

# NEET SS ANESTHESIA

Updated Notes 2026



## PAEDIATRIC ANAESTHESIA



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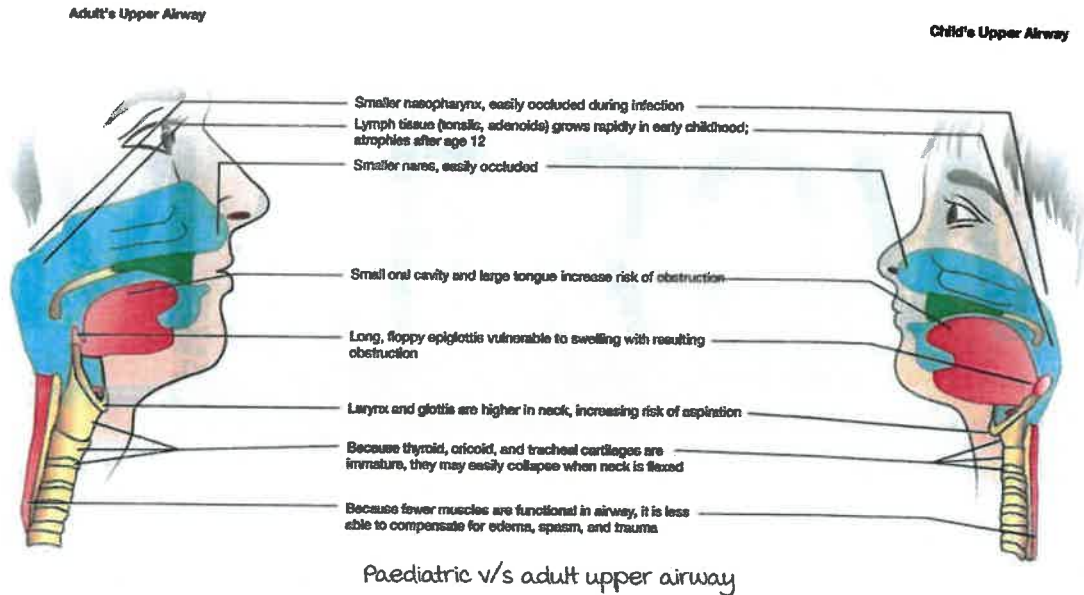
# PAEDIATRIC AIRWAY MANAGEMENT

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## Anatomy

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### The paediatric airway :



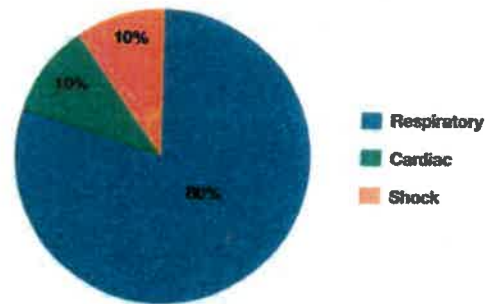
### Note :

most pediatric arrests are of **respiratory** etiology.

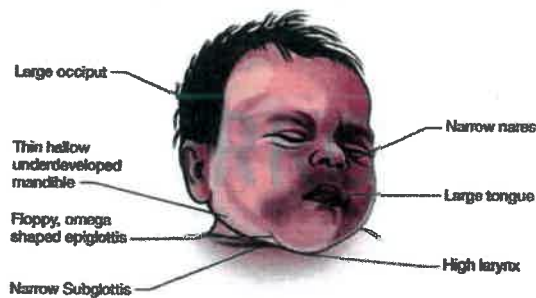
### Age group :

- Neonates : 1st 28 days.
- Infants : 1st year.
- Child : upto 8 years, different anatomy.
- The differences are most pronounced at birth and most unfamiliar under 1 year of age.

