AIRWAY ASSESSMENT AND MANAGEMENT

DEFINITIONS

Airway : ‘’The extrapulmonary air passage, consisting of the nasal and oral cavities, pharynx, larynx, trachea and large bronchi.’’

Airway management : ‘’Is the maintenance of a patent airway.’’

Maintaining a patent airway is essential for adequate oxygenation and ventilation and failure to do so, even for a brief period of time, can be life threatening.

DIFFICULT AIRWAY :

"The clinical situation in which a conventionally trained anesthesiologist experiences difficulty with mask ventilation, difficulty with tracheal intubation or both."

DIFFICULT INTUBATION:

If a normally trained anesthesiologist needs more than 3 attempts or more than 10 min for a successful **endotracheal intubation.**

MANAGEMENT OF THE PATIENTS AIRWAY CONSISTS OF :

- Bag Mask ventilation. (basic)
- Laryngoscopy .
- Endotracheal intubation.
- The Laryngeal Mask Airway (LMA).

1- BAG MASK VENTILATION

* BMV is usually the **first step** in airway management and an essential rescue maneuver when the attempt at intubation fails.

*** Face mask applied before, during and after loss of consciousness at anesthetic induction.**

*** the mandible is held into the mask by the anesthetist (holding rather than pressing)**

- **the mandible is held foreword , helping to prevent posterior movement of the tongue and obstruction of the airway.**

C shaped hold (jaw thrust)

*** The face mask has variants of type and size .**

CONTRAINDICATIONS

full stomach

long procedures

complete upper-airway obstruction

Increased risk of aspiration after paralysis and induction

cardiac arrest.

The **head-tilt/chin-lift** is a procedure used to prevent the tongue obstructing the upper airways

Part of pre-intubation and emergency rescue breathing procedures, the head tilt–chin lift maneuver and the jaw-thrust maneuver are 2 noninvasive, manual means to help restore upper airway patency when the tongue occludes the glottis, which commonly occurs in an obtunded or unconscious patient.

There are two methods of applying BMV:

1. One-hand ventilation in which the mask is held with the left hand of the provider and placed against the face by downward pressure on the mask by the left thumb and index finger (pressure should be placed on the bony mandible (not on the soft tissues)) while the right hand gives positive-pressure ventilation with the breathing bag.

2. Two-hand-ventilation technique in which the provider uses two hands to provide jaw thrust and create a mask seal similarly to the one-hand technique, while an assistant provides positive-pressure ventilation with the breathing bag.

2- LARYNGOSCOPY

A medical procedure that is used to obtain a view of the vocal folds and the glottis. Laryngoscopy performed to facilitate tracheal intubation during general anesthesia.

It is carried out (usually) with the patient lying on his or her back

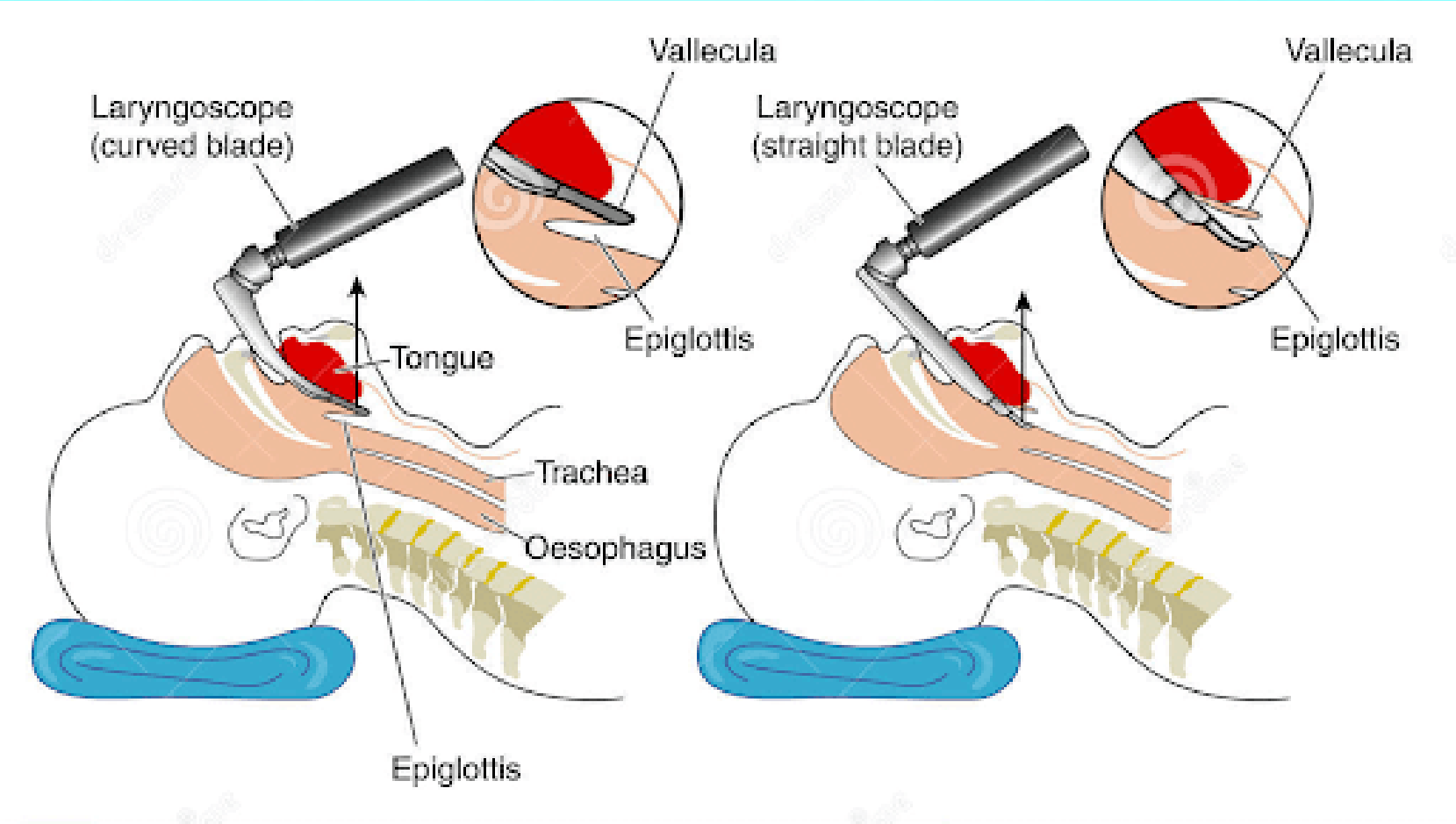
This procedure is done in an operation theatre with full preparation for resuscitative measures to deal with respiratory distress.

There are at least ten different types of laryngoscope used for this procedure.

It is extremely uncomfortable and is not typically performed on conscious patients, or on patients with an intact gag reflex.

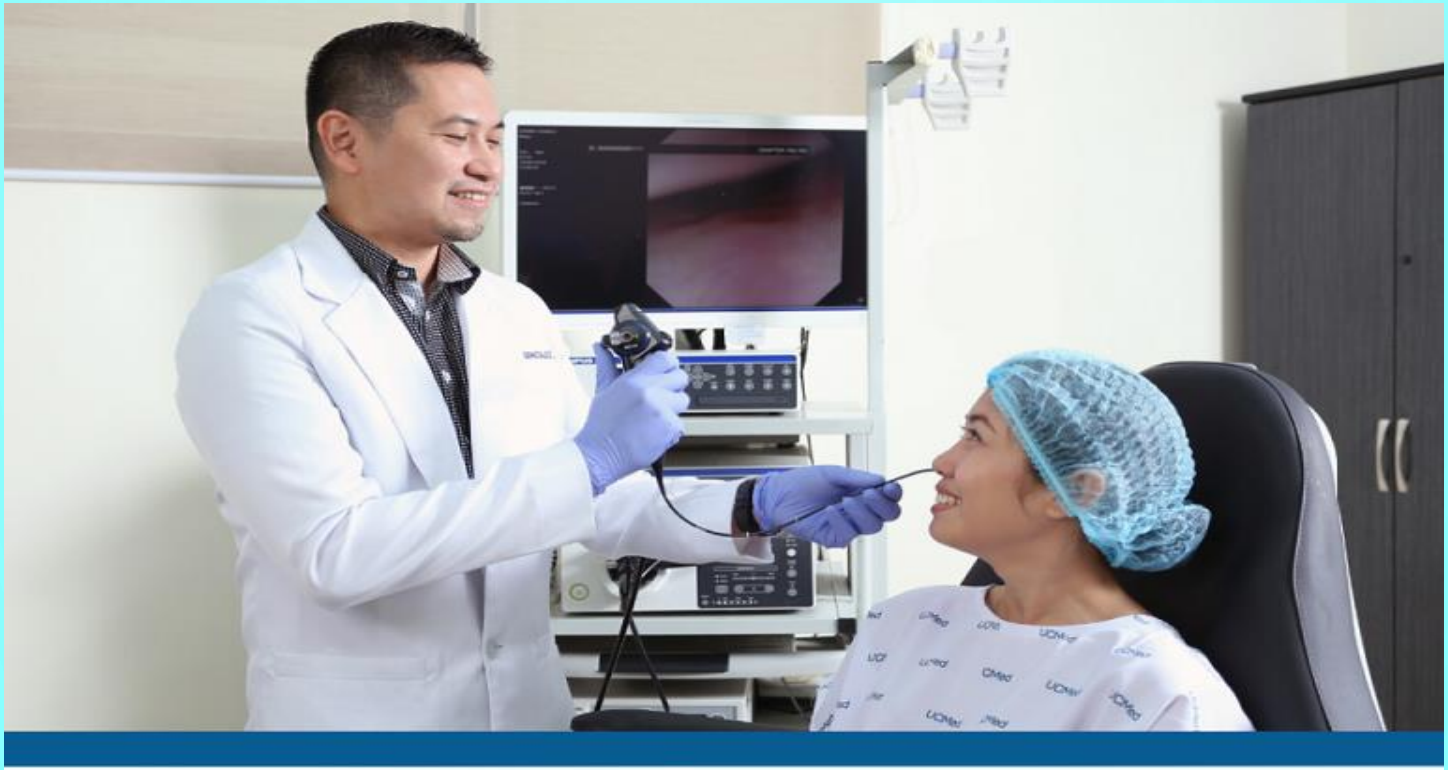
Direct laryngoscopy : this procedure is performed to see the vocal cords directly.

