ENDOTRACHEAL INTUBATION

Dr Parul Mrigpuri

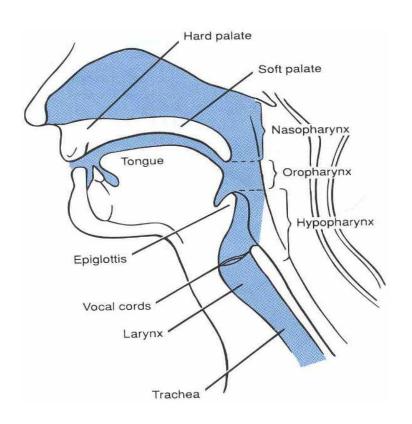
Department Of Pulmonary Medicine

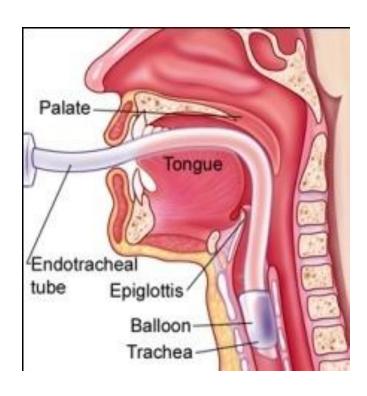
Govt. Medical College & Hospital,

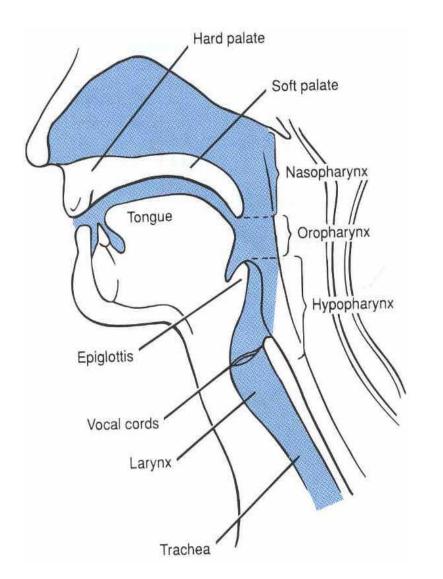
Patiala

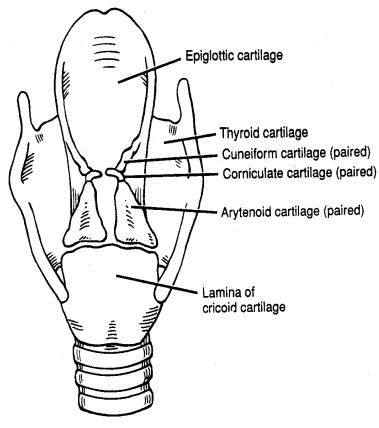


Anatomy Of the Airway





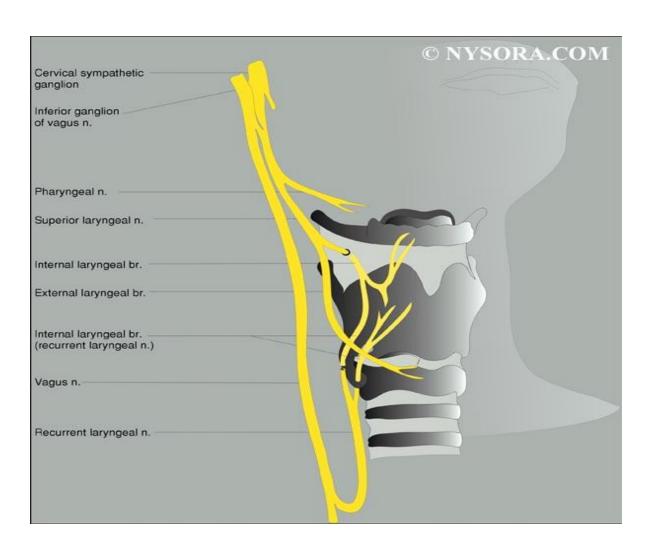




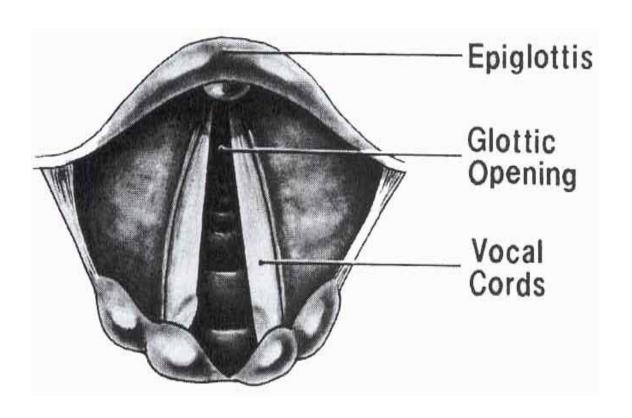
Airway Innervation

- Knowledge of innervation is important for application of airway anaesthesia to facilitate awake intubation
- Posterior one-third of the tongue, soft palate and palatoglossal folds are innervated by glossopharyngeal nerve
- Laryngopharynx, inferior aspect of epiglottis and larynx above the cords are innervated by Internal br. of Superior laryngeal nerve.
- Below the cords- by Recurrent laryngeal br. of vagus nerve

Airway Innervation



The Laryngeal Inlet



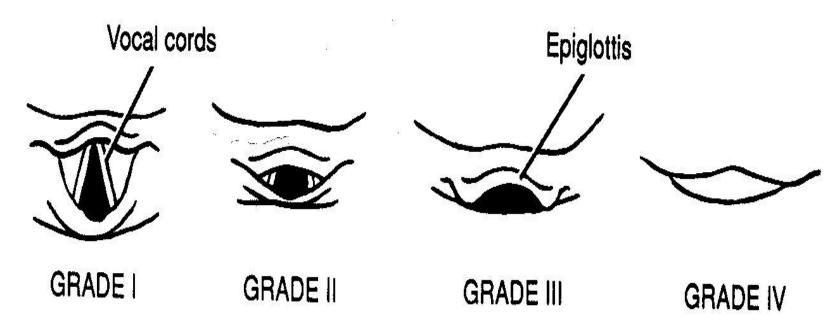
The view of the laryngeal inlet obtained at direct laryngoscopy is recorded using a scale described by Cormack and Lehane scale

Another classification is the **POGO** score used to describe the **Percentage Of Glottic Opening**

Cormack & Lehane grade	Cormack & Lehane grade description	Cook Modification	Description of Cook Modification	Alternative Cook nomenclature
Grade- 1	All or most of the glottic aperture is visible	Grade- 1		Easy
Grade -2	Only the posterior extremity of the glottis is visible	Grade- 2A	Posterior cords and cartilages visible	
		Grade – 2B	Only posterior cartilages visible	Restricted
Grade- 3	Only the epiglottis can be visualized	Grade -3A	Epiglottis visible and can be lifted	
		Grade- 3B	Epiglottis adherent to posterior pharynx	Difficult
Grade -4	Not even the epiglottis can be visualized			

Laryngoscopic view





grade 3,4 -> risk for difficult intubation

What is Endotracheal Intubation?

