



# Airway Management & Equipment

## Objectives

- Describe the applied anatomy of the airway.
- Conduct a preoperative airway assessment .
- Identify a potentially difficult airway.
- Learn about the management of airway .
- Become familiar with airway equipment.
- Understand issues around aspiration prophylaxis.
- Become familiar with controlled ventilation.

Important - Golden Note - Notes - 436 Notes

# Airway Anatomy

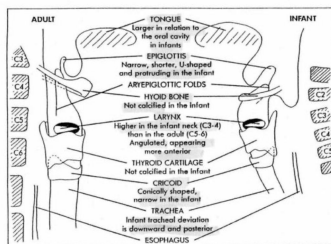
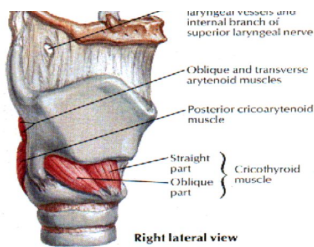
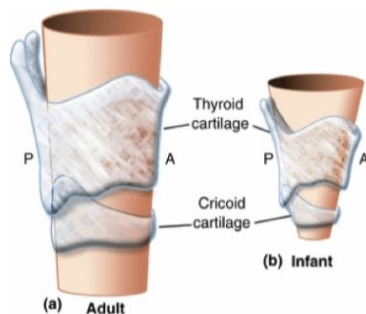


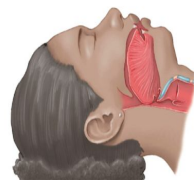
Figure 1. Comparison of adult and infant airway anatomic differences. (From Ho M. The Pediatric Airway. In Ball C, Hughes C, Orr T (eds). The Pediatric Anesthesia Handbook. St. Louis, Mosby Year Book, 1991, p 130. Adapted from Cole CJ, Todres ID: The Pediatric Airway. In Ryan JF, et al (eds): A Practice of Anesthesia for Infants and Children. Orlando, Grune & Stratton, 1986, with permission.)



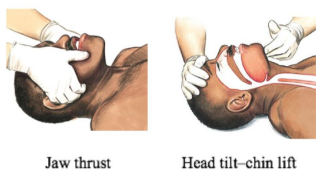
- The hyoid bone in pediatrics is not calcified.
- sometimes to save patient life you need to stab thyrocricoid membrane and put a tube.
- When you extubate the patient and he is not deeply anesthetized or he is fully awake he will feel the tube come out so the muscle will contract and close the glottis and the patient will desaturate and undergo hypoxia.
- Exam question: Larynx C3,C4 in children. C5,C6 in adults.
- In infants cricoid cartilage is smaller than glottis, be careful when choosing the size of the tube.

## Airway Control

- The problem: drop of the tongue to the posterior pharyngeal wall due to relaxation of muscles of the tongue.
- We do head tilt, chin lift, jaw thrust. Chin lift is used when we are sure that there is no cervical spine injury to avoid causing quadriplegia to the patient. While jaw thrust is performed when we are suspecting spinal injury.

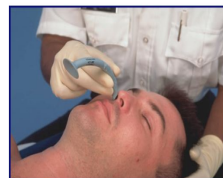


### Opening the Airway



### Nasal Airway

- We measure its size from the nostril to the angle of the mandible.
- This is more tolerable especially in bariatric or obese or epileptic patients, and it's left until they're full awake.
- Lubricate well, to not injure the nose and bleed (cause more obstruction)



Nasopharyngeal Airway

### Oral Airway



- We measure the size from the edge of the mouth to the angle of the mandible (you have to choose the size properly).
- Remember: the patient must be deeply anesthetized or there will be gag reflex.



Oropharyngeal Airway

Proper size

# Airway Control

## Ambu Bag

- **Ambu** = from ambulatory, ambulation of air (rebreathing)
- **Bag:** When we have patent airway but no air entry.
- Self inflated bag either from air oxygen or from connected oxygen source.
- We use it in case of emergency or if the anesthesia machine not working.



