London Health Sciences Centre
Southwest Ontario Regional Base Hospital Program

Pediatric Airway Assessment and Management

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Peds – few and far between

- **Present many challenges and obstacles:**
  - **Different sized equipment**
  - **Anatomical changes with growth**
  - **Genetic anomalies**
  - **Different drug doses with age and size**
  - **Performance anxiety**
  - **Critically ill children create dynamic situation**
    (parents, guardians, siblings increased level of stress)
  - **Increased risk of making physical and mental mistakes**

Objectives

The paramedic will be able to:

- **Describe the anatomical and physiological differences of the pediatric patient.**
- **Assess the pediatric patient's respiratory system.**
- **Identify and manage common pediatric airway difficulties.**
- **Manage a pediatric airway using age appropriate techniques including equipment selection.**

Pediatric Definition

- Neonate: < 28 days
- Infant: 2 to 12 months
- Toddler: 1 to 3 years
- Preschooler: 3 to 5 years
- School Age: 6 to 12 years

(BLS, 2006)

Approach to the Airway

- Children obstruct easier then adults
- More susceptible to obstruction due to swelling
- Interventions can lead to increased problems
- Child anxiety and crying increase work of breathing 32 fold
- 1st principal is trying to keep the child in a quiet comfortable environment.

Anatomical differences

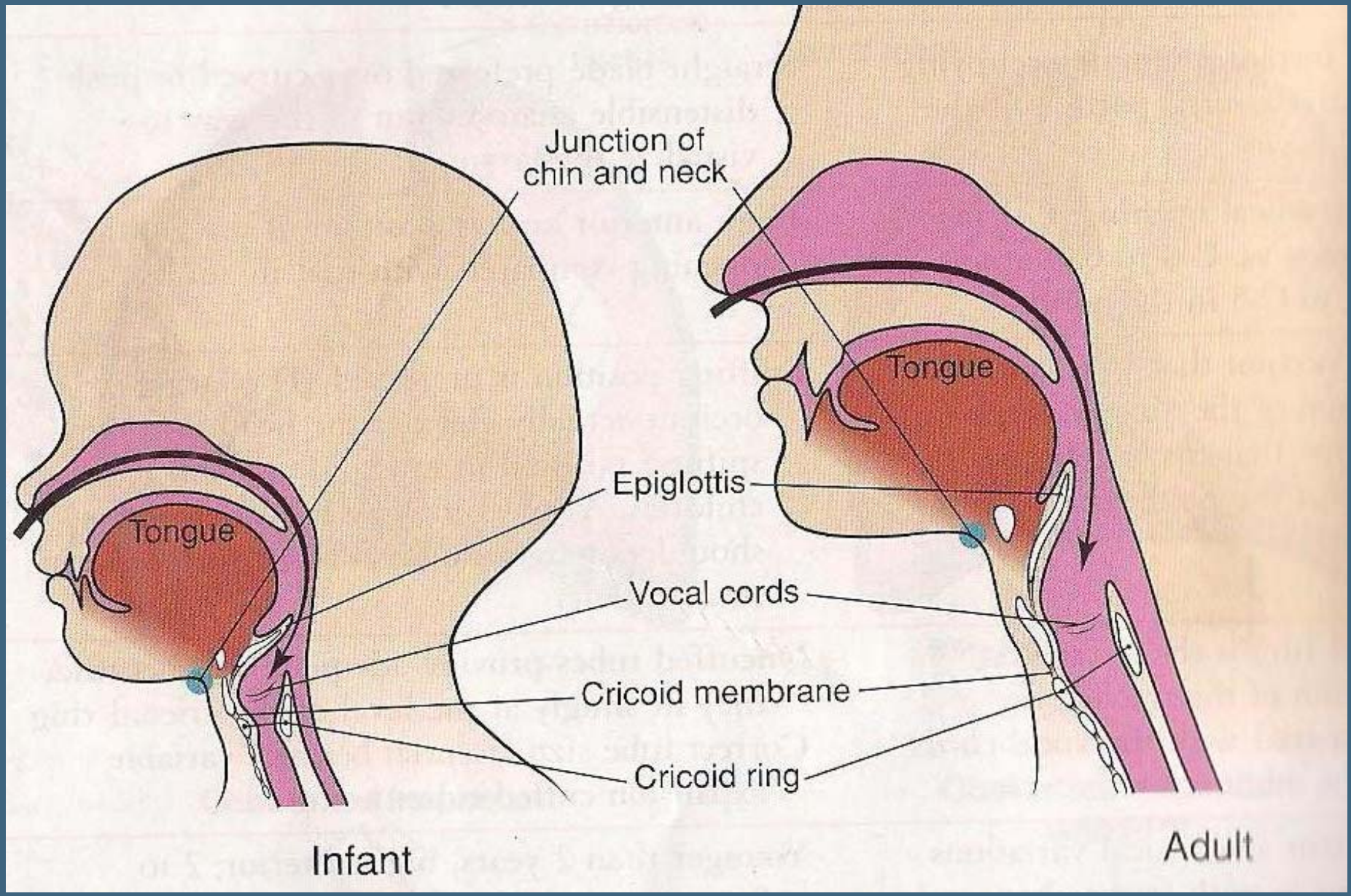
- **Glottic opening**

Infant	**C-1**
Age 7	**C-3 – C-4**
Adult	**C-5 – C-6**

****significance** glottic opening tends to be more cephalic and more anterior compared to adults**

Anatomical differences

- Tongue is larger compared to the oral cavity, and even larger in infants
- Smaller mandible