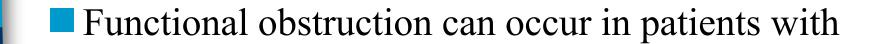
- Endotracheal Intubation is placement of a flexible tube into the mouth or nose down to the airways to provide a person with breathing support.
- It is performed in different circumstances and could be a procedure that occurs when patients are deeply sedated, or might be done with or without local anaesthetic when people are awake

Indications for endotracheal intubation

- There are four broad categories of indications for endotracheal intubation
- A. To obtain and maintain a patent airway e.g in cases of obstructed airway from any cause
- B. To **correct** deficit gas exchange i.e hypoxia or hypercarbia
- c. To protect the airway e.g against aspiration of gastric contents and blood
- D. To preempt predicted clinical deterioration

Obtain and maintain a patent airway

- It is used to obtain and maintain a patent airway as in cases of obstructed airway from any cause
- Air way obstruction can occur from
- 1. Functional causes
- 2. Pathological causes
- 3. Mechanical causes



- A. Depressed level of consciousness
- B. Loss of the muscular tone

- Pathological obstruction can result from Intrinsic processes such as
- i. Oedema
- ii. Hematoma
- iii. Infection
- iv. Tumour

Mechanical obstruction results from

Extrinsic processes such as

i. Foreign body

Predicted clinical deterioration

- Respiratory rate > 35 breaths per minute
- Vital capacity < 15 ml/kg in adults and 10 ml/kg in children
- Inability to generate a negative inspiratory force of 20 mm Hg
- PaO2 (arterial partial pressure of oxygen) < 70 mm Hg
- A-a gradient (Alveolar-arterial) > 350 mm Hg on 100% oxygen
- PaCO2 (arterial partial pressure of carbon dioxide) > 55 m
 Hg (except in chronic retainers)
- Dead space > 0.6 L

Indications for ENDOTRACHEAL

INTUBATION in the operating room

- The need to deliver positive pressure ventilation
- Protection of the respiratory tract from aspiration of gastric contents
- Surgical procedures involving the head and neck or in nonsupine positions that preclude manual airway support
- Almost all situations involving neuromuscular paralysis
- Surgical procedures involving the cranium, thorax, or abdomen
- Procedures that may involve intracranial hypertension

1) Condition that associated with difficult intubation

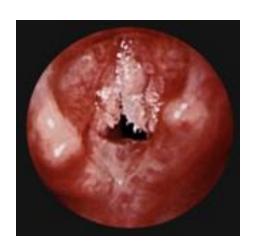
: Congenital anomalies ---> Pierre Robin syndrome,

Down's syndrome

: Infection in airway--> Retropharyngeal abscess,

Epiglottitis

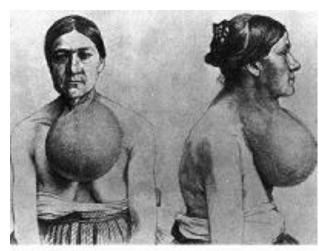
: Tumor in oral cavity or larynx

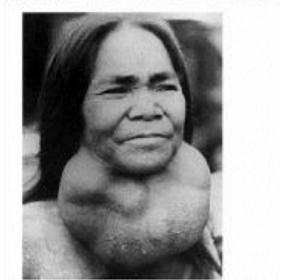


1) Condition that associated with difficult intubation (con't)

: Enlarge thyroid gland

trachea shift to lateral or compressed tracheal lumen





1) Condition that associated with difficult intubation (con't)

: Maxillofacial ,cervical or laryngeal trauma

: Temperomandibular joint dysfunction

: Burn scar at face and neck



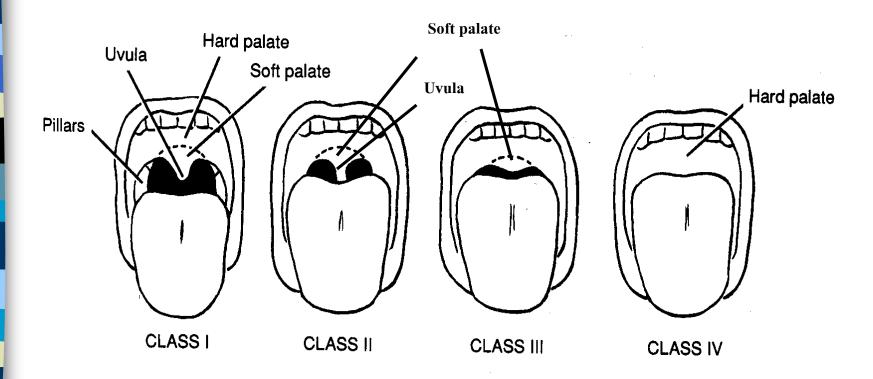
: Morbidly obese or pregnancy

2) Interincisor gap: normal -> more than 3 cms



3) Mallampati classification: Class 3,4 -> may

be difficult intubation

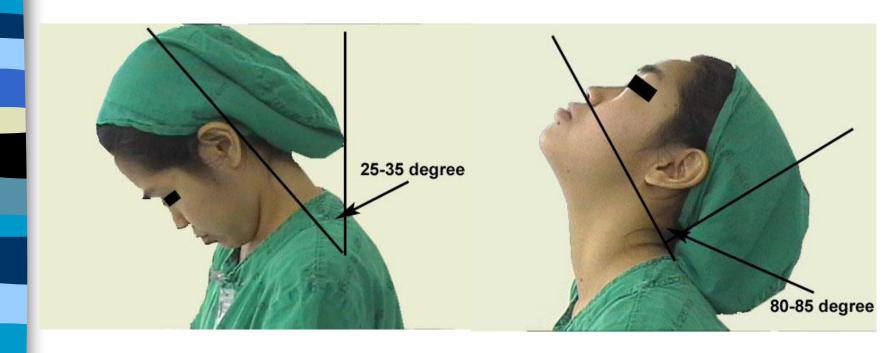


4) Thyromental distance: more than 6 cms





5) Flexion and extension of neck



6) Movement of temperomandibular joint (TMJ)



Grinding

Preparation



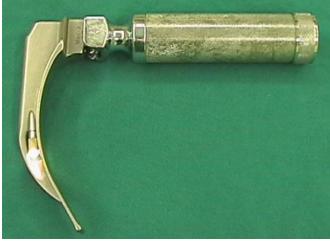
Preparation for Endotracheal Intubation

- Following preparations are important prior to proceed with Endotracheal Intubation.
- Equipment
- Patient and Clinician Positioning
- Premedications
- Intra Venous access
- Personnels

1) Laryngoscope: handle and blade







LARYNGOSCOPIC BLADE

- Macintosh (curved) and Miller (straight) blade
- Adult: Macintosh blade, small children: Miller blade