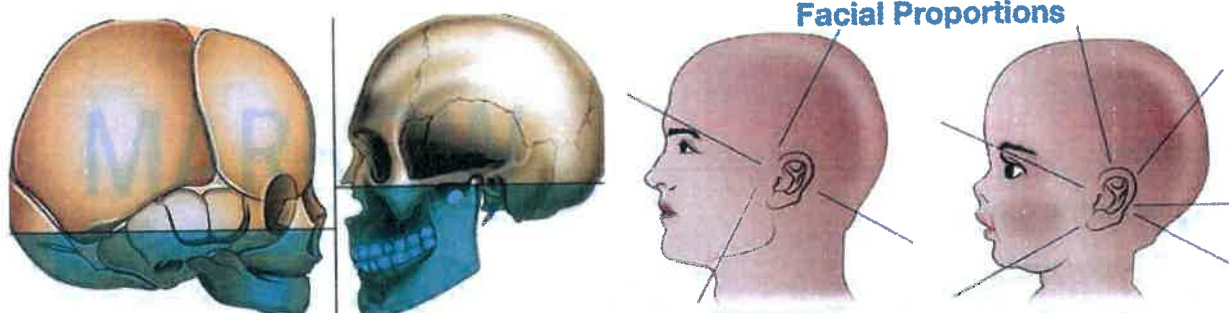
### Pediatric Cardiopulmonary Arrest



### Difference in infants



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**Craniofacial anatomy :**

Difference in craniofacial anatomy of adults and children

**Paediatric age group :**

- Airway is crowded in initial stages of life.
- Children are not small adults.
- Head is larger with a relatively shorter neck .
- Flexed neck results in airway obstruction.
- Laryngoscopy : Difficult as OPT (Oro pharyngeal tracheal) axis doesn't align.
- Softer tissue and absence of bony prominence makes standard mask holding techniques ineffective.

**Anatomy of nose :**

- Infant : Blockage of nose → Respiratory distress.
- They are **obligate nasal breathers until 5 months**.
- Nose/pharynx is responsible for 50% of total airway resistance :
  - Kid's noses are shorter, flatter, with small circular nares.
  - 20 mm in diameter.

**Anatomy of tongue :**

- The tongue is proportionally large & occupies most of the oral cavity.
- The mandibular space is small.
- Adenoids & tonsils are prominent → makes airway further narrow.

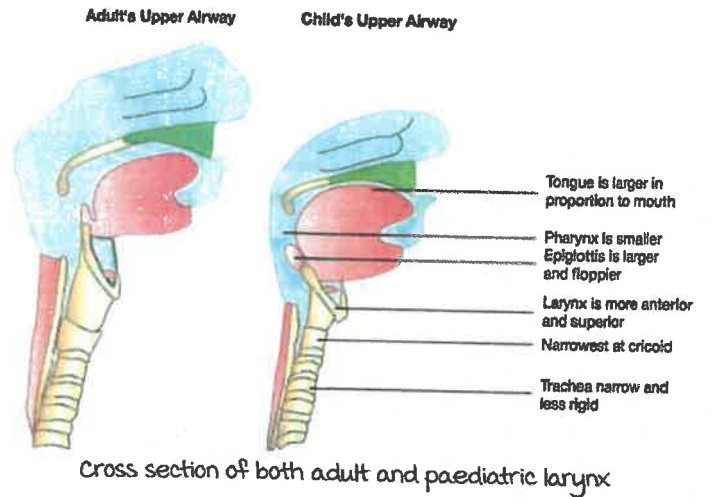
- Loss of tone : Sleep, sedatives, hypnotics & anaesthetics cause obstruction (Tone is normally low in children).
  - Difficulty with mask ventilation & obstruction.
  - Frequent cause of upper airway obstruction.
  - This phenomenon is called the tongue fall.

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**Anatomy of larynx :**

**Larynx anatomical considerations :**

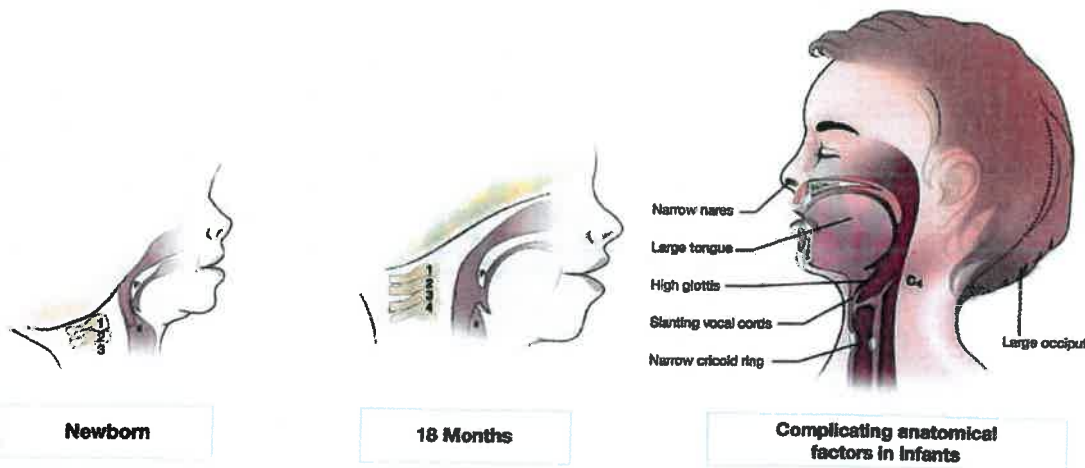
- The infants larynx is higher (Rostral) in the neck & more anterior.
  - Neonates : C1 (VC : C4).
  - Six months : C3 (VC : C5).
  - Adults : C4-C6 (VC : C6).
- During ingestion higher larynx pull airway up → Food (milk) enters esophagus as per gravity → Prevents aspiration.
- Angled vocal chords (Posterior end higher than anterior end) affects the tube placement.
- With suboptimal views this can result in trauma.
- Can collide with anterior commissure of the vocal chords and cause edema.