Rigid:



FIBEROPTIC LARYNGOSCOPES

Flexible fiberoptic bronchoscope or rhinoscope can be used for office-based diagnostics or for tracheal intubation. The patient can remain conscious during the procedure, so that the vocal folds can be observed during phonation. Surgical instruments passed through the scope can be used for performing procedures such as biopsies of suspicious masses /difficult intubation

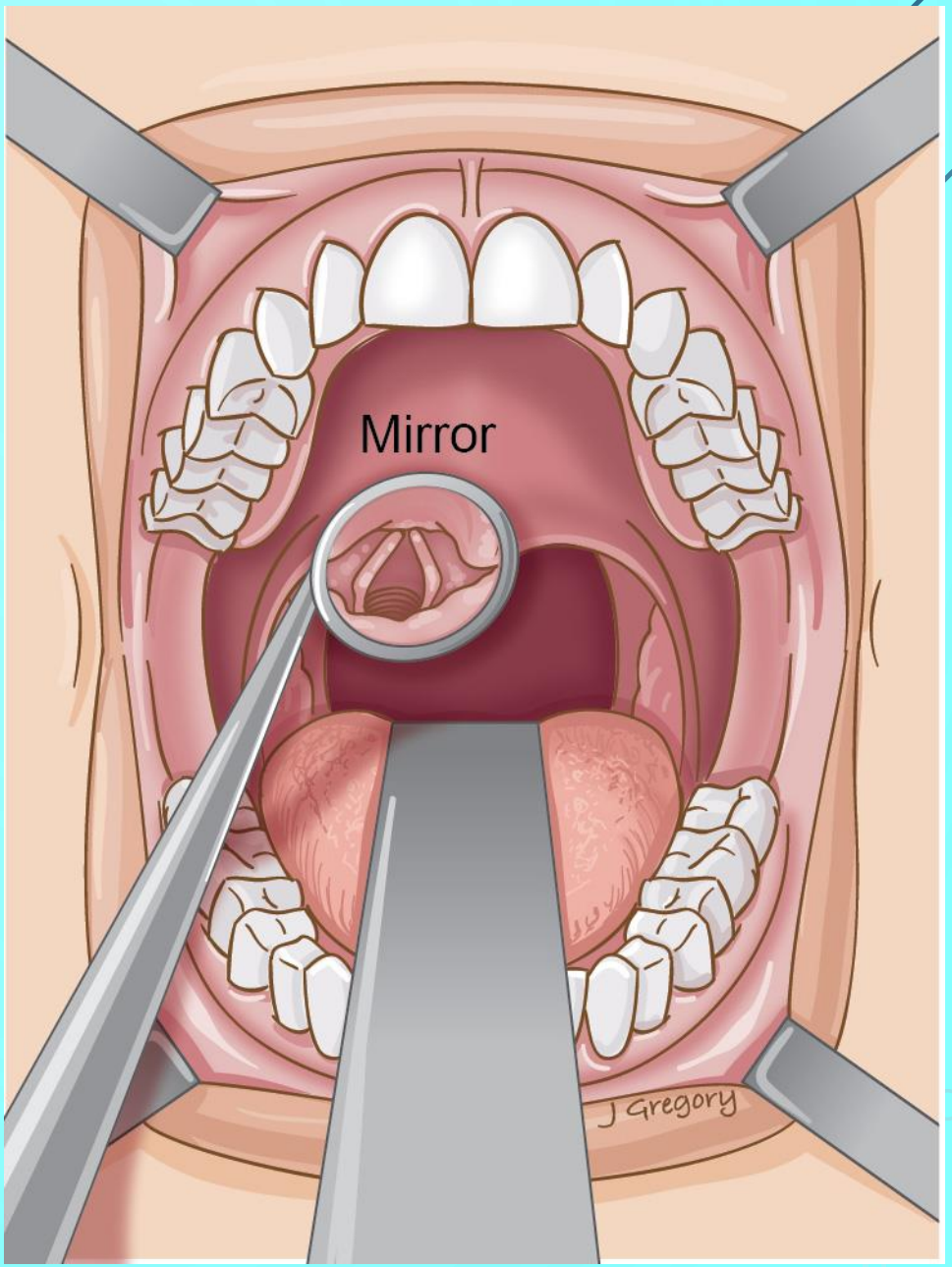


Flexible Fiberoptic Laryngoscope

- Indirect laryngoscopy :
- is performed when

we see the vocal cords

through mirrors.



CONVENTIONAL LARYNGOSCOPES

The vast majority of tracheal intubations involve the use of the conventional laryngoscope.

The conventional laryngoscope consists of a handle containing batteries with a light source, and a set of interchangeable blades.

LARYNGOSCOPE BLADES

Two basic styles of laryngoscope blade are currently commercially available:

The curved blade and the straight blade. The Macintosh blade is the most widely used of the curved laryngoscope blades , while the Miller blade is the most popular style of straight blade.

Both Miller and Macintosh laryngoscope blades are available in sizes 0 (neonatal) through 4 (large adult).

There are many other styles of curved and straight blades (e.g., Phillips, Robertshaw, Sykes, Wisconsin, Wis-Hipple, etc.) with accessories such as mirrors for enlarging the field of view and even ports for the administration of oxygen. These specialty blades are primarily designed for use by anesthetists, most commonly in the operating room.

The straight blade is difficult to control in adult humans and can cause pressure on the vagus nerve, which can cause unexpected cardiac arrhythmias.

CONVENTIONAL LARYNGOSCOPES

- The Macintosh blade is positioned in the vallecula, anterior to the epiglottis, lifting it out of the visual pathway, while the Miller blade is positioned posterior to the epiglottis, trapping it while exposing the glottis and vocal folds.

- Incorrect usage can cause trauma to the front incisors; the correct technique is to displace the chin upwards and forward at the same time, not to use the blade as a lever with the teeth serving as the fulcrum.

- The Miller, Wisconsin, Wis-Hipple, and Robertshaw blades are commonly used for infants. It is easier to visualize the glottis using these blades than the Macintosh blade in infants, due to the larger size of the epiglottis relative to that of the glottis.

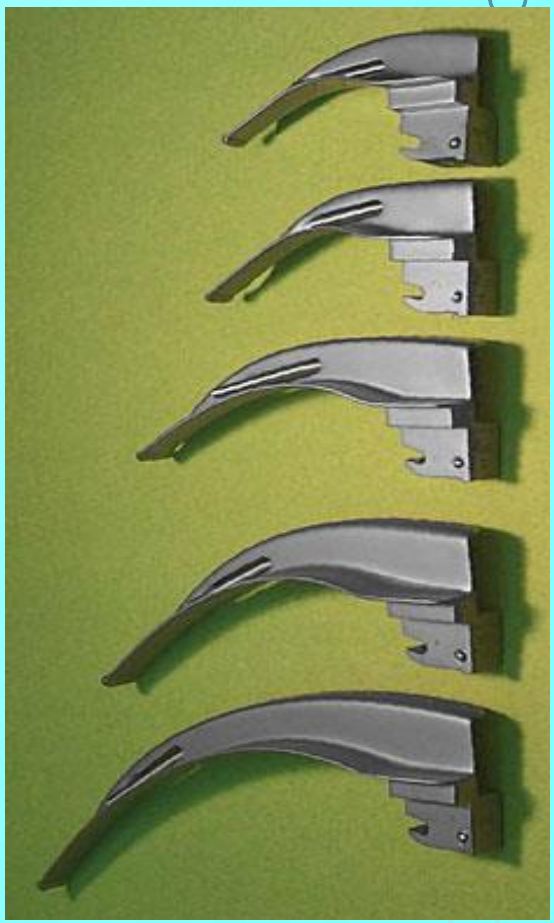
Macintosh laryngoscope

Miller laryngoscope

VIDEO LARYNGOSCOPE

- Video laryngoscopes are specialized fiberoptic layngoscopes that use a digital video camera sensor to allow the operator to view the glottis and larynx on a video monitor.

LARYNGOSCOPES



TRACHEAL INTUBATION

Tracheal intubation is the placement of a flexible plastic tube into the trachea to maintain an open airway.

Tracheal Intubation is useful to ***deliver anaesthetic gases*** directly to trachea and allow ***control of ventilation*** and oxygenation. The airway device is maintained in situ from the start to the end of anesthesia.

It is frequently performed in critically injured, ill or anesthetized patients to facilitate ventilation of the lungs, including mechanical ventilation, and to prevent the possibility of airway obstruction.

Before starting the intubation, you should perform patient airway assessment to predict any difficulty on direct laryngoscopy and ETT placement.

INDICATIONS OF TRACHEAL INTUBATION

* **Deliver anesthetic gases**
* **Control of ventilation**
* **The patient is unable to protect their airway:**
  - **Loss of reflexes e.g., obtunded or GCS less than 8.**
  - **Relaxation of muscles e.g., malignant hyperthermia.**
  - **Risk of aspiration from the stomach, blood or secretions.**

* **Prophylactically:**
  - **High risk of losing airway protection or patency e.g., local neck hematoma, epiglottitis , or airway burns.**
  - **To control the airway e.g., pre-transfer, clinical deterioration expected, uncooperative patient needing urgent investigations or treatment.**

Indications of Tracheal Intubation

Inadequate ventilation:

-Treatment of hypercapnia e.g., severe COPD, head injury.