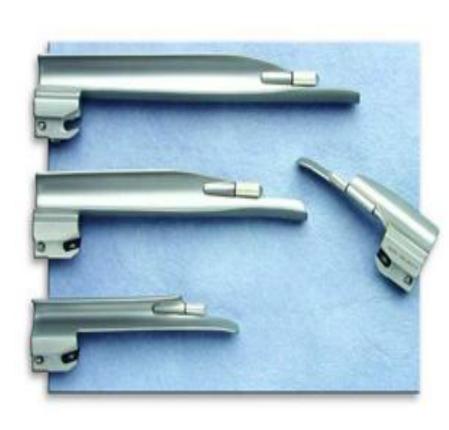
Miller blade

Macintosh blade

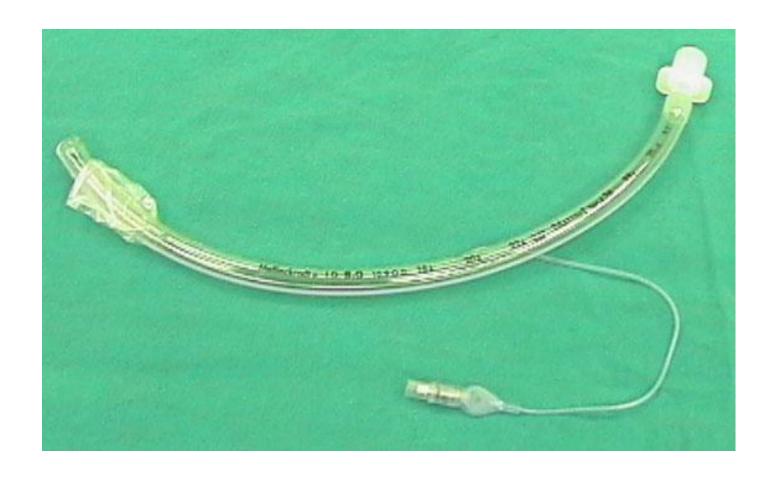
Philip's Blade

Wisconsin's Blade





2) Endotracheal tube



Endotracheal tube

1) Size of endotracheal tube: internal diameter (ID)

Male: ID 8.0 mms. Female: ID 7.5 mms

New born - 3 months: ID 3.0 mms

9 3-9 months : ID 3.5 mms

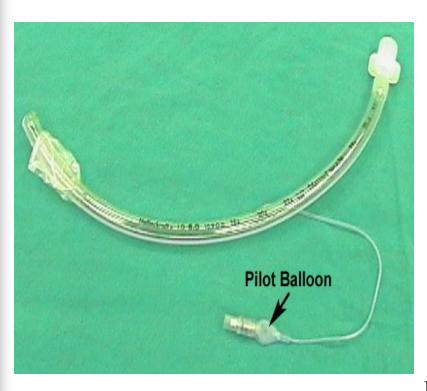
9-18 months : ID 4.0 mms

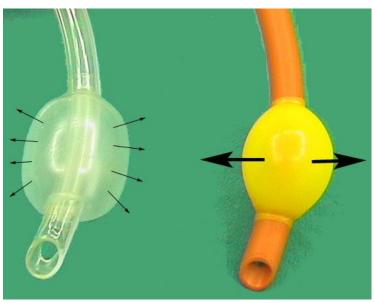
P = 2-6 yrs : ID = (Age/3) + 3.5

 $\rho > 6 \text{ yrs}$: ID = (Age/4) + 4.5

2) Material: Red rubber or PVC

3) Endotracheal tube cuff

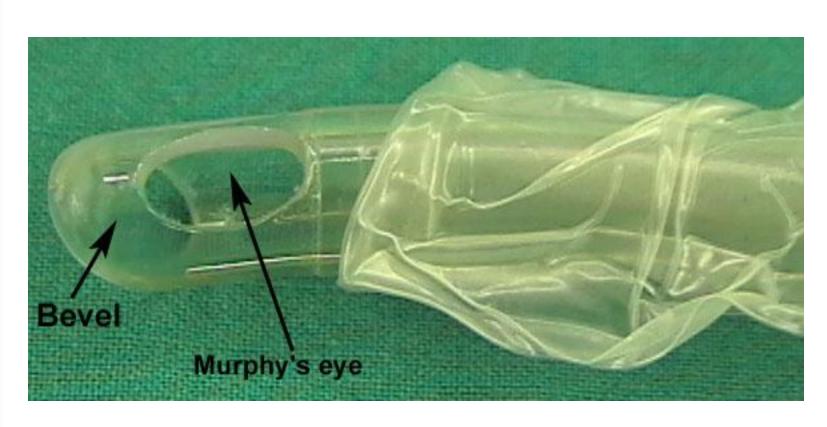




High volume Low volume

Low pressure cuff High pressure cuff

- 4) Bevel
- 5) Murphy's eye

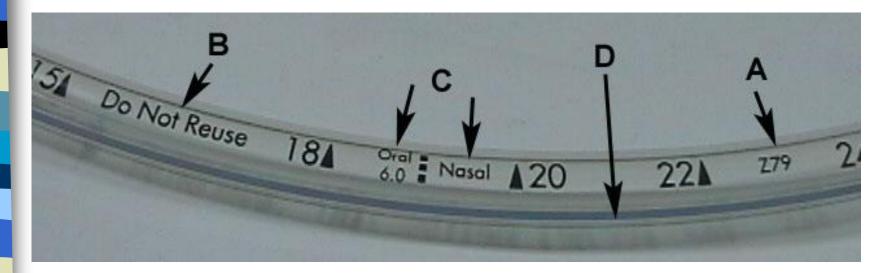


- 6) Depth of endotracheal tube: Midtrachea or below vocal cord ~ 2 cms
- Adult -> Male = 23 cms, Female = 21 cms
- **Children**

Oral endotracheal tube
$$= (Age/2) + 12$$
 (cm)

Nasal endotracheal tube = (Age/2) + 15 (cm)

7) Tube markings



- © Z-79
- **Disposible** (Do not reuse)
- Toral/ Nasal
- **Radiopaque** marker

3.3) Suction catheter

3.4) Slip joint





3.5) Face mask and self inflating bag



3.6) Magill forcep



- **3.7**) Syringe
- 3.8) Lubricating jelly
- 3.9) Plaster for strap endotracheal tube
- 4. Monitoring success of endotracheal intubation
- 4.1) Stethoscope
- **4.2**) Endtidal CO₂
- **4.3**) Pulse oximeter

POSITIONING

Clinician Positioning

Patient Positioning

Clinician Positioning

- Experienced clinicians stand at the back with straight back and arms and hold the laryngoscope closer to the base of the blade.
- During direct laryngoscopy, the laryngoscopist's arm should be only modestly flexed at the elbow and adducted.