**Note :**

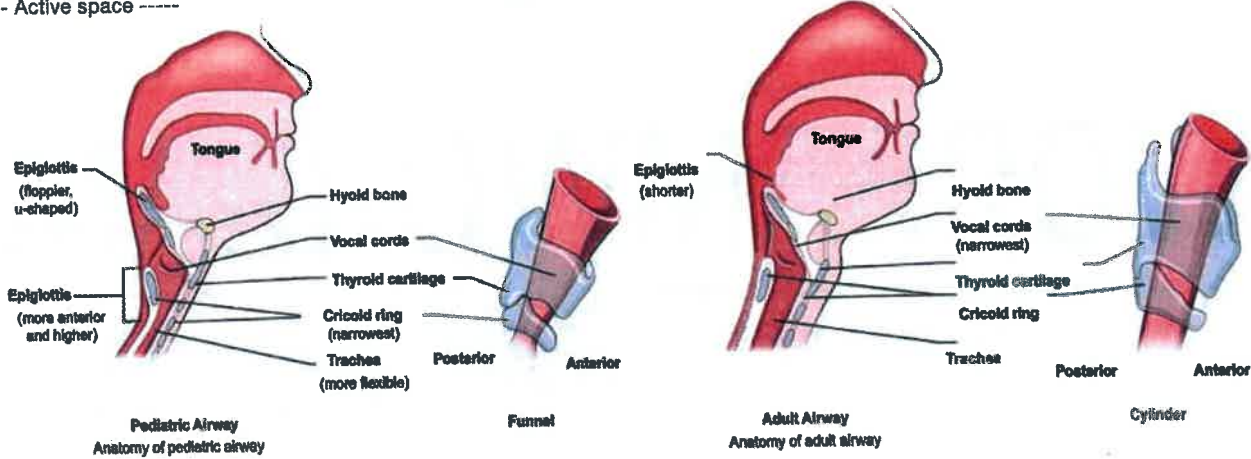
- In children larynx is more funnel shaped (Cylindrical in adults) : Therefore advised to use ET tube a size less than estimated size during laryngoscopy.
- This helps prevent trauma/bleeding.
- Narrowest point of larynx = **Cricoid cartilage** till 8 years (Adults : vocal cords).
- Cricoid is the only complete cartilage ring.

**Complicating Anatomical Factors in Infants**

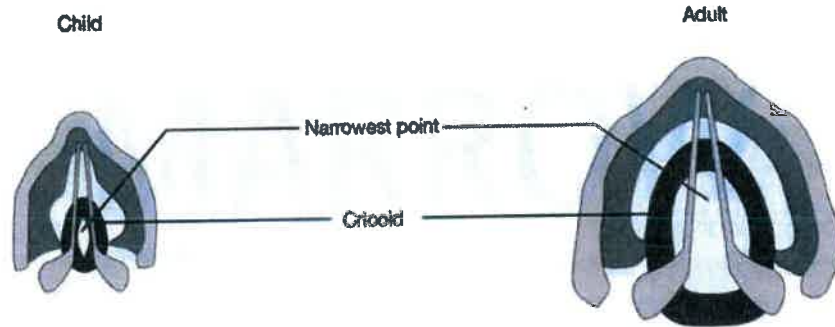


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Adult v/s Pediatric Airway



Anatomy of Larynx



Epiglottis location :

- Adult : C4-5.
- Child : C2-3.
- Relatively large size in children.
- Floppy & not much cartilage (Fibrous tissue < Elastic tissue).
- Neonate : u shaped epiglottis.
- Child : Omega shaped epiglottis.

Epiglottis Location



Note :

Arytenoids are more bulkier in children than adults :

- Choice of blade : Straight blade over curved as to include epiglottis.



