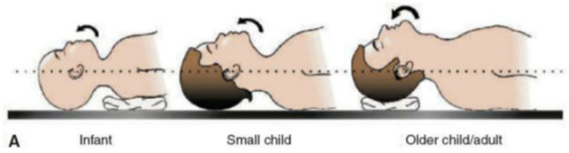
- Prominent adenoids, tonsils and a big tongue
- Loss of upper airway space
  - Obstruction during spontaneous ventilation
  - Difficulty with BVM
  - Sedatives result in loss of upper airway tone = upper airway obstruction

Positioning



Harless, Ramaiah, Bhananker, Int J Crit Illn Inj Sci 2014

Positioning Differences

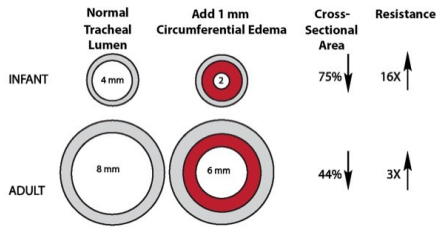


Walls Manual of Emergency Airway Management, 5th Edition

The Breathing Child

- The nose/pharynx responsible for **50%** of airway resistance
  - Noses shorter, flatter, with small nares
- Obligate nasal breathers until ~ 5 months of age
  - Blockage of nose = respiratory distress

Resistance to Flow



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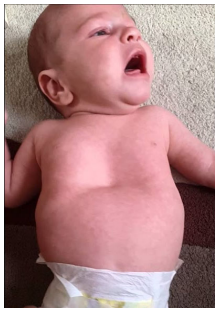
The Breathing Child

- Compliant but non-ossified chest wall
  - Intrinsic muscle tone required to maintain lung volume and prevent chest wall distortion
  - More likely to experience respiratory muscle fatigue, atelectasis and failure
- Calcification of larynx and trachea not until teens
- Flexible cartilaginous rings dynamically obstruct with negative pressure ventilation

The Breathing Child



Suctioning

Yes!	No!
• Unable to remove their own secretions	• Able to clear secretions • Cough or blow nose
• Secretion removal for children with bronchiolotis	• Concern for croup or epiglottitis
	• Trauma to face (basilar skull fracture)

Suctioning

Age	Size
Newborn	6 fr
6 month	8 fr
1-8 yr	10 fr
8 + yr	14 fr

Suctioning Using a Bulb Syringe

- For infants < 6 months

Squeeze the bulb | Insert tip into baby's nostril | Release the bulb

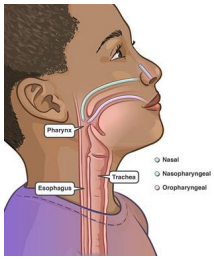
NP Suctioning

- Measure from tip of nose to earlobe

- You need:
  - Clean gloves
  - Suction catheter
  - Facemask with shield / surgical mask with eye protection
  - Surgi-lube
  - Saline drops

Suctioning

- Place 2-3 saline drops in each nostril
- Lubricate tip of catheter with surgi-lube
- Insert catheter to measurement
- Initiate suction
- Pull back slowly while moving the catheter in a circular motion
  - Never suction more than 5-10 seconds at a time



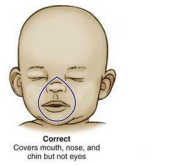
Would YOU Like It Up YOUR Nose?

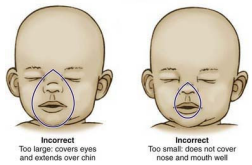
- Position of comfort until set up and ready to go
- Restrain only just before and during suctioning
- Explain procedure to parents if they are present
  - Child will scream and cry
- Make sure you have enough help prior to starting
- Comfort wrapping/swaddling "like a burrito" or "angel wrap"
- Singing, music, videos, distraction

BVM Ventilation

- Small, fixed tidal volumes relative to body size
  - Susceptibility to iatrogenic barotrauma
- Mask seal and mask technique CRITICAL
- Both VOLUME and RATE of breath delivery important

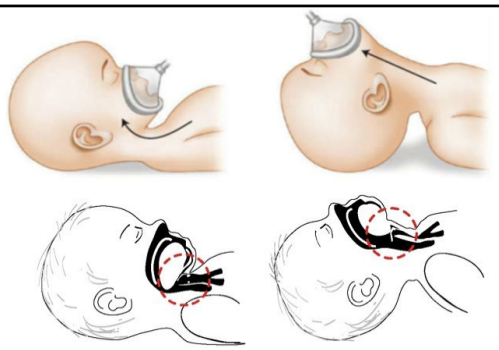
Ventilating a Child





https://obgynkey.com/pediatric-emergencies-and-resuscitation/

Ventilating a Child



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Bag Valve Mask Ventilation

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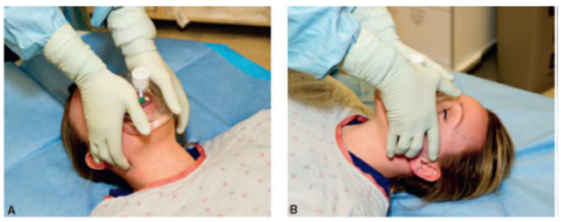
Bag Valve Mask Ventilation



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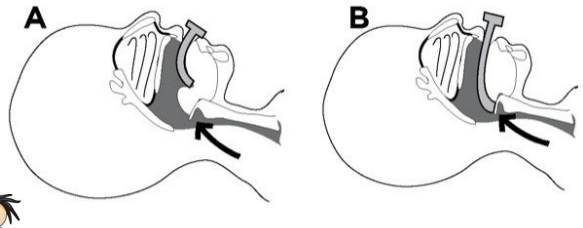
Once size does NOT fit all…



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Measure Twice, Place Once!