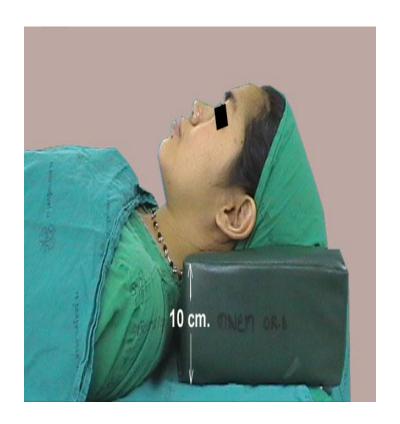
Patient Positioning

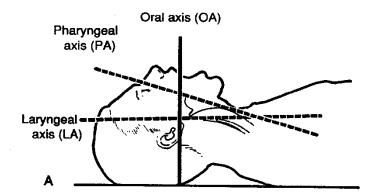
- Three aspects of the patient positioning are crucial
- A. Up- Down- the patient should be at appropriate height with middle of the patient's head at the level of clinician's belt buckle
- B. North-South- The patient's head should be positioned as close as possible to the upper (north) end of the stretcher.
- c. Sniff- that is the head and neck position

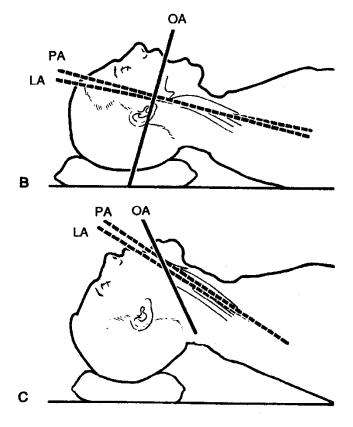
Sniffing position

- Normal airway axes-In the standard anatomic position, axis of oral cavity is at right angle to the axis of pharynx and trachea
- To obtain direct visualization during laryngoscopy this angle needs to be increased to 180.
- This is achieved by putting the patient in sniffing position i.e flexion at lower cervical spine and extention at the atlanto-occipital joint.

Sniffing position







Positioning in special situations

- Cervical spine injuries- DL is difficult in cervical spine injuries
- Morbid Obesity
- Pregnancy- Patients in advanced stages of pregnancy must be positioned with right hip wedge
- Patients in extreme respiratory distress- They can be intubated in sitting and semi sitting position

In Case of Suspected C-spine

Injury

Chin lift

Jaw thrust







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Position In Obese Person

Premedication

It includes

- 1. Preoxygenation
- 2. Fluid preloading and pretreatment
- 3. Induction medications
- 4. Paralytic agents

Preoxygenation

- It is a critical step aimed at maximizing blood oxygen saturation levels and creating an oxygen reservoir in the lungs
- Preoxygenation may be accomplished through various protocols,
 depending on the characteristics of the patient.
- The most straightforward protocol is to deliver high-flow oxygen via a nonrebreather face mask to a spontaneously breathing patient for 3 minutes
- Preoxygenation before induction and paralysis allows up to 8 minutes of apnea time in healthy adults before arterial oxygen desaturation below 90% occurs

Bag mask ventilation

- It is a critical step in oxygenating the patient before and between intubation attempts
- It is also known as manual resuscitator
- It consist of –
- 1. A self inflating bag
- 2. A one way bag inlet valve
- 3. A non breathing patient valve



BMV TECHNIQUE

There are three components to proper

BMV technique –

Mask seal

2. Airway opening

3. Ventilation

■ Assessing adequacy of BMV

A simple look, listen and feel approach is followed

Look for-

- 1. Chest expansion
- 2. Reservoir bag filling from O₂ source
- 3. Improving pulse oximeter reading
- 4. Improvement in patient's colour

■ Listen for-

- 1. Any hiss of escaping air caused by a poorly sealed face mask
- 2. The pulse oximeter tone
- ☐ Feel for-
- 1. Compliance of the self inflating bag
- 2. Leaking air against one's hand

■ Prediction of difficult BMV-

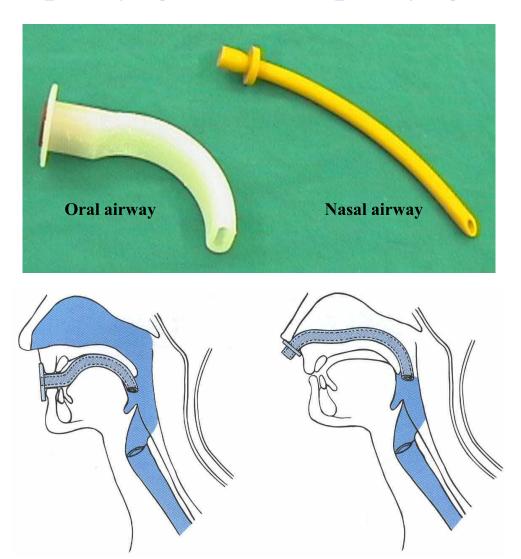
- 1. Beard
- 2. Obesity
- 3. Older
- 4. Toothless
- 5. Sounds

Adjuncts to BMV devices -

OROPHARYNGEAL AIRWAY

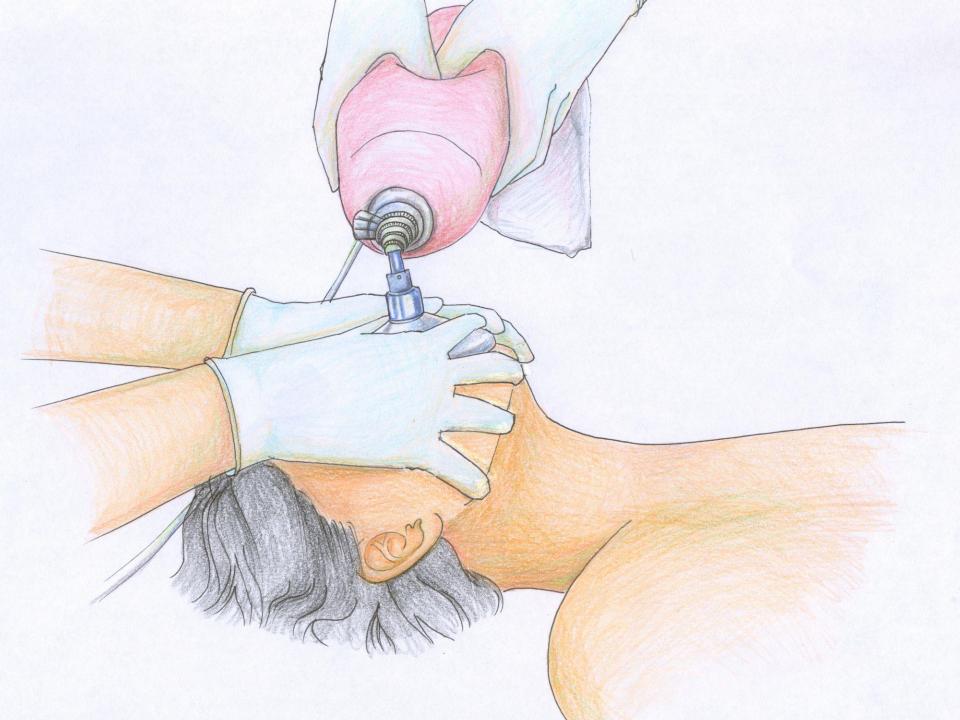
■ NASOPHARYNGEAL AIRWAY

3.2 Oropharyngeal or nasopharyngeal airway



Response to difficult BMV

- Perform exaggerated head tilt or chin lift.
- Do an exaggerated jaw thrust
- Consider oral or nasopharyngeal airway
- Perform 2 person bag mask technique
- Ease up cricoid pressure if being applied
- Consider mask change if seal is an issue
- Rule out foreign body