Paediatric epiglottis

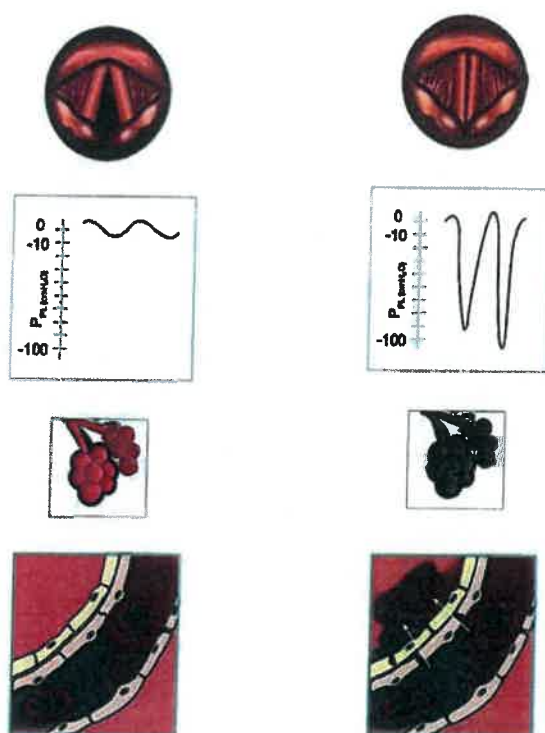


Adult epiglottis

### Airway anatomy :

- In adults laryngeal mucosa is adherent to underlying structures but not in children :  
Therefore any injury/trigger cause edema under the mucosal layer.
- Hyoid bone is the 1st airway structure to ossify (6-7 years).
- The cartilaginous portions of the airway are soft and compliant.
- Negative pressure beyond threshold → Airway collapse.
- Laryngospasm is more common.
- Negative pressure → Dynamic obstruction → Negative pressure pulmonary edema.
- Therefore PEEP is so effective in children.

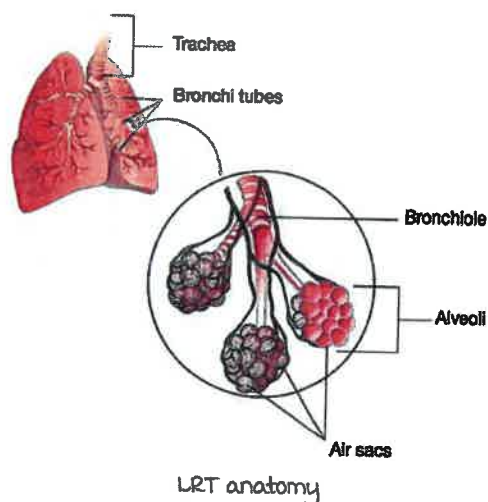
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Airway pattern

### Anatomy of lower respiratory tract (LRT) :

- The trachea is short.
- Tracheal & bronchial passes in children is relatively small, soft cartilage, the lack of elastic tissue.
- Right bronchus : Is more straight, like a direct extension of the trachea (more chance of the right lung atelectasis or emphysema) : vulnerable for right lobar intubation.
- Left bronchus : Is the separation from the trachea.



LRT anatomy



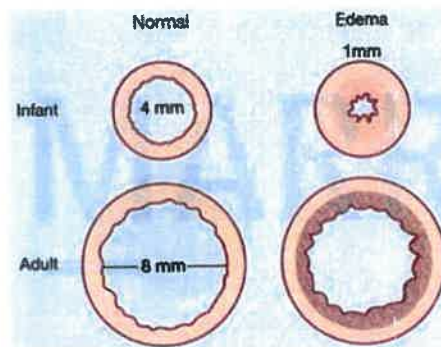
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- The bronchus is divided into inter-lobe bronchus, segmental bronchus & bronchioles.
- LRT : Vulnerable, easy to cause airway narrowing and obstruction.
- Bronchioles : No cartilage, smooth muscle imperfect development, mucosa rich in blood vessels, mucous glands hypoplasia, lack of secretion of mucus, poor mucociliary movement.
  - Can be a cause of post operative complications like infections.

### Physiology :

#### Effect of edema :

- Poiseuille's law  $R = 8\eta l / \pi r^4$ 
  - R = Resistance.
  - $\eta$  = Viscosity.
  - l = Length.
  - r = Radius.