- Children have large tonsils and adenoids that can bleed significantly
- The angle between the epiglottis and laryngeal opening is more acute
- Trachea bifurcates higher


Junction of
chin and neck
Tongue
Epiglottis
Vocal cords
Cricoid membrane
Cricoid ring
Infant
Tongue
Adult

Anatomical differences

- Children have a small cricothyroid membrane
- Children < 3-4 its almost non-existent
- Needle cricothyrotomy will be difficult
- Surgical cricothyrotomy contra-indicated
- SWORBHP for Cricothyrotomy >40kg and >12 y/o

Anatomical differences

- <2 y/o have cephalic anterior airways = difficult visual of the glottis.
- Ages >8 y/o tend to be similar to the adult
- 2-8 y/o is the transition period = proper equipment selection and positioning important.

Anatomical differences

- Intubation
- Oral intubation – preferred
  - Blind and nasotracheal (contraindicated <8 SWORBHP)
  - Children have large tonsils and adenoids that can bleed significantly if injured and the angle between the epiglottis and laryngeal opening is more acute

Physiological differences

- Children have a basal oxygen consumption that is approx. x2 of adults
- Decreased FRC (smaller O2 reserves)
- Children de-saturate much more rapidly given equivalent pre-oxygenation then adults
- Maintaining adequate O2 saturations is of high importance!!

Physiological differences

- Pediatrics main support for the chest comes from chest muscles
- Use of these muscles ↑ metabolic and O2 oxygen consumption **they can fatigue easily** = respiratory arrest
- Most causes of cardiac arrest are the result of respiratory insufficiency
- Have proportionally smaller tidal volumes and 02 metabolic demands are double that of a adult
- Respiratory compensation is usually at max until depleted **early recognition**