Fluid Preloading and Pretreatment

A fluid bolus of 10-20 ml/kg is given in an attempt to minimise post intubation hypotension

PREMEDICATIONS

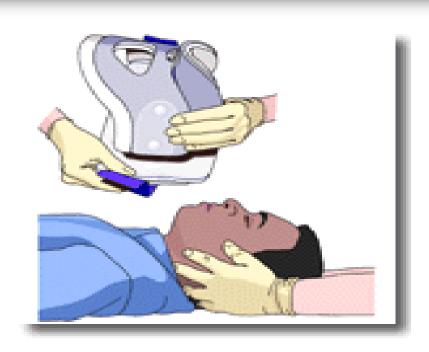
Drug		0	Duration		
Name Generic (Trade)	Adult Dose	Onset of Action	of Action	Advantages	Cautions
Fentanyl	1-2 mcg/kg slow IV push (over 1-2 min)	Immediate	0.5-1 h	Primary pretreatment drug to provide sedation and analgesia; decreases hypertensive response to intubation	Hypotension; chest wall rigidity at high doses (ie, >15 mcg/kg)
Lidocaine (Xylocaine)	1.5 mg/kg IV push	1-2 min	10-20 min	Useful in patients with asthma/COPD to decrease hypertensive response	Hypotension
Atropine	0.02 mg/kg (usually about 0.4 mg) IV push Typically administered for pediatric patients ≤8 y	2-4 min	Up to 4 h	Antisialagogue	Tachycardia
Vecuronium (Norcuron)	Defasciculating dose: 0.01 mg/kg IV push (typically about 1 mg, or 10% of intubation dose)			Decreases fasciculation and potassium release from cells; particularly useful if intend to use succinylcholine	Avoid higher doses that may produce paralytic effect

Drug Name Generic (Trade)	Adult Dose	Onset of Action	Duration of Action	Advantages	Cautions
Etomidate (Amidate)	0.3 mg/kg IV push (normal adult dose about 20 mg)	0.5-1 min	3-5 min	Does not alter hemodynamics or intracranial pressure (ICP); no histamine release; generally does not induce apnea; useful for patients with multiple trauma and hypotension (does not alter systemic BP)	Commonly causes myoclonus; pain upon injection; adrenal suppression (typically no clinical significance); does not suppress sympathetic response to laryngoscopy; nausea;
	INDUCT MEDICA			vomiting; lowers seizure threshold; does not provide analgesia	

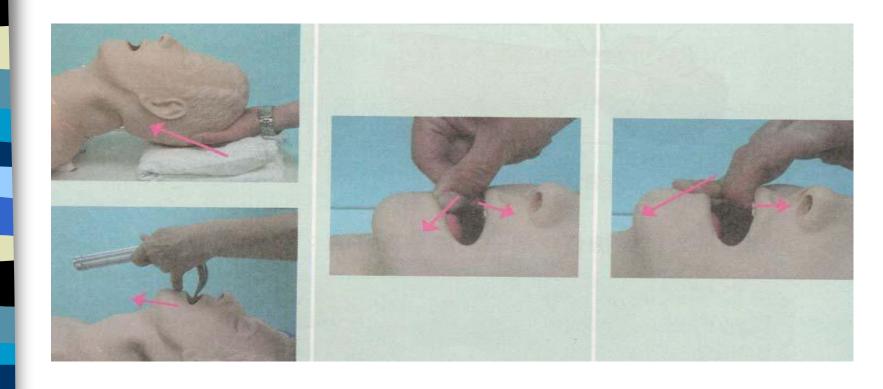
Ketamine (Ketalar)	1-2 mg/kg slow IV push (not to exceed 0.5 mg/kg/min)	0.5-1 min	5-10 min	Bronchodilatory effects advantageous if hypotension or lung disease present (leaves airway and other protective reflexes intact); rarely used in adults	Reported to increase ICP (avoid with head injury); hallucinations; increases sympathetic tone, potent cerebral vasodilation, cardiovascular stimulation (do not use with ischemic heart disease); emergence delirium common, but more of a concern when used for conscious sedation with painful procedures (approximately 12%) in adults < 65 y
Propofol (Diprivan)	2-3 mg/kg IV push Decrease dose if patient unstable	< 1 min	3-10 min	Provides rapid onset and brief duration; cerebroprotective (decreases ICP); amnestic properties; extremely potent	Causes cardiovascular depression and hypotension; respiratory depression is dose-dependent

			PARA			
Drug Name Generic (Trade)	Adult Dose	Onset of Action	Duration of Action	Advantages	Cautions	
Succinylcholine (Anectine)	0.3-2 mg/kg IV push (average dose 1.5 mg/kg)	1 min	4-6 min	Depolarizing NMB; drug of choice for emergency pediatric intubation; rapid onset (< 60 s) and brief duration of action; enhances nondepolarizing neuromuscular blocking effects	Increased serum potassium; muscle fasciculation; malignant hyperthermia; cardiac arrest in children with muscular dystrophy; dysrhythmia with multiple doses	
Rocuronium (Zemuron)	0.6-1 mg/kg IV push	< 1 min	30-60 min	Nondepolarizing NMBA; minimal effect on hemodynamics; low incidence of histamine release (0.8%)	Duration prolonged with hepatic impairment	

Steps of oroendotracheal intubation



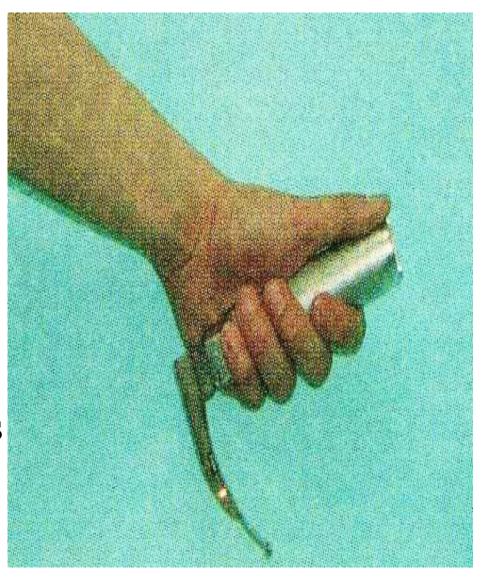
Open Mouth Techniques



- ☐ Hyper-extension technique (no touch technique)
- Cross fingers techniques

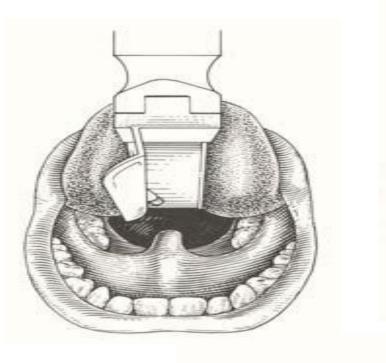
Holding a Laryngoscope

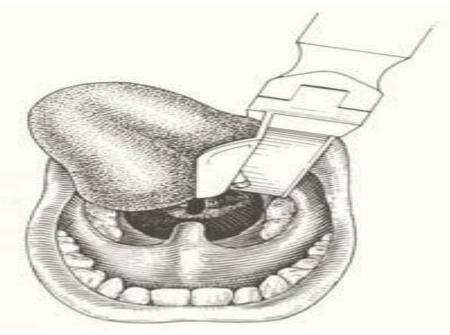
Hold the handle of
the laryngoscope
with
your left hand unless
you are left-handed