Effect of edema. (Resistance is  $4^4 = 256$  times more)

- Internal diameter of trachea in newborns =  $1/3$  of adult (81 times higher R).
- Radius is the most important determinant of resistance of the airway.
- Small changes in airway diameter in infants/children due to edema/secretions creates a greater effect on resistance.
- Narrowest point = Cricoid cartilage in the child.
- Resistance rapidly increases as diameter decreases.
- If radius is halved, resistance increases 16x.

### Management

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#### Basic airway management :

- Goal of airway management is to anticipate and recognize respiratory problems and to support or replace those that are compromised or lost (Paediatric Advance Life Support manual).
- An individual must be able to support three specific functions :
  - Protect their airway.
  - Adequately ventilate.
  - Adequately oxygenate.
- Failure to perform one will result in respiratory failure.
- There are many simple, non-invasive techniques to support respiration prior to endotracheal intubation (mnemonic : SOAPPME) :
  - Suctioning.
  - Application of oxygen.

- Adjuncts :

- i. Nasopharyngeal airway.
- ii. Oropharyngeal airway.
- Positioning of the airway.
- Application of positive pressure.
- Assistance of mechanical ventilation with Bmv.

**Positioning :**

- use of the head tilt, chin lift and jaw thrust can help restore flow through an obstructed upper airway by separating the tongue from posterior pharyngeal structures.

**Aligning the axis :**

The goal is to line up three divergent axes :

- Oral.
- Pharyngeal.
- Tracheal.

**Aligning the Axis**

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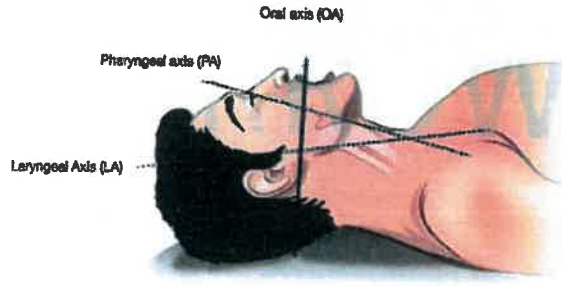
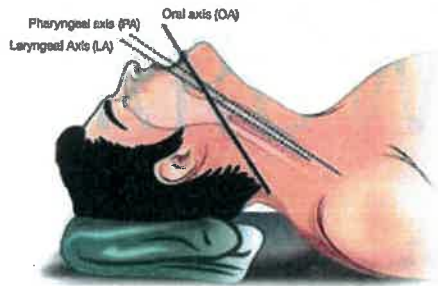
A



B



C



Aligning axis

**Positioning :**

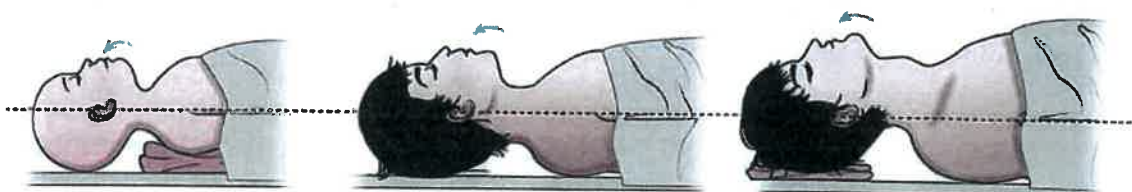
- Less than 2 years : Towel placed under shoulder.
- Children less than 8 years : Neutral position
- Adults or Older children : Extended neck

**Positioning**

**Less than 2**



**Less than 8**

**Adults**



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**Airway adjuncts :**

Oropharyngeal airways	Nasopharyngeal airways
<ul style="list-style-type: none"> <li>• Size determined by measuring from angle of mouth to angle of mandible</li> <li>• Facilitates relief of upper airway obstruction due to a large tongue</li> <li>• Allows oropharyngeal suctioning</li> <li>• Prevents compression of a child's endotracheal tube due to biting</li> </ul>	<ul style="list-style-type: none"> <li>• Size measured from nostril to tragus</li> <li>• Tolerated while awake</li> <li>• Helps in supplementary oxygen insufflation</li> <li>• A regular ETT can be cut &amp; used as a nasal airway</li> <li>• Not commonly used because :                             <ul style="list-style-type: none"> <li>- Smaller diameter of nasopharyngeal route → Higher resistance.</li> <li>- Nasal mucosa is more sensitive, with higher blood supply → High chance of bleeding.</li> </ul> </li> </ul>
	



Nasopharyngeal airway measurement



Depicts airway being inserted



Correct length of airway with adequate space between airway and epiglottis



A bit longer airway, meeting at epiglottis, can lead to airway obstruction and airway irritation (Leads to laryngospasm)