-Selective lung ventilation e.g., massive hemoptysis, bronchopulmonary fistula.

Inability to oxygenate the patient: e.g., severe ARDS or severe CO toxicity.

Drug delivery: a rare indication e.g., surfactant in a neonate.

CONTRA-INDICATIONS OF TRACHEAL INTUBATION

Absolute contra-indications (will necessitate a surgical airway or nasal intubation):

Contraindications to endotracheal intubation include conditions that does not permit the safe placement of an endotracheal tube.

Total upper airway obstruction.

Total loss of facial/oropharyngeal landmarks.

Inability to open the mouth (eg, scleroderma or surgical wiring).

Neck injuries.

ASSESSMENT OF PATIENTS AIRWAY

The goal of assessing patients airways preoperatively is to attempt to **identify potential problems** with maintaining, protecting, and providing a patent airway during anesthesia.

The assessment is performed with the aid of a physical examination and a review of the patients history and anesthetic records.

History : The anaesthesiologist must elicit the history of possible airway difficulty in the past.

General, physical and regional examination :

Patency of nares, Mouth opening, Teeth, Presence of hoarse voice/stridor or previous tracheostomy may suggest stenosis, Any systemic or congenital disease requiring special attention during airway management, Infections of airway and Physiologic conditions : Pregnancy and obesity.

- **LEMON** trial = Evaluating for the difficult airway

Look

Evaluate

Mallampati

Obstruction

Neck movement “chin to chest”

LOOK

1) Neck masses (Goiter), short neck. 2) Large tongue

3) Rheumatoid arthritis 4) Scleroderma 5) Tumors 6) septum deviation. 7) micrognathia

teeth: protruding upper incisors

Obesity.

Surgical causes :

- Facial fractures

-fracture mandible

-surgery in nose

Scars of previous surgery, tracheostomy, burns ,radiotherapy.

Several clinical criteria have been developed to try to estimate the degree of difficulty with direct laryngoscopy and intubation.

These criteria are represented in the

1-2-3 tests

1. Mobility of the temporomandibular joint (TMJ).
2. Oral opening or Inter-incisor gap
3. Thyromental distance

1-2-3 TESTS

1: mobility of the temporomandibular joint **(TMJ).**

Ask the patient to sit up with their head in the neutral position and open their mouth as wide as possible. Note the mobility of the mandibular condyle at the ***TM joint.***

The condyle should rotate forward

freely such that the space created

between the tragus of the ear and

the mandibular condyle is approximately

one fingerbreadth in width.

Fig.6.1: 1 = TMJ mobility.

1-2-3 TESTS

2 :Oral opening or Inter-incisor gap

If the patient has < than 4 cm mouth opening or roughly less than 2 fingerbreadth distance between his teeth, there is a greater chance of difficulty on direct laryngoscopy and ETT placement.

Fig. 6.2: 2 = Mouth opening.

1-2-3 TESTS

3. Thyromental distance

If the distance between the thyroid cartilage and the bony point of the chin is < than 6.5 cm (3 fingerbreadth), there is an increase chance of difficulty on direct laryngoscopy and Intubation.

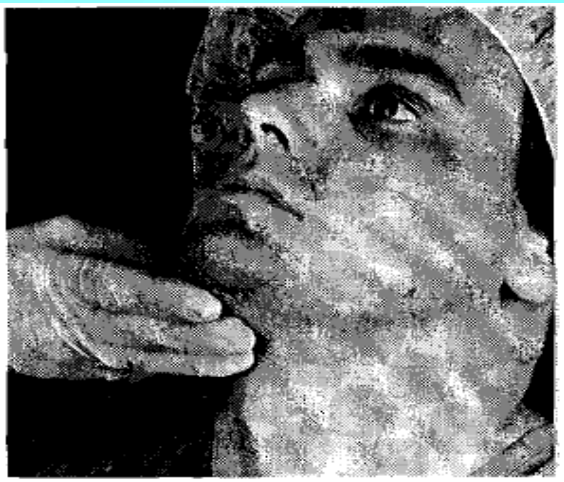


Fig.6.3:
3 = Thyromental distance.

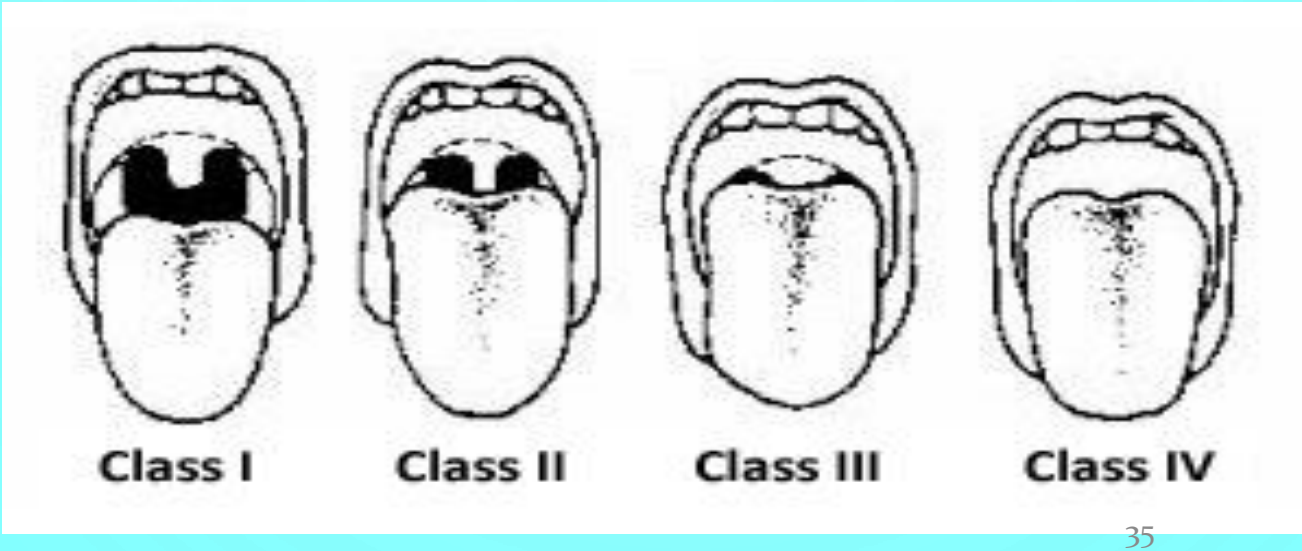
MALLAMPATI SCORE:

* This tests the difficulty of the endotracheal intubation.

* The patient should be in a sitting position, with the head in a neutral position, and the observer located in front of the patient that should not phonate. Unfortunately in emergent circumstances the ideal conditions or a cooperating patient are not the norm.

- **Class I :** Visualization of the soft palate, uvula, anterior and the posterior pillars.
- **Class II** : Visualization of the soft palate and uvula.
- **Class III** : Visualization of soft palate.
- **Class IV**: Only hard palate is visible.

The higher the score the greater chance of difficulty and/or failure.

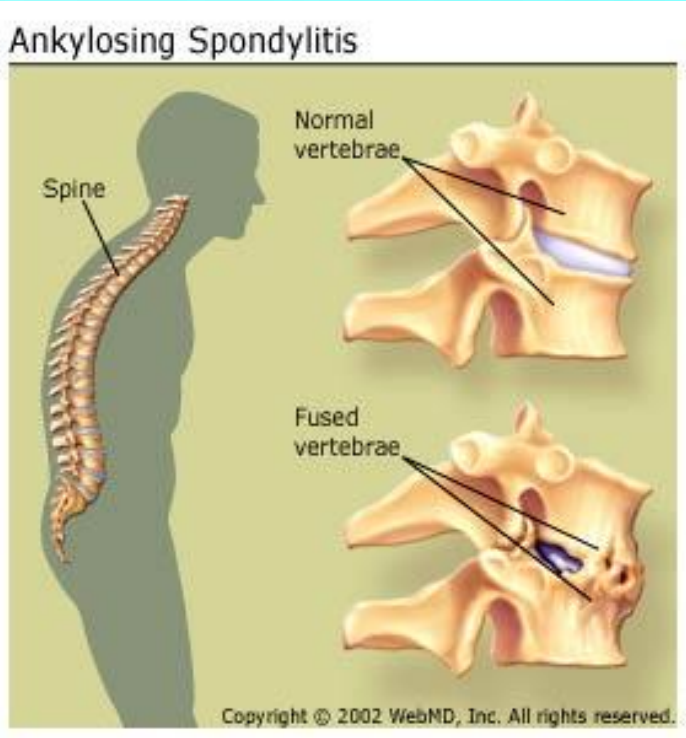


Obstruction :

- Laryngoscopy or intubation may be more difficult in the presence of an obstruction
- Anatomy
- Trauma
- Foreign body obstruction
- Edema (burns)

- **Neck mobility :**
  - The **cervical** spine's **range** of motion is approximately 80° to 90° of flexion, 70° of **extension**, 20° to 45° of lateral flexion, and up to 90° of rotation to both sides.

- **Problems :**
  - **Cervical spine immobization**
  - **Ankylosing spondylitis**
  - **Rheumatoid arthrits**
  - **Halo fixation**



TIME TO INTUBATE . . .