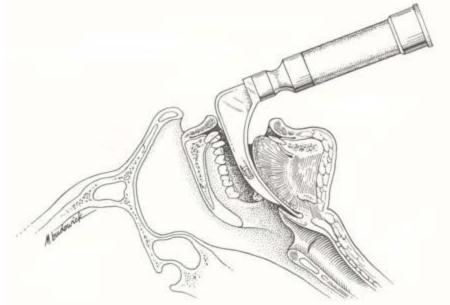


Inserting the Blade

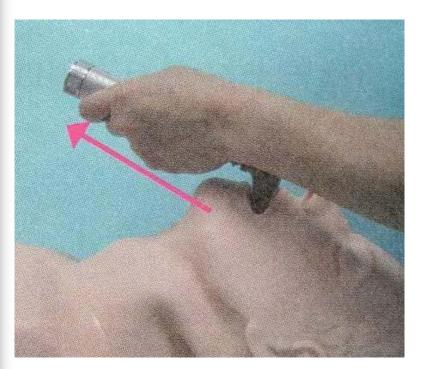
- Advance the blade over tongue until uvula and tonsillar folds are seen.
- Then move it to right side of mouth so it lies between aryepiglottic folds and tongue. This manoeuvre displaces tongue to left.
- Advance blade further until its tip lies in vallecula.

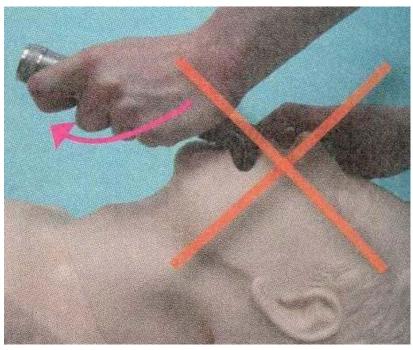






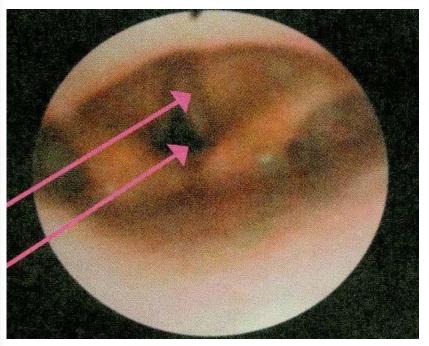
Lifting Up a Laryngoscope

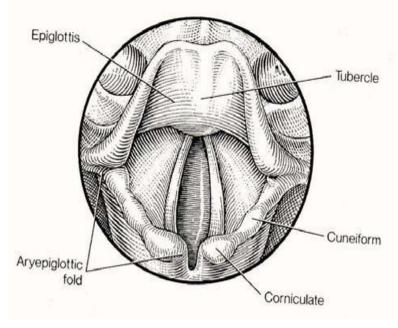




- Pull the blade forward and upward using firm but steady pressure without rotating the wrist
- If possible, avoid leaning on the upper teeth with the blade

Exposure of the Larynx





- In most situations the vocal cords should become visible.
- If not, exert gentle pressure over the cricoid area to help bring them into view.

Once positioned with, the tube is held with one hand

Laryngoscope removed

Cuff inflated with 5-8ml of air

- Cuff over and less inflation both are undesirable
- Less inflation leads to failure of typical objective and subjective signs of intubation to develop
- Over inflation may lead to ischemia of the tracheal mucosa

■ This can be avoided by seeking the

"Minimum leak pressure"

This is done during PPV by gradually withdrawing air from the cuff, 1mm at a time ,till a leak is heard ,at that point the cuff is reinflated by one additional ml . This helps to avoid excessive cuff pressure.

Comparision of DL by straight and curved blades

CURVED BLADE

Blade is inserted on right side

Blade tip puts pressureon hyoepiglotticligament which in turnhelps to lift theepiglottis

STRAIGHT BLADE

Blade is inserted from right side of mouth

Here blade is scooped beneath the epiglottis to achieve its direct elevation

Role of an Assistant



- To provide the endotracheal tube with stylet to the operator's right hand
- To apply cricoid pressure
- Facilitates intubation using BURP manoeuvre



Nasoendotracheal intubation



Nasoendotracheal intubation

- Advantage
- Comfortable for prolong intubation in postoperative period
- Suitable for oral surgery: tonsillectomy, mandible surgery
- **□** For blind nasal intubation
- ☐ Can take oral feeding
- ☐ Resist for kinking and difficult to accidental extubation

Disadvantage

- ☐ Trauma to nasal mucosa
- □ Risk for sinusitis in prolong intubation
- Risk for bacteremia
- Smaller diameter than oral route -> difficult for suction

Contraindication for nasoendotracheal intubation

- ☐ Fracture base of skull
- Coagulopathy
- Nasal cavity obstruction
- Retropharyngeal abscess

Confirmation

There are **objective** and **subjective** means of confirming ETT location

For every intubation at least two objective criteria of ETT location should be met

Objective methods

- 1. Observing the ETT going through the cords
- 2. End Tidal CO2 detection (ETCO2)
- 3. Esophageal detector devices
- 4. Visualization of the tracheal rings

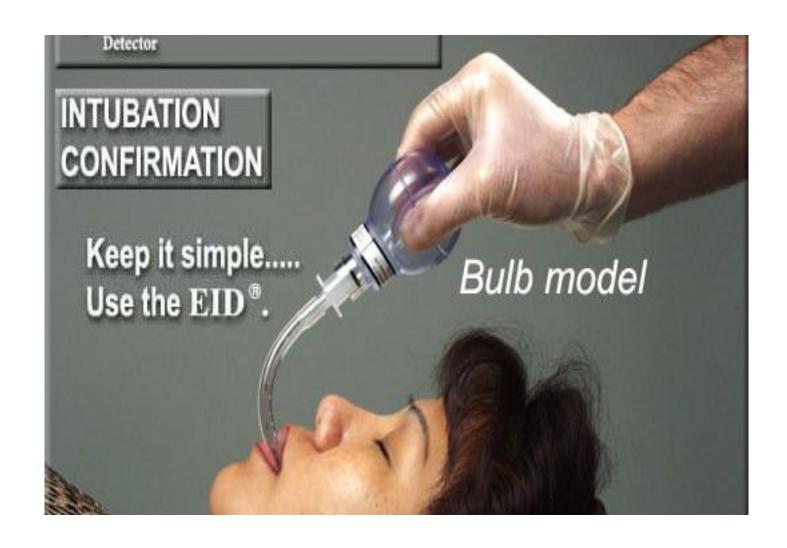
End –tidal CO2 detection

The presence of the exhaled CO2 is indicated by the change in colour of the disposable CO2 detector placed in line at the ET connector.