Shorter airway, tongue obstructs airway

Oropharyngeal airway placement

**Bag mask ventilation :**

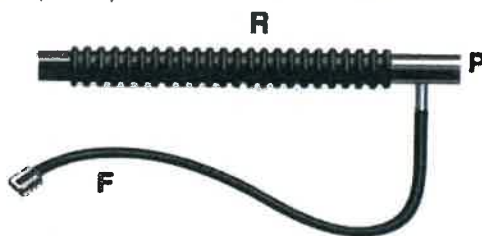
- The most important skill.
- masks should fit easily over the nose & mouth with no pressure on the eyes.
- The base of the mask rests on the chin.
- $ETCO_2$  monitors helps determine if effective.
- Multiple intubation attempts kill kids.

**Bags :**

Self-inflating AMBU bags.

Jackson Rees circuit :

- Has no valves.
- Modified form of Ayer's T piece.
- Minimal dead space.
- Light weight.
- Also helps to :
  - Assess the compliance of airway and easy ventilation.
  - Give a positive pressure if any occlusion.
- White knob on the bag helps to provide a controlled PEEP.



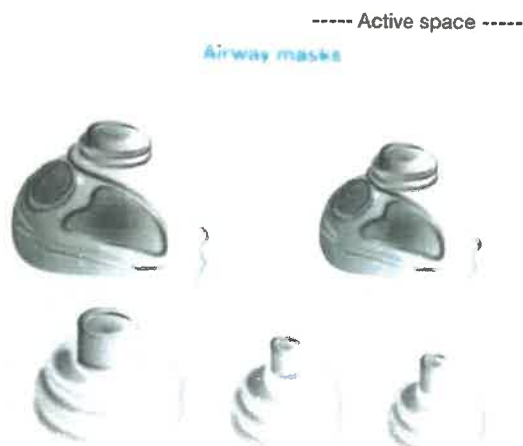
Jackson Rees circuit

**Bag and mask ventilation :**

- Clear, plastic mask with inflatable rim.
- Provides **atraumatic seal**.
- Proper area for mask application—bridge of nose extend to chin.
- maintain airway pressures  $<20$  cm H<sub>2</sub>O (**Barotrauma at the level of alveoli**).

methods to hold and establish chin lift (C and E hold) :

- Place fingers on the mandible to avoid compressing pharyngeal space.
- Hand on ventilating bag at all times to monitor the effectiveness of spontaneous breaths.



Closed circuit

**Bag-Mask Ventilation**

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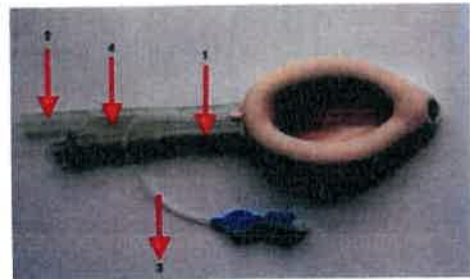
- Continuous positive pressure when needed to maintain airway patency.



C & E hold

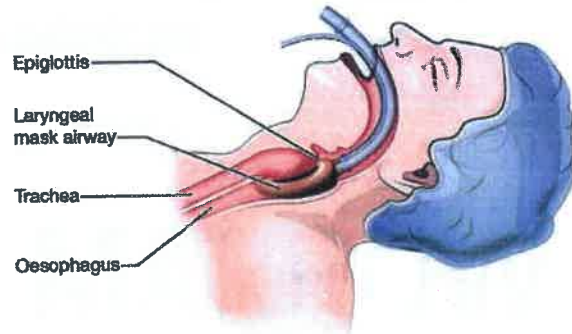
**Laryngeal mask airways :**

- Supraglottic airway
- Between sizes :
  - Use higher number & less air.
  - Better anatomic fit.



Laryngeal mask airway

**Normal Anatomic Position of LMA**



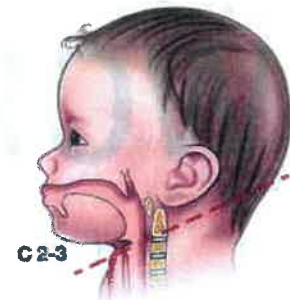
Proximal portion of LMA rests upon the epiglottis and the distal end extends till the upper end of the esophagus

LMA sizing		
Weight	Size	ml
0-5 kg	1	4
5-10 kg	1.5	7
10-20 kg	2	10
20-30 kg	2.5	14
30-50 kg	3	20
> 50 kg	4	30