1- proper preparation

All devices and pharmacologic agents used in intubation should be readily available before the sequence of intubation is started. This includes :

face masks,

laryngoscopes with an assortment of blades of different sizes,

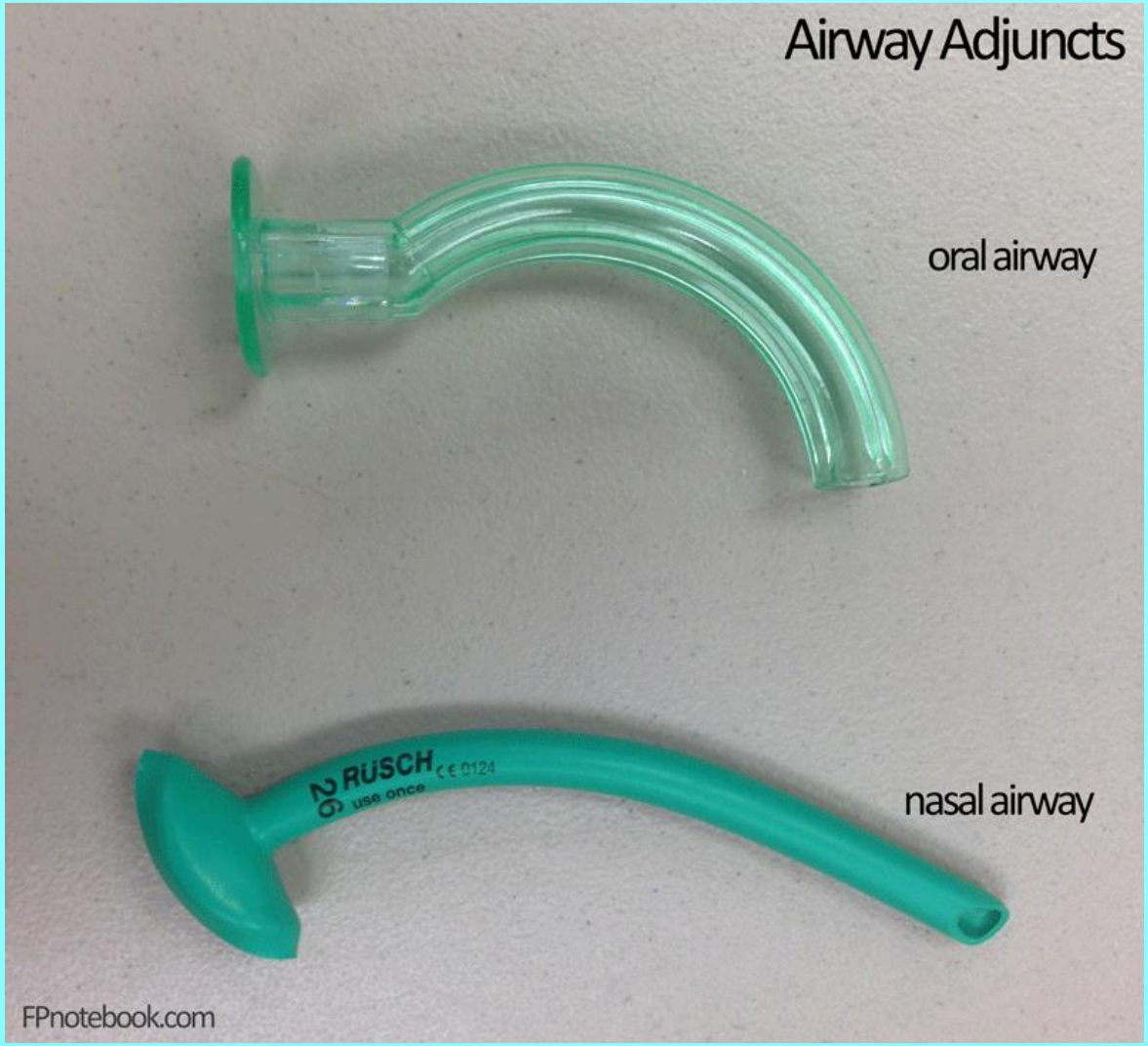
oral and nasopharyngeal airway,

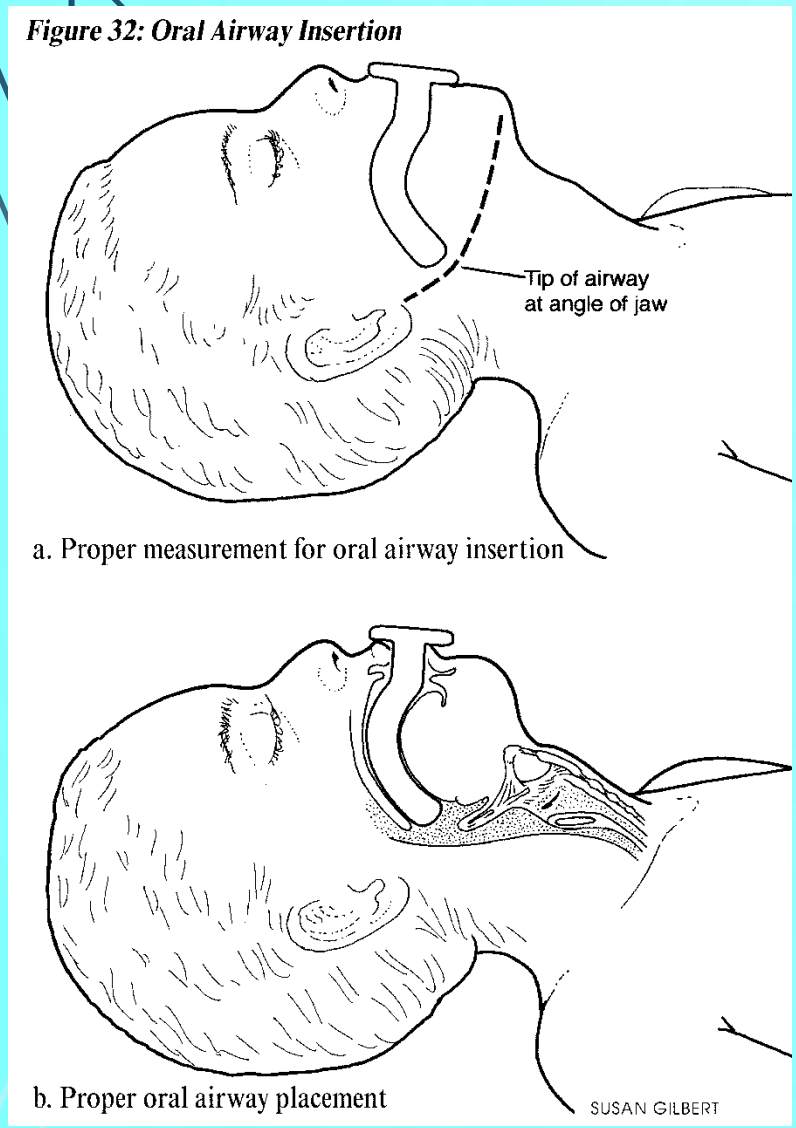
assortment of ETT's of different sizes,

stylets, and

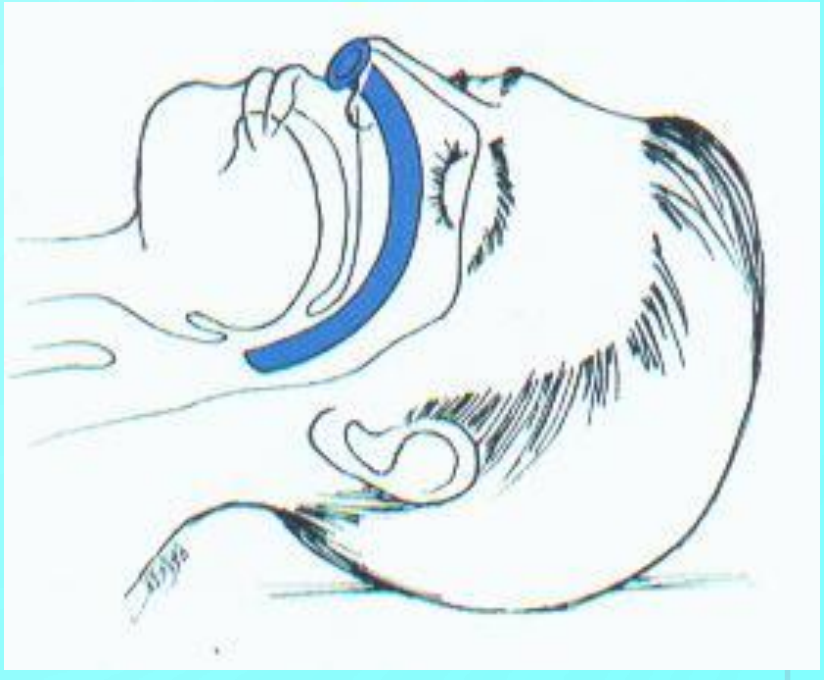
rescue devices, such as LMA's.

ORAL/NASAL AIRWAYS





- Oropharyngeal Airway



- Nasopharyngeal airway

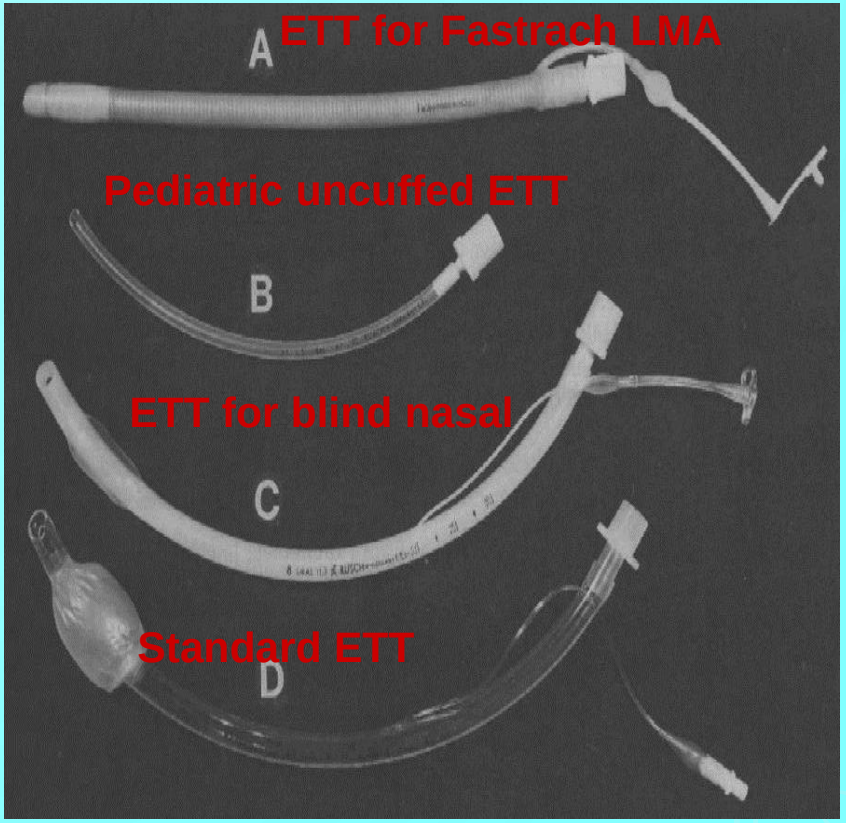
ENDOTRACHEAL TUBES (ETT)