■ False positive readings-

This occurs in three situations-

- CO2 is washed into esophagus during previous
 BMV
- 2. Patient has ingested carbonated beverages
- 3. Patient has ingested Na HCO3 containing antacids



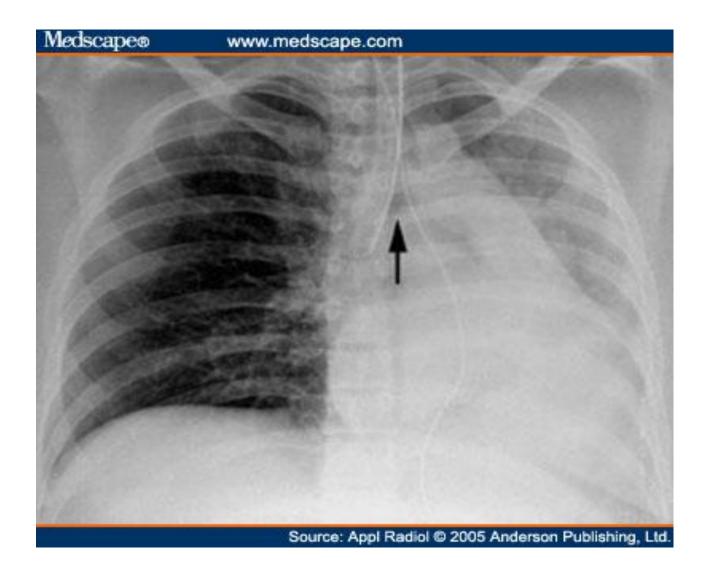
Rubber bulb type EDD



Toomey's syringe

Subjective Signs

- Chest Auscultation
- Increasing oxygen saturation
- BMV device compliance
- Vapour or misting
- Patient can no longer speak
- Auscultation over the stomach
- Normolization of Heart rate and BP
- Chest Xray



Arrow denotes ET tube

- Tracheal Intubation is performed in one of the three ways
- Awake Intubation
- 2. Using Rapid Sequence Intubation (RSI)
- Facilitated by deep sedation but without pharmacological paralysis

Rapid Sequence Intubation

- Technique of simultaneously giving induction agent, muscle relaxant and cricoid pressure to facilitate intubation and reduce risk of gastric aspiration
- Unless contraindicated it is strongly considered for emergency intubation

- Contraindications
- ☐ Inadequate prerequisite clinician factors
- ☐ Anticipated difficult airway
- Unnecessary

Advantages

- ☐ Skeletal muscle relaxation facilitates condition for direct laryngoscopy
- ☐ Application of cricoid pressure decrease risk of aspiration
- ☐ Patient cooperation not required
- Drugs help to control undesirable responses
- ☐ High success rate in experienced hands

Disadvantages

- ☐ Induction agents may cause profound drop in BP eg in shock states
- ☐ Not all physicians are adequately trained
- □ Not adequate in patients with obstructive airway pathology
- ☐ Require intimate knowledge of all drugs and contraindications to the technique
- Succinylcholine will not always wear off in time to have patient resume spontaneous ventilation before life threatening hypoxemia oocurs in "can't intubate situations"

Awake Intubation

- Three broad reasons to consider the patient for awake intubation
- 1. Predicted difficult airway
- 2. Predicted exaggerated hypotensive response to induction medications used for RSI
- 3. RSI not needed as in cases of arrested, critically ill, or intrinsically sedated patient.

- Routes
- Oral
- Nasal
- Blind Nasotracheal Intubation (BNTI)
- Anaesthesia
- Anaesthesia used is topical airway anaesthesia

- Advantages
- ☐ Patient continues to
- 1. Breathe spontaneously
- 2. Maintain and protect his/her airway
- No bridges burned
- Avoids adverse effects of RSI medications
- Avoids risk of hypoxemia during transition from spontaneous respirations to taking over PPV

- Disadvantages
- ☐ Discomfort to the patient
- ☐ Requires patient's cooperation
- Undesirable reflexes like Gag reflex and laryngospasm intact

Post Intubation Management

- Confirmation of the endotracheal tube placement
- ☐ Endotracheal Tube depth
- ☐ Securing the ETT
- ☐ Initiation of the PPV
- ☐ Blood Pressure Recheck
- 1. Post intubation Hypo and hypertension

- Post Intubation sedation and paralysis
- Choices for post intubation sedation-
- 1. Midazolam
- 2. Propofol
- Choices for post intubation analgesia-
- 1. Fentanyl
- 2. Morphine
- Choices for post intubation paralysis-
- 1. Rocuronium
- 2. Vecuronium

Difficult LARYNGOSCOPY

DEFINITION-

DL usually results in visualization in all or at least part of the glottic opening.

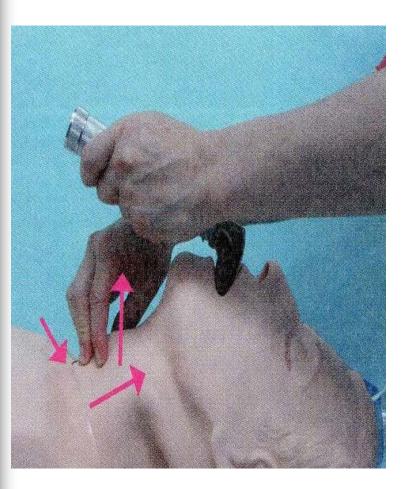
■ Simply put ,difficult laryngoscopy refers to the cormack grade 3 or 4 views where the view of glottic opening is obscured

Response to difficult laryngoscopy

- Initial response is-
- BEST LOOK LARYNGOSCOPY
- Patient position optimized
- Optimal muscle relaxation
- Laryngoscopist position optimized
- Appropriate blade tip location
- Appropriate laryngoscope lift
- Head lift

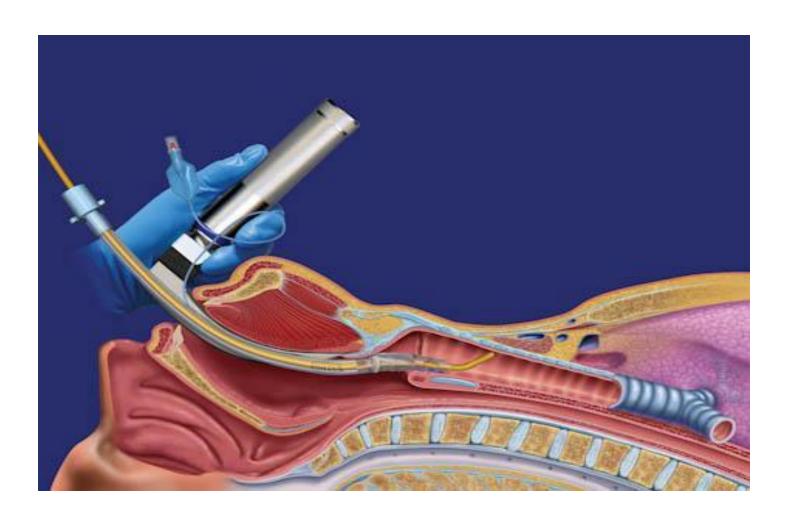
- ELM (External Laryngeal Manipulation)
- Consider if cricoid pressure is obstructing the view
- Use adjuncts to DL
- > Tracheal tube introducer
- > Stylets