**Clinical pearl :**

**Intubation :**

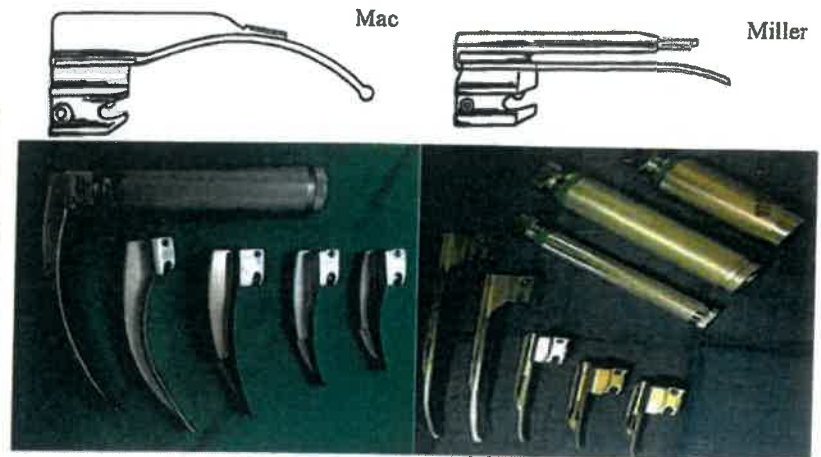
- Larynx cephalad and anterior in children.
- Practitioner may need to be lower than patient and look up.



**Intubation :****Laryngoscope blades :**

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Sizing chart		
Age	miller	mac
Preterm	00	-
Neonate	0	-
Infant	1	1
2 yrs	2	1



Laryngoscope blades

**Intubation technique :**

- Straight laryngoscope blade : To pick up the epiglottis.
  - Better in younger children with a floppy epiglottis.
- Curved laryngoscope blade is placed in the vallecula.
  - Better in older children who have a less floppy epiglottis.

**Intubation Technique****Cole's formula :**

Children &gt; 2 years :

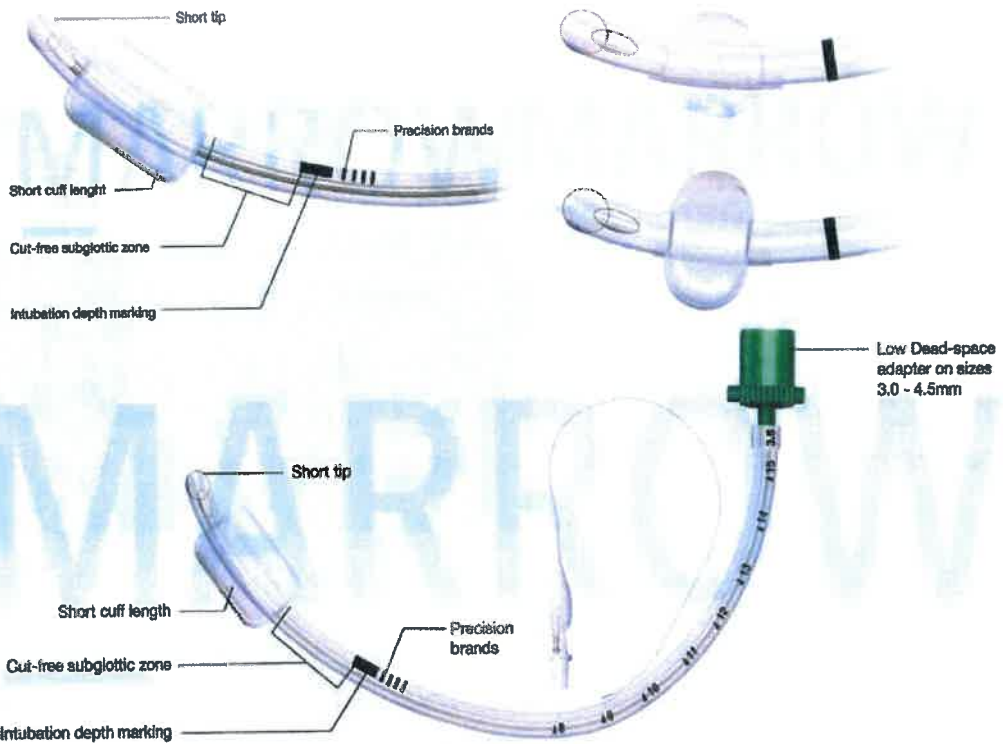
- ETT size :
  - For uncuffed tube :  $(\text{Age}/4) + 4$ .
  - For cuffed tube :  $(\text{Age}/4) + 3.5$ .
- ETT depth (Lip) :  $\text{Age}/2 + 12$ .