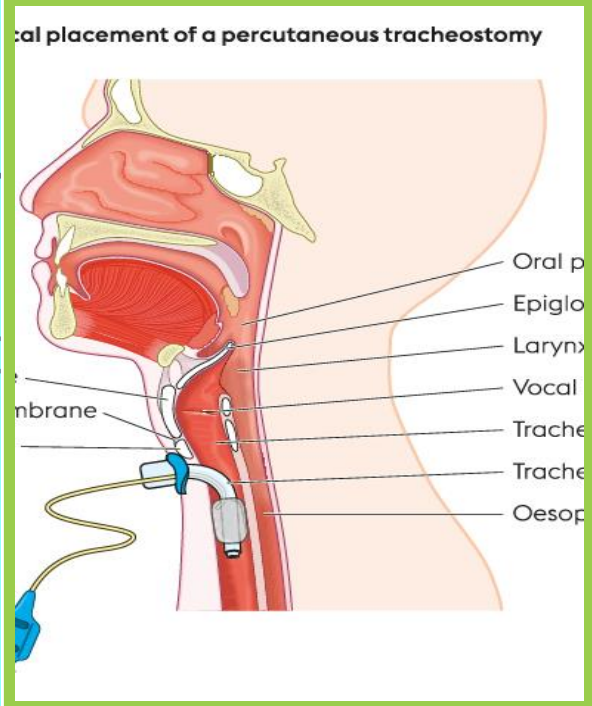
Tracheal tube is a catheter that is inserted into the trachea for the primary purpose of establishing and maintaining a patent airway and to ensure the adequate exchange of oxygen and carbon dioxide.

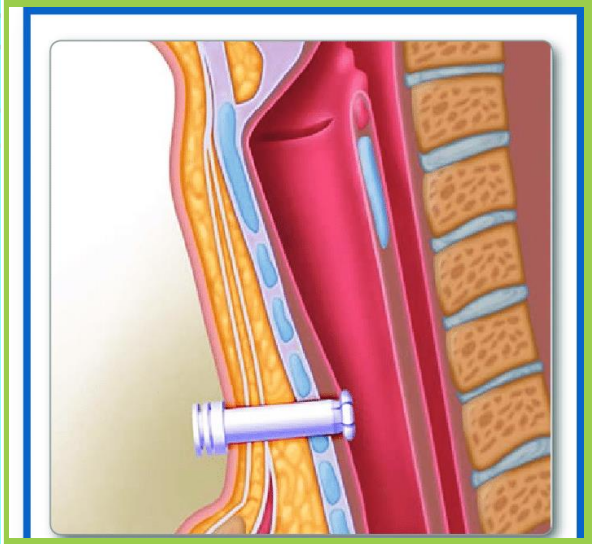
Note :

- Tube size cuffed: Age/4 +3
- Tube size uncuffed: Age/4 +4
- Tube depth: Age/2 +12 for greater than 1 year old;
- Weight/2 + 8 for under 1 year OR 3x ETT size

- The difference between the cuffed and uncuffed that the cuffed has a small pulging piece that help to prevent the aspiration and to place the tube and prevent its movement







TRACHEAL TUBES

- **Many different types of tracheal tubes are available, suited for different specific applications:**

- An **endotracheal tube** is a specific type of tracheal tube that is nearly always inserted through the mouth (orotracheal) or nose (nasotracheal).
- A **tracheostomy tube** is another type of tracheal tube; this 2–3-inch-long (51–76 mm) curved metal or plastic tube may be inserted into a tracheostomy stoma to maintain a patent lumen.
- A **tracheal button** is a rigid plastic cannula about 1 inch in length that can be placed into the tracheostomy after removal of a tracheostomy tube to maintain patency of the lumen.

1- An endotracheal tube :

- ✓ provides a passage for gases to flow between a patients lungs and an anesthesia breathing system .
- ✓ protects the lung from contamination from gastric contents and nasopharyngeal matter such as blood.

Most endotracheal tubes that you will encounter will be made out of plastic (Polyvinyl Chloride, PVC).

These may be visually clear or opaque.

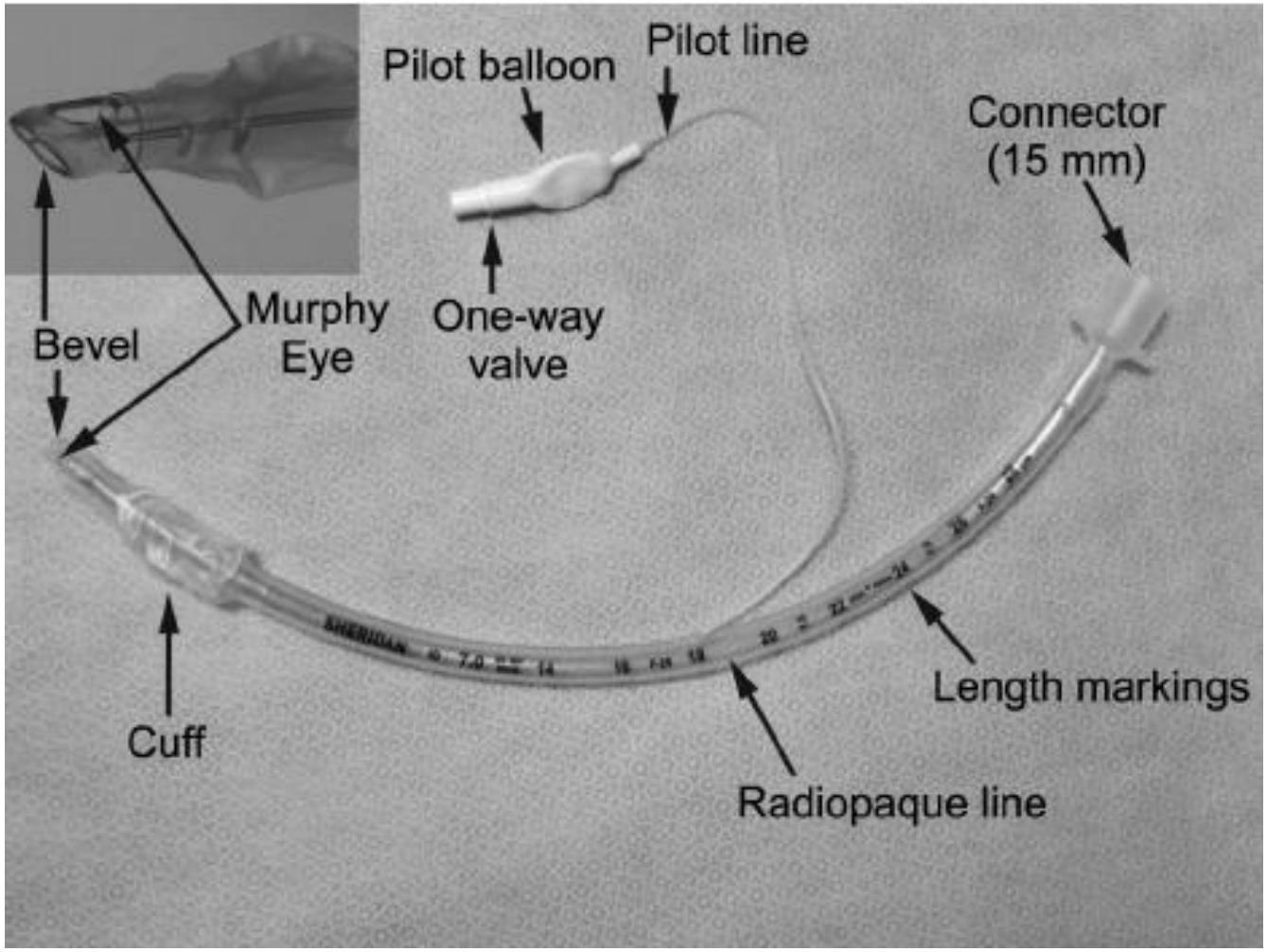
Plastic is not radio opaque and therefore plastic tubes have a line of radio opaque material that makes them more visible on a chest X Ray.

- **Endotracheal tubes** have an inner diameter and an outer diameter.

- The “size” of an endotracheal tube refers to its internal diameter. Therefore if you ask for a “size 6 ” endotracheal tube, you are asking for one with an internal diameter of 6 mm.
- Narrower tubes increase the resistance to gas flow . This can be especially relevant in the spontaneously breathing patient who will have to work harder to overcome the increased resistance. Thus one should choose the largest diameter endotracheal tube that is suitable for a given patient.
- Pediatric endotracheal tubes have a much smaller internal diameter.

- The length of an endotracheal tube is measured from the end that goes into the trachea and is marked in centimeters.
- An endotracheal tube that is too long for a given patient may be more prone to kinking and become obstructed. It can be cut to a more appropriate length if necessary.