BURP Maneuver

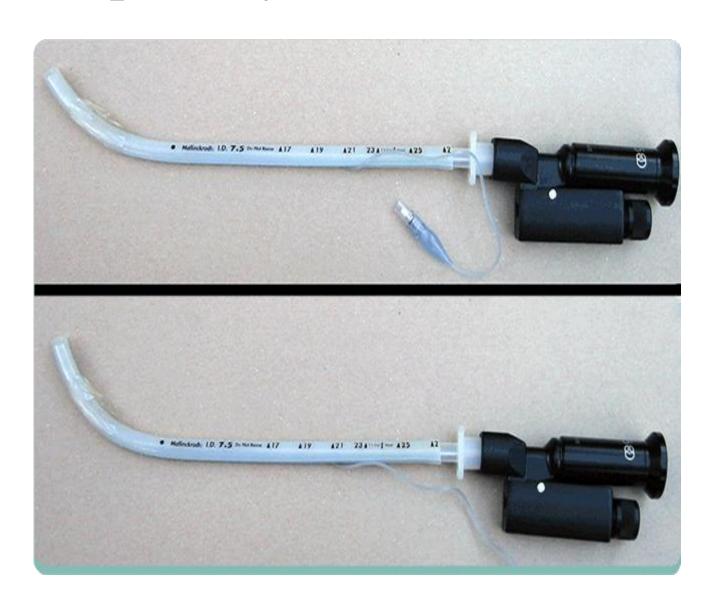


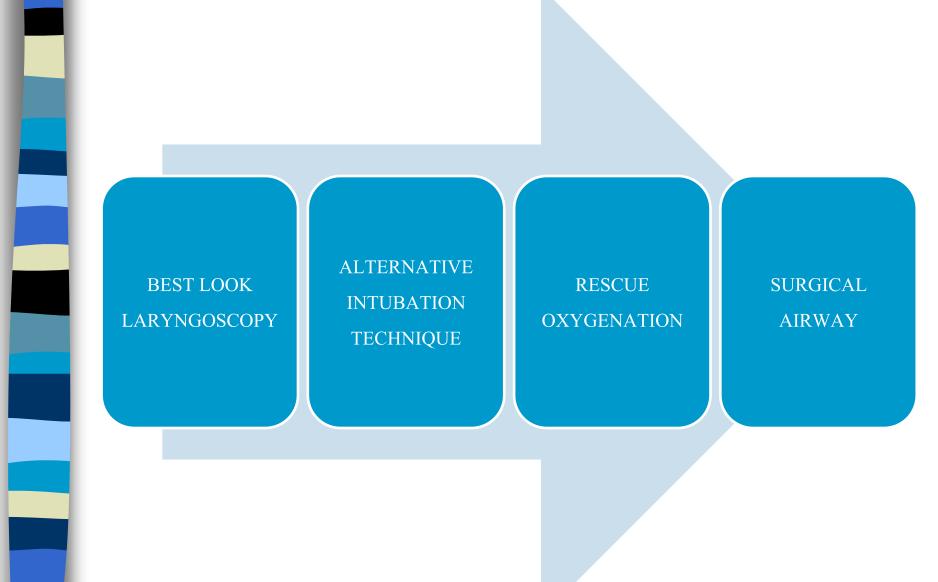
- Backward: posterior
 pressure on larynx against
 the cervical vertebrae
- Upward: superior pressureon larynx as far as possible
- Right: lateral pressure on larynx to the right

Tracheal tube introducer



Fibreoptic Stylets

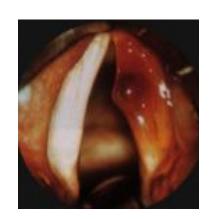




- 1) During intubation
- : Trauma to lip, tongue or teeth
- : Hypertension and tachycardia or arrhythmia
- : Pulmonary aspiration
- : Laryngospasm
- : Bronchospasm

1) During intubation

: Laryngeal edema



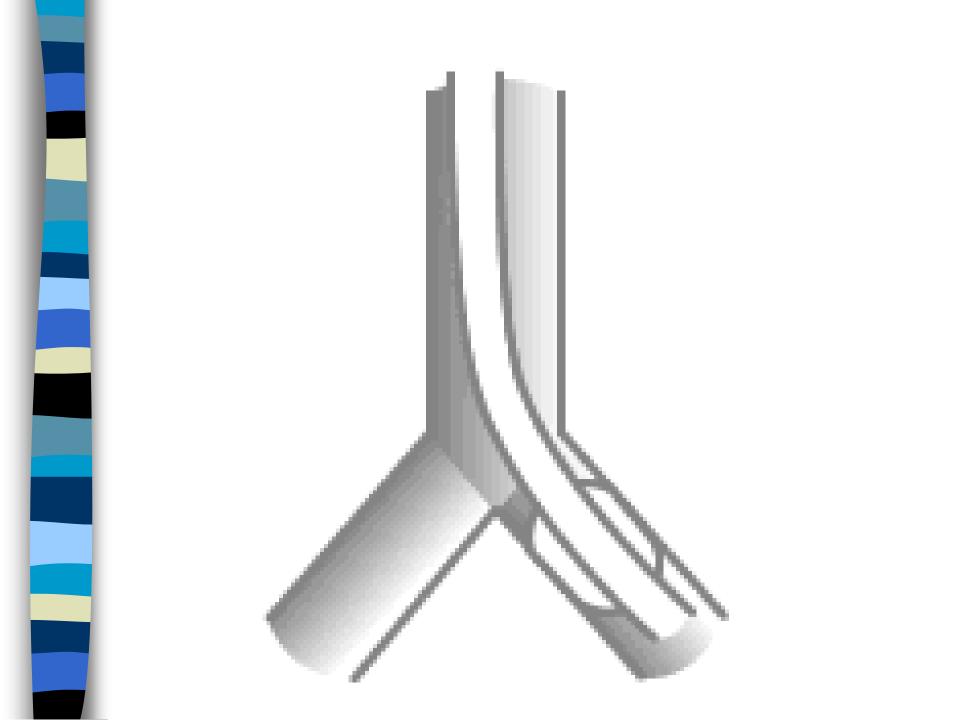
: Arytenoid dislocation -> hoarseness

: Increased intracranial pressure

: Spinal cord trauma in cervical spine injury

: Esophageal intubation

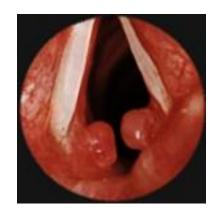
- 2) During remained intubation
- : Obstruction from kinking, secretion or overinflation of cuff
 - : Accidental extubation or endobronchial intubation
 - : Disconnection from breathing circuit



- 2) During remained intubation
- : Pulmonary aspiration
- : Lib or nasal ulcer in case with prolong period of intubation
- : Sinusitis or otitis in case with prolong nasoendotracheal intubation

- 3) During extubation
- Laryngospasm
- Pulmonary aspiration
- **Edema of upper airway**

- 4) After extubation
- Sore throat
- **Hoarseness**
- Tracheal stenosis(Prolong intubation)
- Laryngeal granuloma



= 74AMX 40M