Bag-Valve-Mask  
With oxygen reservoir

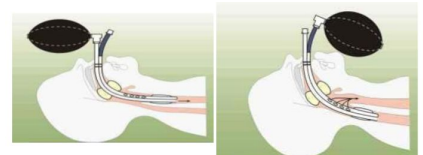
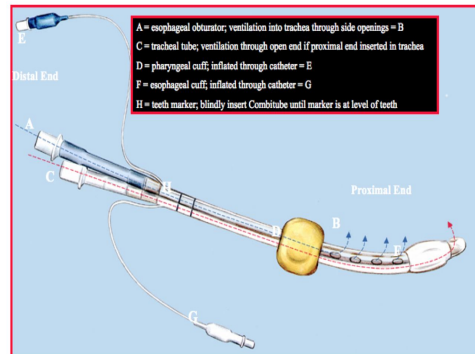
## C-E Maneuver

- It means to perform manual ventilation
- E= for supporting the jaw (little, ring and middle fingers are E shaped)
- C= Ceiling of the mask by the index finger and the thumb.
- Be careful not to press on the soft tissue, especially in pediatrics; because you can cause an obstruction.



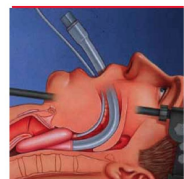
## Esophageal-Tracheal Combitube

- Combi = combo = two
- This provides emergency protection of the airway.
- Usually used in ER and accident field.
- It is inserted blindly.
- How to know if it's in the esophagus or the trachea?  
By connecting capnography (end-tidal CO<sub>2</sub>); if you see etCO<sub>2</sub> at (A) that's mean you inserted the tube in the esophagus and you're ventilating the patient through the blue holes, if you see etCO<sub>2</sub> at (C) that's mean you inserted the tube in the trachea and you're ventilating through the red hole.
- The ideal that it goes to the esophagus.
- We inflate the cuffs to avoid aspiration.
- Capnography is the monitoring of the concentration or partial pressure of carbon dioxide (CO<sub>2</sub>) in the respiratory gases.



## Laryngeal Mask Airway (LMA)

- There are many sizes so make sure to choose the proper size.
- Patient must be deeply anesthetized.
- It is inserted blindly.
- Does NOT protect from aspiration.
- Not indicated in general anesthesia and the patient has a full stomach or has tendency for aspiration.
- Apply cricoid pressure to avoid aspiration. (the tip of it is in the hypopharynx area)



# LEMON (to assess airway) (IMP in OSCE + MCQ)

## Look for any obvious anomaly



- Morbid obesity (BMI)
- Skull
- Face
- Jaw (can't speak or open their mouth due to underdeveloped jaw),
- Mouth, teeth (you may need dentist referral prior to the surgery)
- Neck

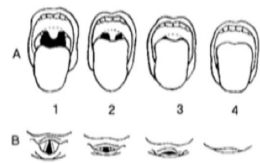
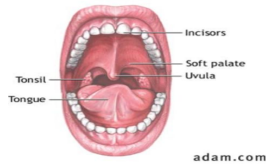
## Examination



- The 3 joints movements: O joint (atlanto-occipital) (15-20 degrees).
- Presence of a gap bet the Occiput and C1 is essential.
  - The cervical spine (range >90) (turn right and left)
  - Temporomandibular (TM) joint (ask the patient to move his lower jaw forward or to open his mouth fully) : Subluxation (1 finger)
- Mouth opening: 3 fingers can enter.
- **Thyromental distance: > 6.5cm** (In hyperextended neck from thyroid to jaw).
- **Sternomental distance > 12.5cm** . less than 12.5? Difficult intubation

## Mallampati

abnormal findings: short mandible, big tongue



- Mallampati test: A score based on the hypothesis that when the base of the tongue is disproportionately large it will overshadow the larynx
  - 1 : when you see hard palate, soft palate, uvula, tonsils.
  - 2: hard palate, soft palate, base of the uvula.
  - 3: hard palate, soft palate and only the tip of the glottis.
  - 4: hard palate only.

- Simple easy test, correlates with what is seen during laryngoscopy or Cormack-Lehene grades, but (not imp)

1. Moderate sensitivity and specificity (12% false +ve).
2. Inter observer variation.
3. Phonation increases false negative view.