ENDOTRACHEAL TUBE



SPECIAL ENDOTRACHEAL TUBES

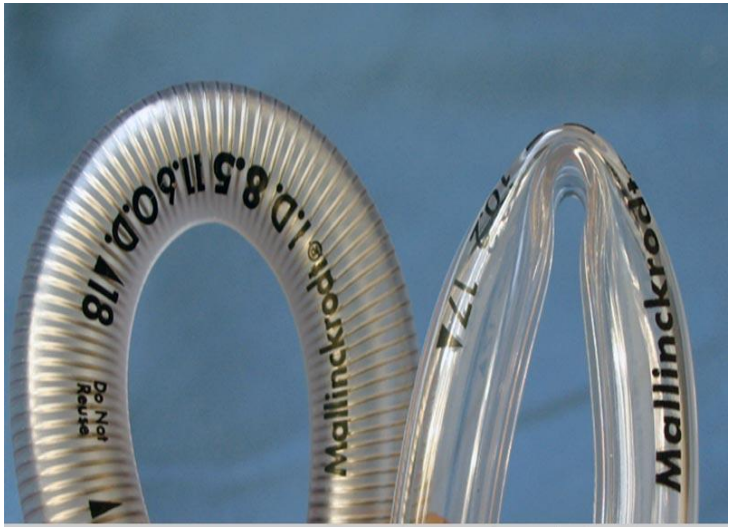
- **PREFORMED endotracheal tubes**

are molded into special shapes that permit good surgical access in the oronasal area. The endotracheal has a special name. It is a "RAE" tube.

- **PEDIATRIC endotracheal tubes**

Endotracheal tubes for pediatric patients are smaller than those meant for adults. Because the pediatric trachea is susceptible to damage by pressure, most pediatric endotracheal tubes are uncuffed. However, cuffed versions similar to adult endotracheal tubes exist and when used, must be inflated with care. A wide range of sizes are available.

SPECIAL ENDOTRACHEAL TUBES



- **Reinforced / armoured endotracheal tubes**

- specially designed to be resistant to kinking, they achieve this property by having a spiral of wire embedded into the wall of the endotracheal tube to give it strength and flexibility at the same time. These are particularly useful for head and neck surgery where the endotracheal tube may be sharply bent and also compressed by the surgeons. Armoured endotracheal tubes can be easily bent away from the area of surgery and thus improve surgical access.

SPECIAL ENDOTRACHEAL TUBES

❖**DOUBLE LUMEN endobroncheal tubes**

- In thoracic surgery, there are times that you may need to isolate and selectively not ventilate one lung. For an example, during an oesophagectomy, one may choose to not ventilate one lung to provide better surgical access to the oesophagus. There are special endotracheal tubes called "double lumen tubes" to achieve this.
- A double lumen tube can be thought of as two endotracheal tubes joined together (see graphic above). One tube is shorter and ends in the trachea and there is cuff at this level called the tracheal cuff (colored red in the image). The other tube extends further and enters a main bronchus and has its own cuff (bronchial cuff, coloured blue).

TRACHEAL TUBES (CONT.)

- **2- Tracheostomy tube**
- Several types of tracheostomy tubes are available, depending on the requirements of the patient, including Shiley, Bivona (a silicon tube with metal rings that are good for airways with damage to the tracheal rings or otherwise not straight), and fenestrated.
- **3- Tracheal button**
- A tracheal button is generally used in people with severe obstructive sleep apnea, who often wear this device during waking hours and remove it while sleeping to ensure a patent airway and reduce the risk of asphyxiation. Since the tube does not extend far into the trachea, it is easy to breathe and speak with the device in place.

TT CUFF

Most TTs have cuff inflating system consisting of valve, balloon, inflating tube and cuff.

Uncuffed tubes used in children to minimise pressure injury

❖Purpose of cuff is:

- ❖ Airtight seal between tube and trachea
- ❖ Protect from aspiration of blood, mucus or vomitus.

MAGILL FORCEPS

Designed for *guiding tip of ETT through larynx* nasal intubation.

Malleable Stylet

- Thin piece of metal of plastic
- Threaded through lumen of ETT
- In the emergency setting, where speed of insertion and the possibility of gastric aspiration are always of concern, it is preferable to always use a malleable stylet inside the ETT to control the shape and direction of the tip of the tube. It is important to ensure that the tip of the stylet does not protrude beyond the tip of the ETT.

BOUGIE

2- Patient position

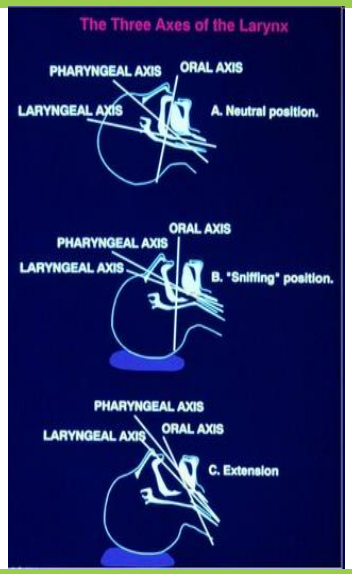
The patient should be aligned without lateral deviation of the head or neck.

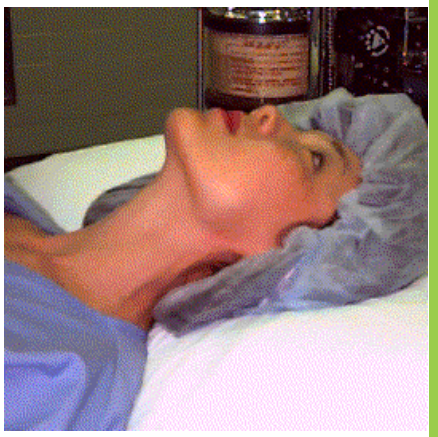
The head should be extended on the neck with a pillow under the occiput. If cervical spine trauma is suspected, have an assistant provide in-line immobilisation.

The neck should be flexed to approximately 15 degrees on the chest.

Try to keep the external auditory meatus and sternal notch in same horizontal plane (except infants or when cervical spine injury is present or suspected).

In infants aged under 2, the occiput naturally extends the head and the chin alone needs lifting into the neutral position. In older children a "sniffing" position should be used.





Sniffing Position

- Flexion of lower cervical spine & extension of A-O joint
- Long axes of mouth, pharynx and trachea are in straight line

SNIFFING POSITION

- The sniffing position
- only in the absence of cervical spine injury

- Position the patient supine on the stretcher.
- Proper sniffing position aligns the external auditory canal with the sternal notch. To achieve the sniffing position, folded towels or other materials may need to be placed under the head, neck, or shoulders, so that the neck is flexed on the body and the head is extended on the neck. In children, padding is usually needed behind the shoulders to accommodate the enlarged occiput.

3- BLADE INSERTION

The blade of the laryngoscope is introduced into the right side of the mouth.

it is advanced toward the base of the tongue, keeping it to the left side of the blade.

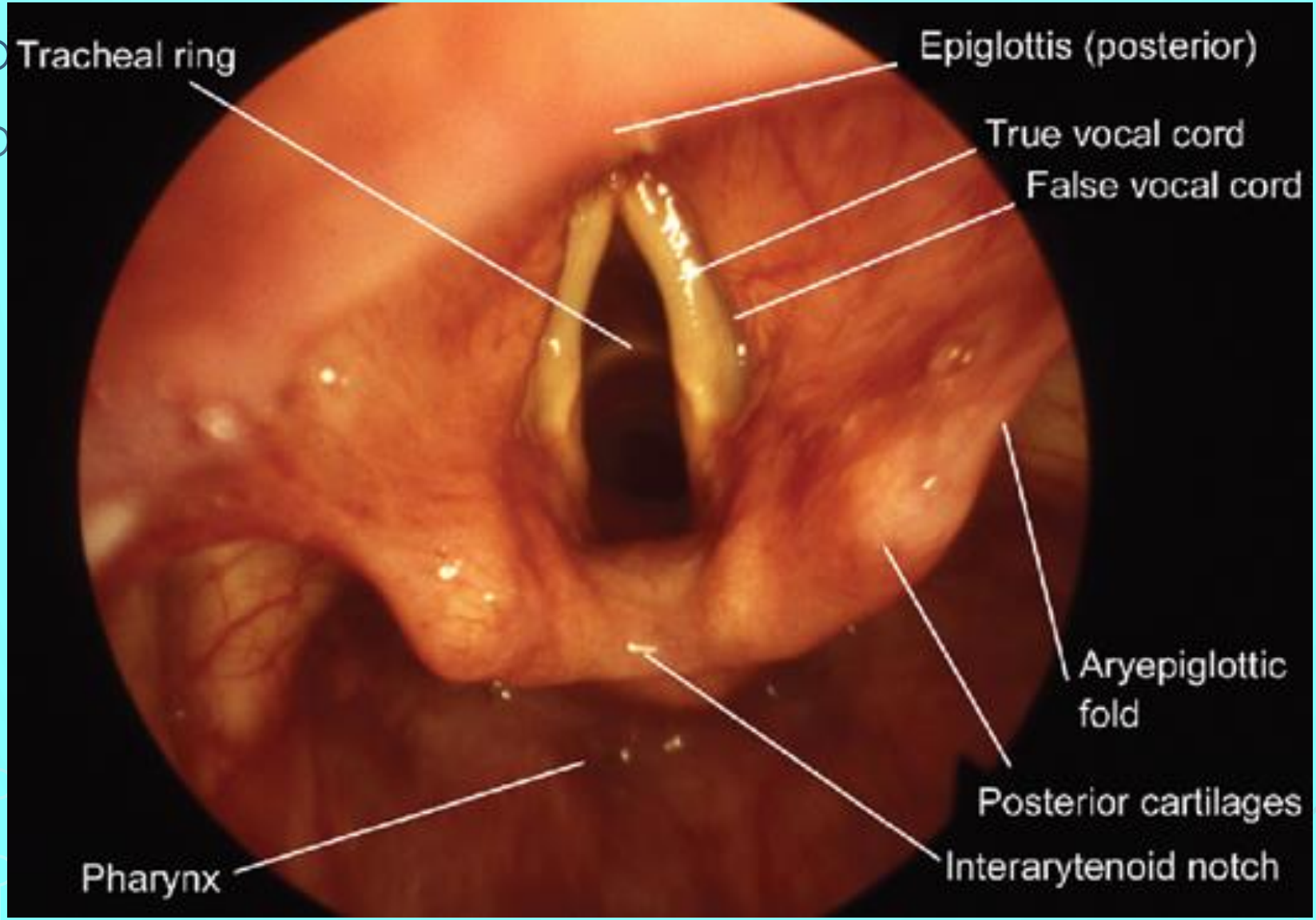
Once the oropharynx is passed and the tongue is being held in place, the operator should lift the laryngoscope blade forward to show the glottic opening.