Pediatric Assessment

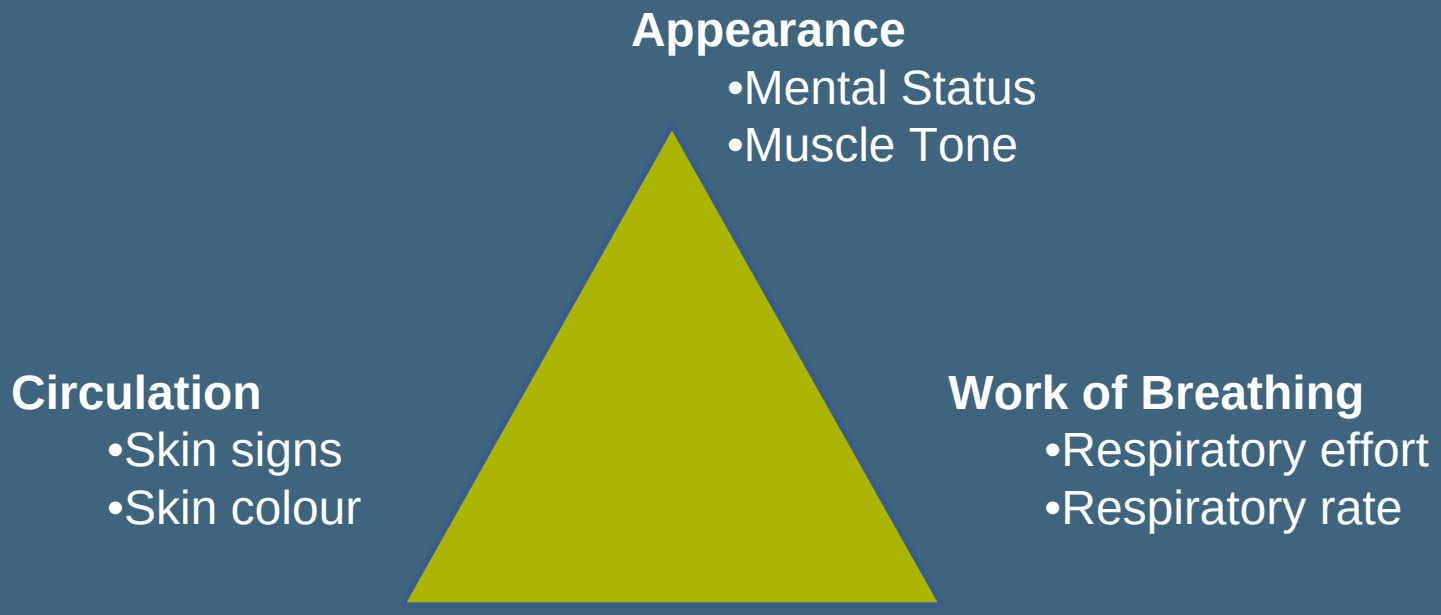
- Agitation tends to make respiratory distress worse.
- Young children are often frightened of strangers and dislike being examined.
- Physical exam of the conscious child in respiratory distress should be limited to the essentials.
- As much information as possible should be obtained by observation.
- Always look before touching!

Assessment of the Pediatric Respiratory System

- **Form a general impression of patient.**

  Do they have a life threatening condition?

  Pediatric assessment triangle



(Sanders, 2007)

Appearance

- How does the patient look?
- Is there acknowledgment of your presence?
- General impression of appearance quickly reflects adequacy
  - Ventilation
  - Oxygenation
  - Brian perfusion
  - CNS function
- A loud, boisterous crying child verses a flaccid, unresponsive child with a fixed gaze?

(Sanders, 2007)

Appearance Continued..

- **TICLS mnemonic (Murphy et al., 2008)**
  - Tone
  - Interactivness
  - Consolability
  - Look/gaze
  - Speech/cry

Work of Breathing

- Assesses oxygenation and ventilation status along with breath sounds and respiratory rate (Murphy et al., 2008)
- Is child in respiratory distress and still compensating?
- Any abnormal, audible sounds without auscultation?
  - Snoring
  - Stridor
  - Grunting

Audible Airway Sounds

- Snoring, difficulty swallowing secretions, muffled or horse voice
- Stridor: high pitched, audible on inspiration
- Grunting: provides PEEP (positive end-expiratory pressure)

Work of Breathing Continued..