Sizing chart			
Age	Kg	ETT	Length (Lip)
Newborn	3.5	3.0-3.5	9
3 mos	6.0	3.5	10
1 yr	10	4.0	12
2 yrs	12	4.5	12

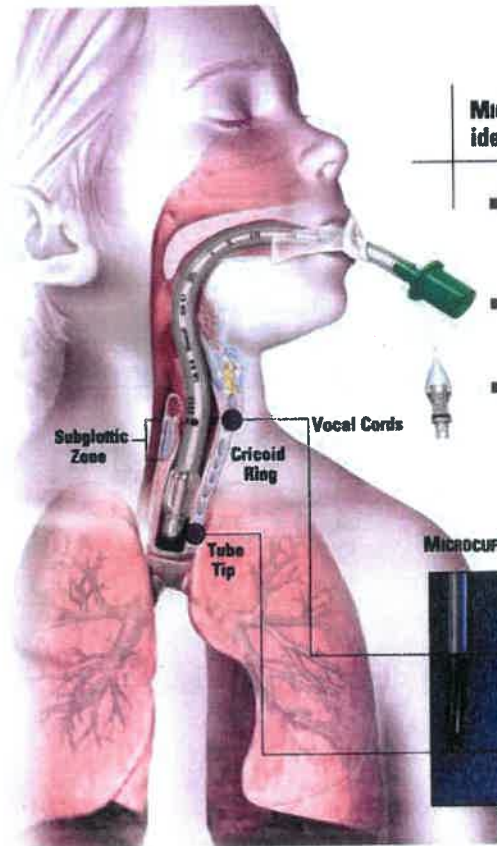
**Types of tube :**

- uncuffed endotracheal tube.
- Cuffed endotracheal tube (Cuff placed below cricoid).
- microcuffed endotracheal tube.
  - 10 microns thin.
  - 10 cm H<sub>2</sub>O pressure.
  - Elliptical paediatric airway seal with minimum pressure.

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microcuffed intubation tube



**Microcuff® tube is designed for ideal anatomical cuff placement**

- Short, cylindrical cuff placed near the tracheal tube tip  
— securing cuff placement in the trachea, not in the pressure-sensitive larynx
- Anatomically-based intubation depth mark results in correct placement and a cuff-free subglottic zone\*
- Four precision bands to facilitate and confirm optimal tube placement

**Microcuff® tube is designed for pediatric airway**



microcuffed intubation tube : Placement

### Preparation for endotracheal intubation :

- Need trained personnel.
- monitoring.
- Endotracheal tubes, laryngoscope blades : variety of sizes.
- Adjuncts (Stylet, oral airway, securing mechanism).
- Suctioning equipment : Size of suction catheter is 6-10 Fr.
- JR circuit attached to universal gas outlet at flow greater than 6 L/min.
- IV access.
- medications/drugs.
- Throat-pack.

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### Confirm placement :

#### Look :

- Colour of patient.
- mist in ET tube.
- Equal chest rise.

#### Listen :

- Remember that infants can easily transmit breath sounds to the stomach.
- There's nothing better than watching the ETT go through the cords.

Capnography :  $\text{ETCO}_a$  trace (GOLD standard).

## PAEDIATRIC RESPIRATORY SYSTEM

### Physiologic considerations

00:01:48

#### Growth of the lungs :

##### First trimester :

- 5 weeks : A lung bud appear → Splits into left and right.
- 8 weeks : Organogenesis → Lung buds divide → Over and over again → Branch like pattern.

##### Second trimester :

- main airways are developed.
- Air sacs and blood vessels start to develop.

##### Third trimester (After 28 weeks) :

- Preparing lung for breathing : Basement membrane becomes progressively thinner → Blood vessels start to form on the other side →  $O_2$  transfer into the blood vessels through the membrane → Type 2 pneumocytes secrete surfactant → Surfactant coat → Reduces the surface tension.



Development of the surfactant layer

##### Newborn :

- Fluid in their lungs → First breath after birth → Negative pressure expands the lung with air entering in it → Collapsed alveoli becomes the normal alveoli → Blood vessels open due to hypoxic pulmonary constriction → Decreased pulmonary vascular pressure.
- 15% alveoli develop in the birth.

##### 0 to 6 months :

- Sharp increase in the number of air sacs in their lungs.

##### 3 years :

- mini adult lung develops.
- Then increases as per height.