((One of the common mistakes made during laryngoscopy is not having control of the tongue. The tongue occupies a great deal of the surface area of the mouth and if not displaced properly (laterally and to the left) it will “herniate” to the right side of the blade and obstruct your field of vision and not allow the ETT to be introduced into the larynx))

At this point, where the tip of the blade ends up depends on the type of blade you are using:

i. Straight blades: The tip should extend underneath the epiglottis and lift it.

ii. Curved blades: The tip should extend into the vallecula.


Tracheal ring
Epiglottis (posterior)
True vocal cord
False vocal cord
Aryepiglottic fold
Posterior cartilages
Interarytenoid notch
Pharynx

4- ETT PLACEMENT:

Once the cords are exposed, the ETT is handed by an assistant and introduced with the right hand.

Once the ETT is placed, the laryngoscope is taken out, the ETT cuff is inflated, the operator or assistant holds the tube in place, and correct placement is confirmed.

5- CONFIRMATION OF ETT PLACEMENT:

1. Directly observing the endotracheal tube pass through the vocal cords.
2. Capnography
3. ETT fogging or condensation
4. Symmetrical chest movement.
5. Presence of bilateral breath sounds.
6. Absent gastric sounds and distention.
7. Radiographic confirmation.

6- ETT FIXATION

Once the correct ETT position has been confirmed, the next step is to secure the tube in place to prevent tube migration and even extubation.

Methods of fixation:-

1- adhesive tape.

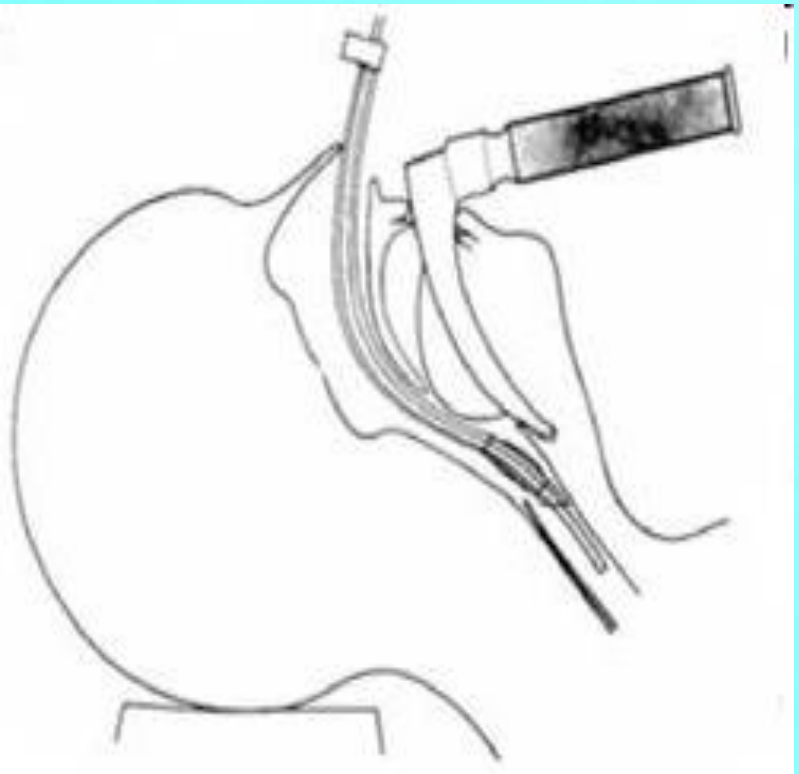
2- circumferential tape around the neck has been recommended - Keep in mind that if not done properly it can restrict venous return from cranial Structures.

NASOTRACHEAL INTUBATION

- Indications
  1. Oral Surgery
  2. Faciomaxillary surgery
  3. If mouth need to be closed after surgery
  4. Closed mouth
  5. Difficult oral intubation
  6. Prolonged mechanical ventilation in ICU
- Contraindications
  1. Coagulopathy
  2. Severe intranasal pathology
  3. Fracture of skull base
  4. CSF leak

NASOTRACHEAL INTUBATION

- Technique



- Apply vasoconstrictor nasal drops
- Lubricate tube wall. Length should be 2 cm longer and 1-2 mm smaller diameter
- Guide the tube slowly but firmly into the nasal passage, going up from the nostril (to avoid the large inferior turbinate) and then backward and down into the nasopharynx
- Proceed with the procedure as an orotracheal intubation, guiding the tube through the vocal cords with a Magill's forceps