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BVM Ventilation Rate

Infant	Child	Adolescent
30-40	20-30	12-16
1 every 2 seconds	1 every 3 second	1 every 5 seconds

BVM Ventilation Volume

Target= 5-8 ml/kg

1488 ml

665 ml

258 ml

Allied Healthcare BVM

Age	Weight (kg)	TV (5 ml/kg)	TV (8 ml/kg)
Birth	3.25	16.3	26
3 mo	6	30	48
6 mo	7.5	37.5	60
1 yr	10	50	80
2 yr	12	60	96
3 yr	14	70	112
4 yr	16	80	128
5 yr	18	90	144
6 yr	20	100	160
7 yr	22	110	176
10 yr	32.5	162.5	260

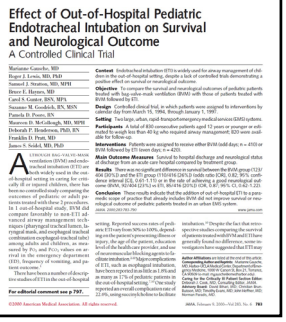
Physiologic Differences in Kids

- Oxygen consumption greater than adult
  - 6 vs 3 mL/kg/min
- Lower functional residual capacity = rapid desaturation
- CO_2 production increased
  - 100-150 vs 60 mL/kg/min
  - Since TV (mL/kg) is consistent across ages, RR is higher in infants to maintain the minute ventilation necessary

Prehospital Paramedic Endotracheal Intubation

No difference in survival
- BVM: 123/404 [30%]
- ETI: 110/416 [26%]
  - OR 0.82; [0.61-1.11]

No difference in neurologic outcome
- BVM: 92/404 [23%]
- ETI, 85/416 [20%]
  - OR 0.87; [0.62-1.22]



Effect of Out-of-Hospital Pediatric Endotracheal Intubation on Survival and Neurological Outcome

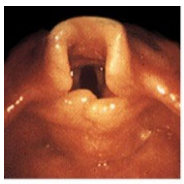
A Controlled Clinical Trial

Prehospital Paramedic ETI

- Large ground system*
  - 66% overall FPS
  - 53% infant FPS
  - 56% cardiac arrest FPS
- Many systems have removed Pediatric ETI

*Prekker et al Ann Emerg Med 2016

Intubating the Child



Infant

Toddler

Adult

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Added Challenges!

Syndrome	Airway implication
Pierre robin sequence	Micrognathia, glossoptosis, cleft palate
Goldenhar syndrome	Micrognathia (unilateral), cervical dysfunction
Treacher Collins syndrome	Micrognathia, small oral opening, zygomatic hypoplasia
Apert syndrome	Limited cervical motion, macroglossia, micrognathia, midface hypoplasia
Hunter and Hurler syndromes	Cervical dysfunction, macroglossia
Beckwith-Wiedemann syndrome	Macroglossia
Freeman-Sheldon syndrome	Circumoral fibrosis, microstomia, limit cervical motion
Down syndrome	Atlantooccipital abnormalities, small oral cavity, macroglossia
Klippel-Feil syndrome	Cervical fusion
Hallermann-Streiff syndrome	Microstomia
Arthrogryposis	Cervical dysfunction
Cri-du-chat syndrome	Micrognathia, laryngomalacia
Edwards syndrome	Micrognathia
Fibrodysplasia ossificans progressiva	Limited cervical motion

Harless, Ramaiah, Bhananker, Int J Crit Illn Inj Sci 2014

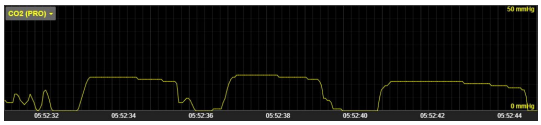
To Cuff or Not to Cuff

- Cuffed ETT provide better ventilating conditions
- Cuff pressure is critical
  - Median cuff pressure 40-60 cm H_2O well exceeding target <20 cm H_2O*

*Ong, et al Anesthesia 2008

The Pediatric Trachea

- Its Short!
  (5 cm in neonate to ~ 12 cm in adult)
  - Right mainstem intubation
  - Inadvertent extubation



Avoid Pediatric Peril

Practice, practice, practice…

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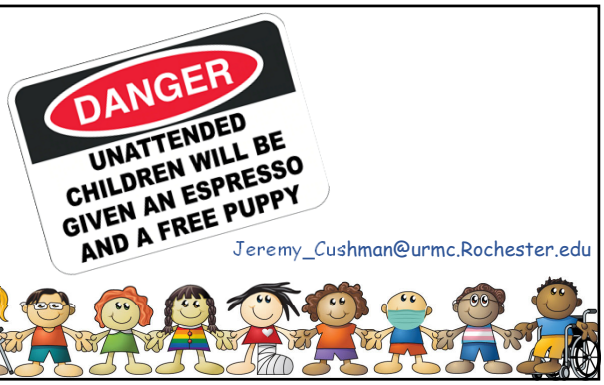
- Suctioning
- Adjunct Use (OPA/NPA)
- Bag Valve Mask Ventilation



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