- **Additional signs of increase work of breathing:**
  - **Sniffing position**
  - **Tripod position**
  - **Retraction of the sternal notch, supraclavicular areas and intercostals spaces**
  - **Head bobbing**
  - **Nasal flaring**

Sniffing Position

(Whitethorn, 2000, pg 9)

Tripod Position

(Whitethorn, 2000, pg 10)

Retraction and Nasal Flaring

(Whitethorn, 2000, pg 8)

Auscultation of Lower Airway

- **Placement of stethoscope bell near the armpit to maximize transmitted breath sounds (Murphy et al., 2008).**

Wheezing :

- **Lower airway sound heard in children with respiratory compromise (Murphy, et al., 2008).**
- **Movement of air through partially blocked smaller airways**
- **Initially hear on exhalation**
- **As degree of obstruction increases, heard in both inspiration and expiration.**
- **Increase work of breathing leads to fatigue and respiratory arrest = silent chest = pre-arrest.**

Circulation

- Adequacy of cardiac output and oxygenation
- Peripheral or central cyanosis = significant hypoxemia.
- Corrective action = airway management and optimal oxygenation

Normal Pediatric Vital Signs

	Neonate	Infant	Toddler	> 5 yrs
Pulse	**< 180**	**<140**	**< 120**	**< 100**
RR/min	**< 60**	**< 40**	**< 30**	**< 20**
SBP	**Lower limit (> 1 year): 70 + (2 x age)** **Normal SBP (> 1 year): 90 = (2 x age)**			
Weight (kg)	**(age x 2) + 10**			

Provincial Medical Directives, 2009– Reference Notes

Respiratory Rate

- Tachypnea/tachycardia is often first clinical sign of respiratory distress in children (Murphy et al., 2008).
- Tachypnea → Marked Tachypnea→ Bradypnea
- Tachycardia→ Marked Tachycardia → Bradycardia
- Respiratory distress→ Respiratory Failure→ Respiratory arrest

Pre-Hospital Airway Emergencies

- Medical
- Genetic / Anatomical
- Trauma

Airway Emergencies - Medical

- **Medical:**
  - **Croup / Epiglottis**
  - **Asthma**
  - **Broncholitis**
  - **Pneumonia**
  - **Aspiration**
  - **Anaphylaxis**

Airway Emergencies - Trauma

- Burns
- Laryngospasm
- Direct trauma, eg fractured larynx, continuous hemorrhaging

Airway Emergencies – Genetic/Anatomical

- Downs syndrome
- Cleft and lip palate

Medical

Croup:

- Common viral infection
- 6 months to 4 years (<8 protocol)
- Fall and winter months

S&S:

- History of upper airway infection, low grade fever, barking cough, inspiratory stridor, respiratory distress with accessory muscle use

Trt:

- Nebulized epi , and supplemental O2

Medical

Epiglottitis

- Bacterial infection
- Ages 3-7 y/o although can occur at any age
- Edema causes occlusion from swelling of the epiglottis and supraglottic structures (pharynx, epiglottic folds, arytenoid cartilage)

S&S:

- Sudden onset with rapid progression
- High fever
- Sore throat→ difficulty swallowing → trademark drooling
- Sniffing position, inspiratory stridor

Trt:

- Monitor vitals, blow by O2, remain in position of comfort

Medical

Asthma

- Swelling, Bronchoial constriction and spasms, secretions
- increase airway resistance and air trapping causing hypoxemia
- Common in children >2

S&S:

- Anxiety, tachypnea, tripod position with accessory muscle use, audible wheezes, prolonged expiratory phase

Trt:

- O2, nebulized ventolin,
- Epi and ventilatory assistance with BVM if signs of respiratory failure/arrest
- BVM difficult in asthma patient
- Intubation discouraged

Medical

Pneumonia

- Acute infection of the lower airway and lungs
- Bacterial or viral

S&S:

- Decreased breath sounds
- Fever
- Pain the chest
- Rhonchi (localized or diffuse)
- Tachypnea, grunting

Trt:

- Monitor for signs of respiratory distress/respiratory failure
- Supplemental O2 and ventilation with BVM if indicated
- Ventolin if wheezing present

Trauma

Burns:

- Humidified oxygen
- Rapid transport
- Close attention to swelling of the airway
- Intubation, may be necessary

Trauma

Laryngospasm:

- Partial or full closure of the vocal cords
- Can happen in response to drowning
- Stimulation from intubation
- Positive pressure ventilations can stimulate opening if larynx (Holm-Knudsen and Rasmussen, 2008)

Genetic Anomalies

- Downs syndrome (trisomy 21)
- Pierre robin
- Beckwith weidemann
- Treacher collins
- Cleft lip and palate