EXTUBATION

MUSCLE RELAXANT FULLY REVERSED

PATIENT AWAKE & RESPONSIVE, SUITABLE VITAL SIGNS

100% OXYGEN AT HIGH FLOW 2-3 MIN

REMOVE SECRETION IN TRACHEA OR PHARYNX

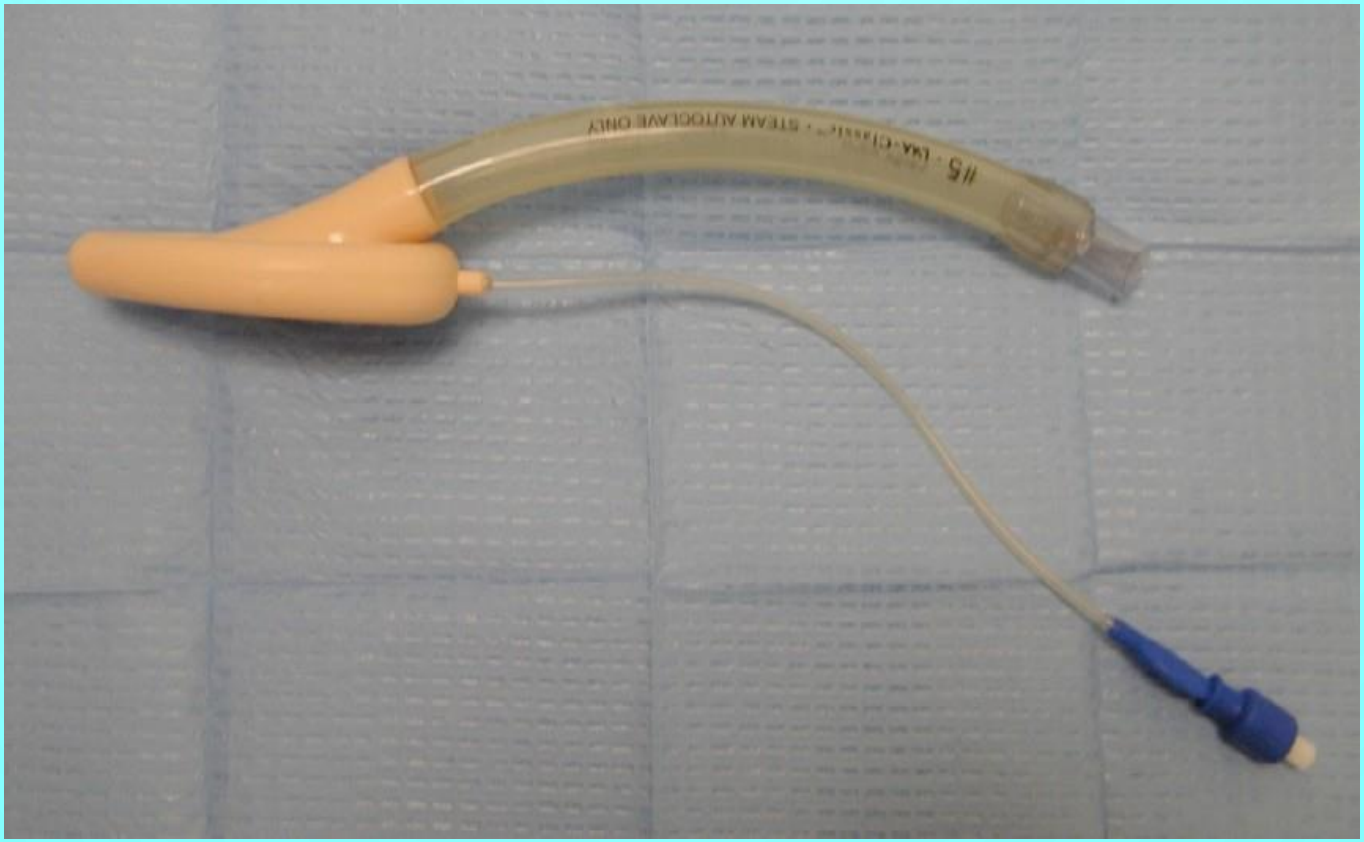
TURN PATIENT TO LATERAL POSITION

DEFLATE CUFF AND REMOVE ETT DURING INSPIRATION

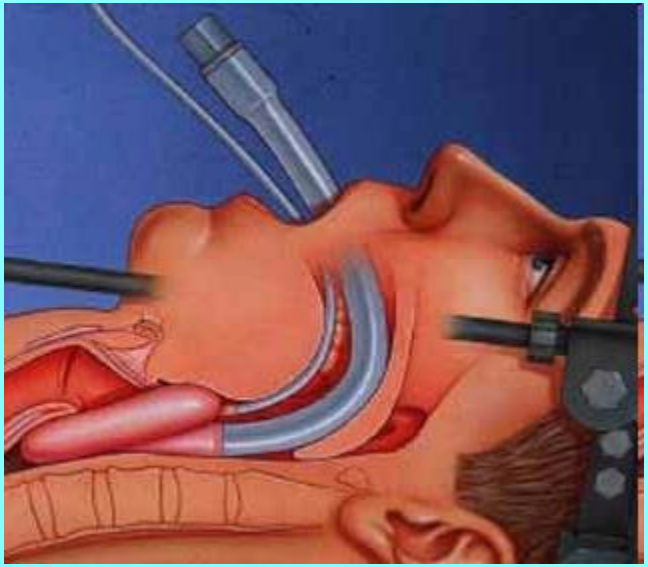
CONTINUE 100% OXYGEN BY FACEMASK

EXTUBATION IN SEMICONSCIOUS PATIENT CAN PROVOKE LARYNGOSPASM

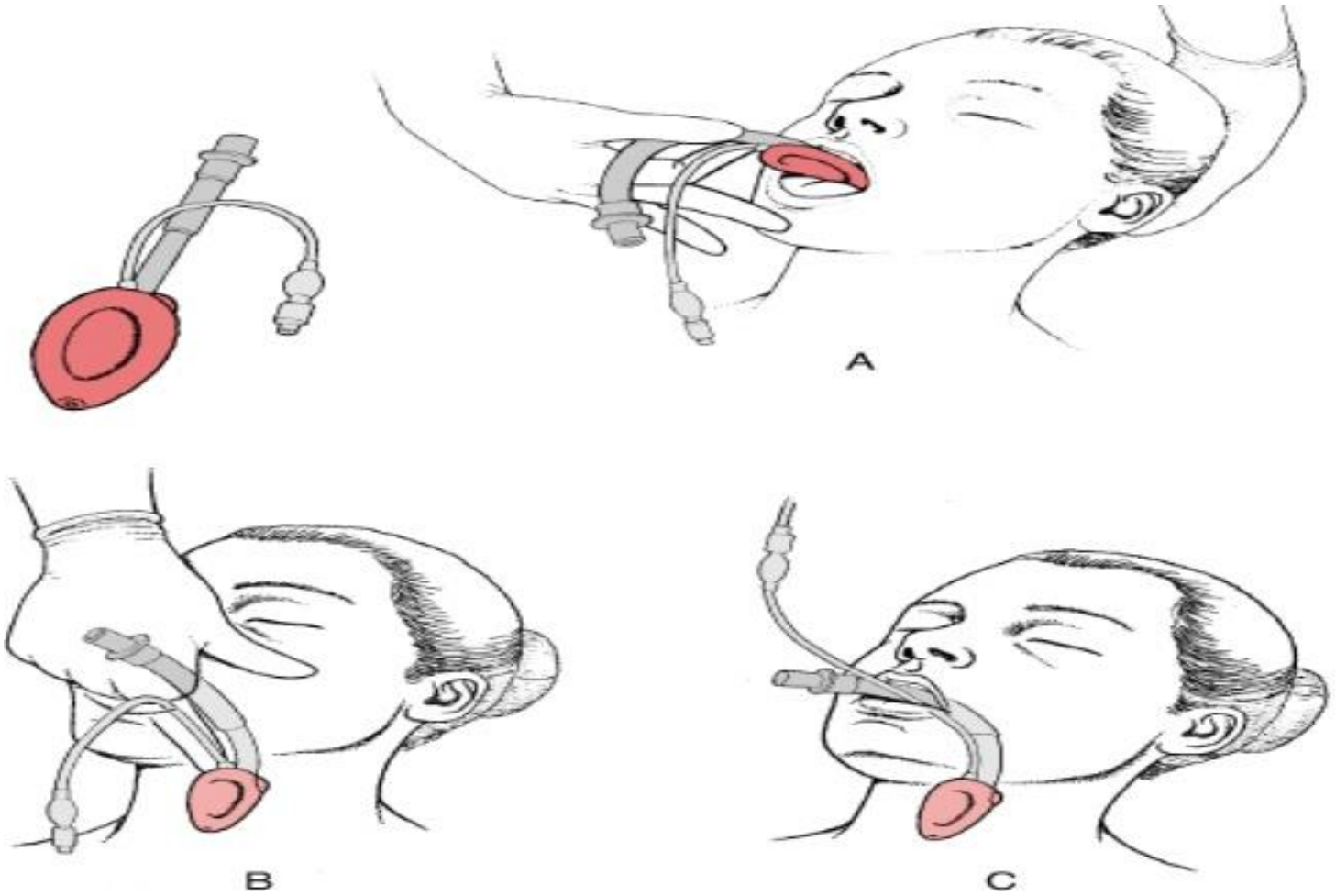
THE LARYNGEAL MASK AIRWAY (LMA)



THE LARYNGEAL MASK AIRWAY (LMA)



- New device to maintain airway during anesthesia when TI is not desired.
- It was developed as an alternative to either ETT or face mask ventilation.
- It's easier in insertion and has high rate of success
- It's made in 8 sizes to suite neonates, children and adults.
- Better inserted with propofol (that depresses laryngeal reflex) or deep inhalation anesthesia.
- After adequate anesthesia, LMA is inserted to mouth blindly without laryngoscope and pushed downward till resistance is felt. The cuff is then inflated.


A
B
C

LARYNGEAL MASK AIRWAY

- **indications**
- A. In the simple procedures that are not axial (head, neck, thoracic, and abdominal surgery).
- B. Avoid the use of tracheal intubation during spontaneous ventilation .
- C. in a case of difficult intubation , to facilitate subsequent insertion of a tracheal tube

- **Contraindications**
- **A.** Full stomach or any condition lead to delayed gastric emptying.
- B. Possible regurgitation .
- C. Surgical access is Impeded By the cuff of the LMA(face and neck surgery).
- D.an unusual position (Prone).
- E. A Caesarean section.
- F. pregnancies.

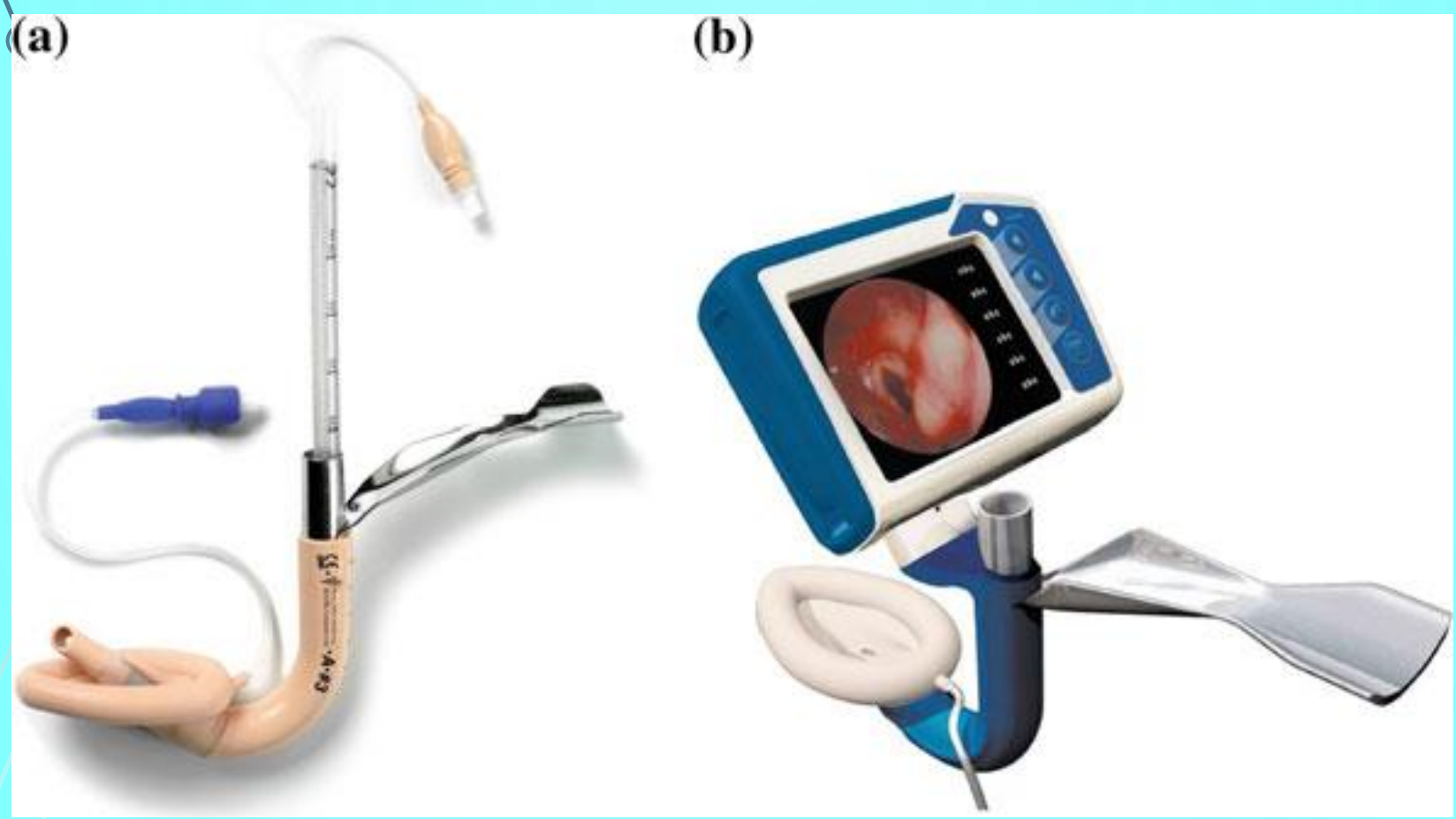
LARYNGEAL MASK AIRWAY

Use of LMA avoids occurrence of most TI complication.

The major disadvantage is lack of mechanical protection from regurgitation and aspiration.

Other problems are laryngospasm, coughing and sore throat.

A. INTUBATING LMA FASTRACH
B. INTUBATING LMA C-TRACH



I-GEL LMA