Down syndrome (Trisomy 21)

- Large tongue
- Larygomalacia
- Subglottic stenosis
- Narrow nasopharynx

Pierre Robin

- Cleft soft palate
- High arched palate
- Small jaw with receding chin
- Mandible is placed usually fare back in the throat
- Large tongue compared to mandible
- Small opening in the roof of the mouth which caused choking

Pierre Robin

- **Complications**
  - **Choking episodes**
  - **Feeding difficulties**
  - **Breathing difficulties, especially when the child sleeps**
  - **Low blood oxygen and brain damage (due to difficulty breathing)**
  - **Death**
  - **Pulmonary hypertension**
  - ****do not lie them on their back as the tongue will obstruct the airway.****

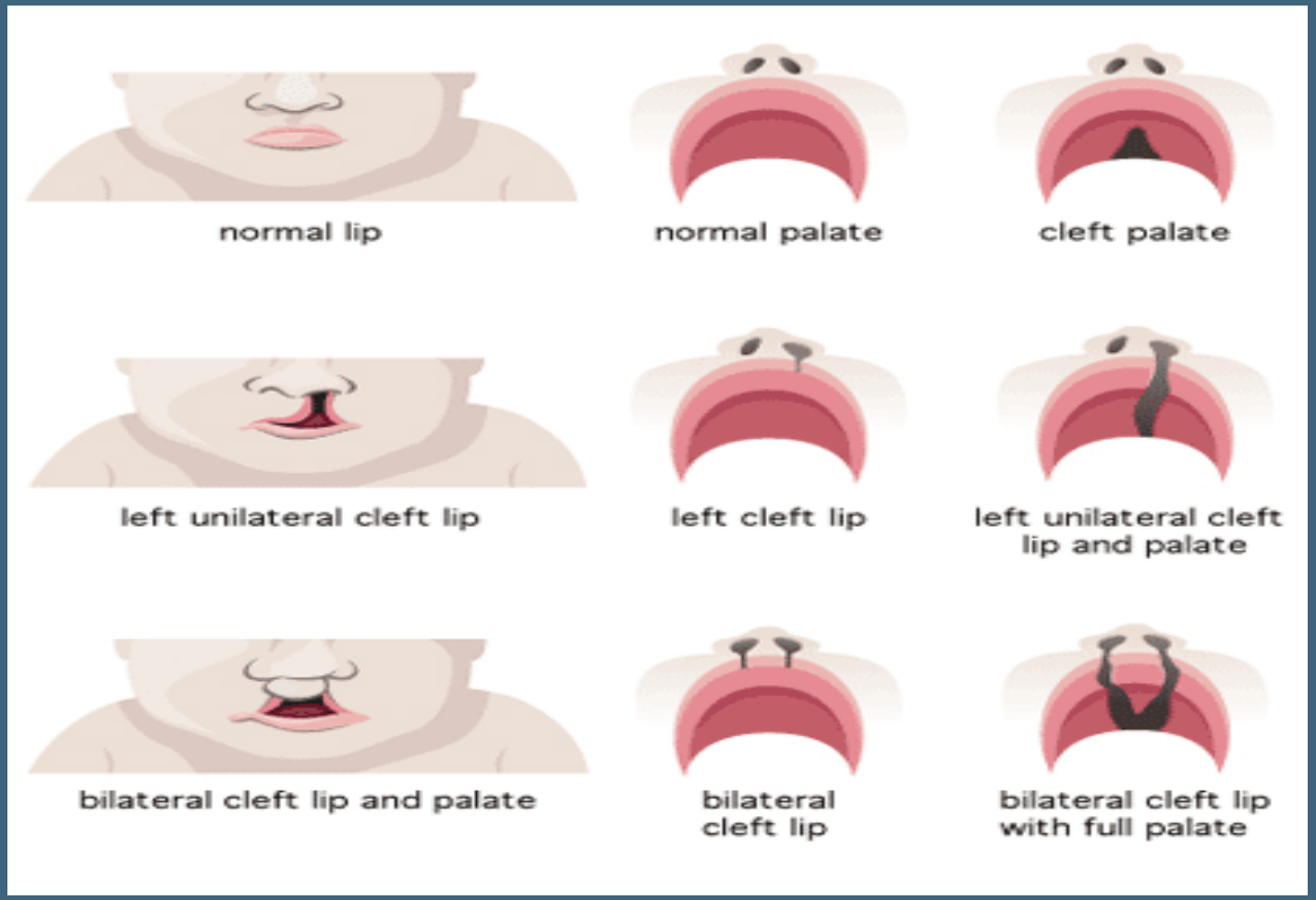
Beckwith Weideman

- Over growth disorder
- Large tongue (marcoglossia)
- Many other of the disorders include:
  - Increased risk of cancer
  - Overall larger babies
  - Hypoglycemia

Treacher Collins

- Abnormal eye shape
- Flat cheekbones
- Clefts in the face
- Small jaw
- Low set ears
- Abnormally formed ears
- Abnormal ear canal
- Hearing loss
- Defects in the eye (coloboma that extends into the lower lid)
- Decreased eyelashes on the lower eyelid

CLEFT LIP AND PALATE



Pediatric Airway Techniques

- Airway devices and techniques tend to differ from adults the most in the smaller children (< 3 years) and infants (younger than 1) (Walls, 2008)

- Because of two factors (Walls, 2008):
  1. Airway anatomy is different from the adult
  2. Some commonly used devices not available in pediatric sizes.

Bag-mask Ventilation (BMV)

- **Positive pressure ventilation with O2 should be initiated:**
  - **Poorly responsive child +/- respiratory distress/failure (BLS Patient Care Standards, 2007)**
  - **Child with S&S of respiratory distress/failure and poor oxygenation (SPO2< 90)(Walls, 2008 and BLS Patient Care Standards, 2007)**
  - **Initial airway procedure in pediatric resuscitation (American Heart Association, 2000; Walls, 2008).**

Endotrachael Intubation (ETT)

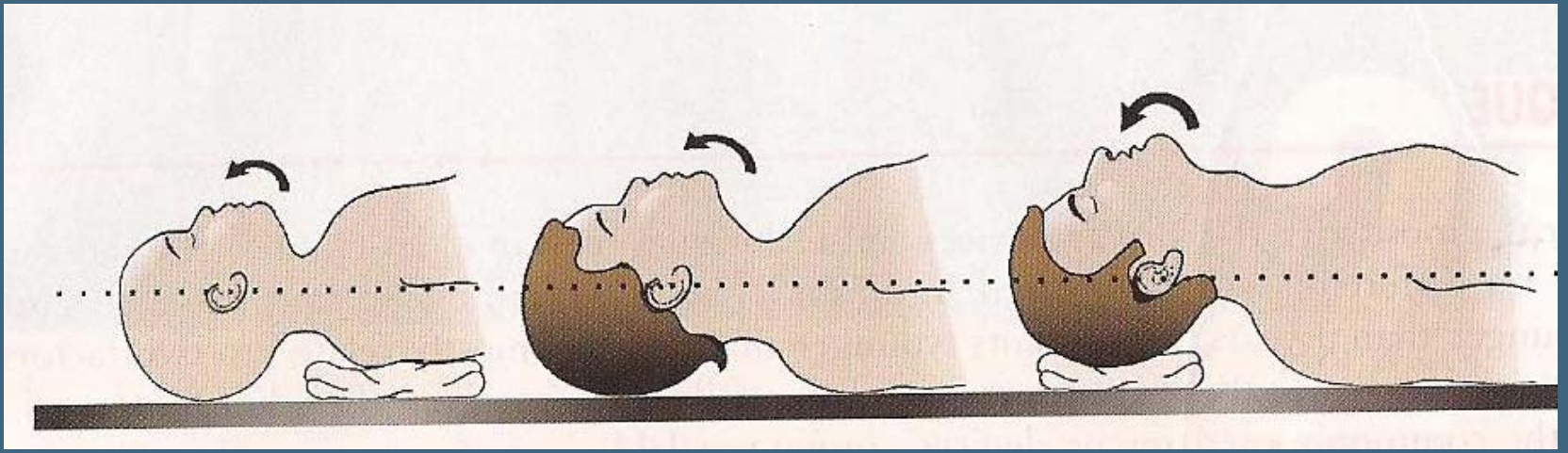
- **Indicated:**
  - **In unresponsive child with signs and symptoms of respiratory arrest and cardiac compromise (bradycardia with poor perfusion) that does not respond to BVM FiO2 1.0 (SWORBH, 2009; and Saunders, 2007).**
  - **In child in cardio respiratory arrest (SWORBH, 2009)**

Pediatric BMV and ETT - Positioning

- **Optimal position =** “Sniffing Position”

(Holm-Knudsen and Rasmussen, 2009, pg 2)

Airway Positioning



Padding under the shoulders <3 y/o

Padding under the occipital >3 y/o

or

Use a line passing through center of the ear to the anterior shoulder this will help to align the airway

Suctioning

- Can stimulate posterior pharynx producing vagal response = bradycardia and apnea
- Monitor HR while suctioning
- Length of suction attempt = ~ 5 sec in the infant
- Allow for spontaneous or assisted ventilations in-between suction attempts to re-oxygenate

(Sanders, 2007)

BMV Technique

- Oral airways in the unconscious child being ventilated with a BVM (Walls, 2008).*
- Maintain sniffing position: one-handed, C-grip Walls, 2008)**

BMV One-handed C-grip Technique

(Holm-Knudsen and Rasmussen, 2009, pg 2)

BVM Technique

- Squeeze bag slowly until adequate chest rise for appropriate tidal volume.
- Ventilatory pressures > 40cm H2O = barotrauma and gastric distension/cricoid pressure is optional (Walls, 2008)***
- Use mnemonic “squeeze, release, release” for proper cadence of bagging.
- Rate =1 breath q 3-5 sec (American Heart Association, 2000)

Pediatric ETT Equipment Selection

Pediatric Endotracheal Tube Size & Depth Estimation

Size for children ≥ 1 year of age: $\frac{\text{Age in years} + 4}{4}$

Size for infant < 1 year of age:

Gestational age	Weight	ETT Size
< 28 weeks	< 1 kg	2.5
28-34 weeks	1-2 kg	3.0
34-38 weeks	2-3 kg	3.5
Term infant	> 3 kg	3.5
1-12 months	> 4 kg	4.0

Depth for children > 2 years of age: $\frac{\text{Age in years} + 12}{2}$

or depth = tube size (internal diameter) x3

Pediatric Endotracheal Intubation Techniques

- Visualization of glottis is difficult (esp in <1 year old and trauma patients) (Walls, 2008)
- External manipulation of the airway may be necessary (Walls, 2008).
- Lifting of epiglottis, is cautioned (Murphy et al., 2008).
- External pressure over the larynx to lift up epiglottis (Murphy et al., 2008)

Laryngeal grip to allow fifth finger to apply pressure on anterior neck

A. Glottic view without applying external pressure

B. Glottic view with a slight pressure on larynx with fifth finger

Pediatric Endotracheal Intubation Techniques

- Tip of tube can get caught on cords* (Murphy et al., 2008). Correct by slightly rotating tube.
- Accurate location of tip of tube is very sensitive (Walls,2008)
- Securing tube at mouth and use of a cervical collar important in the infant (Walls, 2008).

Summary

- Assessment is the key to gathering critical evidence of a pediatric patient's respiratory status or warning of impending respiratory arrest.
- Cardiorespiratory compromise best treated with proper oxygenation and ventilation techniques.
- Interventions can increase respiratory problems
- Intubate if no improvement or a decline after O2 and BVM.

Summary

- Anatomical and physiological considerations when managing airway
  - Cephalic anterior glottic opening
  - Don’t hyperextend neck; sniffing possition
  - Uncuffed tubes < 8years
  - Straight blades in younger children
  - External pressure and manipulation of airway can aid ETT success
  - Anticipate rapid desaturation and decline in condition
- Equipment selection and proper technique important in successful management of pediatric airway

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