## Obstruction

- Apparent cause e.g. goitre.
- OSA (obstructive sleep apnea).
- Noisy breathing or stridor.
- Signs of upper airway obstruction.
- Other causes (intraoral mass).

## Neck Mobility

(Neck instrumentation → can't extend)

Prior condition: they all cause limitation of mobility

- Surgery
- Rheumatoid arthritis (Joints)
- Osteoarthritis,
- Short muscular neck .



# Management

## I. History:

- A. **previous history of difficulty is the best predictor IMPORTANT!!**
- B. Inquire about:
  - Nature of difficulty.
  - No of trials.
  - Ability to ventilate bet trials.
  - Maneuver used.
  - Complications.

II. Snoring and sleep apnea (edematous airway).

III. Predictors of DMV (**obese**). Where O stands for Obesity, B for beard, Edentor (no teeth), Snoring and elderly (excessive neck fat and shorter space).

## Proper Equipment

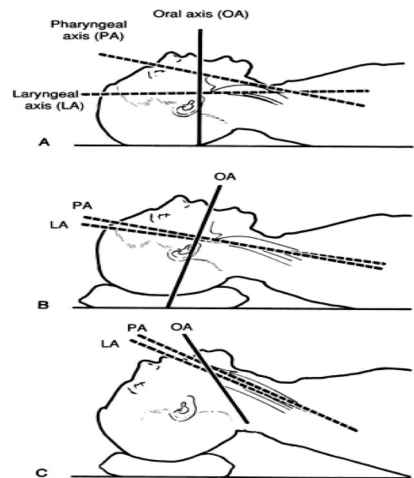
- Bag and mask, oxygen source.
- Airways oro-nasopharyngeal and LMA.
- Laryngoscopes different blades.
- ETT different sizes.
- Suction on.

## Airway Gadgets



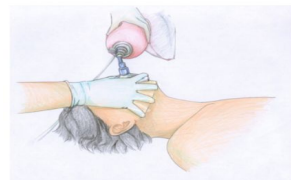
## Positioning for Successful Intubation

- Alignment of 3 axes or assuming sniffing position.
- Any anomaly in these 3 joints: A-O, T-M or C-spine can result in difficult intubation.
- If the patient is supine (A) and not in sniffing position the trachea won't be straight and I'll have difficult intubation. Sniffing position : add all axis in one line.



## Mask Ventilation

- Induction of anesthesia produces upper airway relaxation and possible collapse.
- Holding the mask C-E maneuver.
- Be careful not to compress soft tissue.



# Endotracheal Intubation

## Indications

- We can summarize them in two things:
  1. To Protect airway from aspiration.
  2. Ventilate.
- Resuscitation (CPR).
- Prevention of lung soiling (entry of acid into the lung causes permanent damage).
- Positive pressure ventilation (GA). Muscle Relaxant + ventilate throughout OR always
- Pulmonary toilet (with normal saline to dilute the thick mucus in COPD to make it easy to aspirate mucus and maintain airway patency).
- Patent airway (coma or near coma).
- Respiratory Failure(CO2 retention type 2).
- ❖ **Respiratory failure types:**
  1. Hypoxia (O2 supplementation)
  2. CO2 retention (intubate)



## Technique

Look for epiglottis under the epiglottis you will find the vocal cords.

- If initially not found insert laryngoscope further.
- If this maneuver does not work slowly pull laryngoscope back.

Once epiglottis visualized, push laryngoscope into vallecula and apply traction at 45 degree angle to “push” epiglottis up and out of the way

## Confirm Tube Position

- Direct visualization of ETT between cords.
- Continuous trace of capnography
  - ◆ if only 2 tiduals of CO2 then it disappears = esophagus, continuous tidal = trachea
- 3 point auscultation (left chest, right chest and epigastric).
- Bronchoscopy; carina seen.
- Esophageal detector device.
- Other as bilateral chest movement, mist in the tube, CXR.
- If you hear in right → left, that means you are in the right main bronchus which is wrong (one lobe insertion may lead to lung atelectasis).
- If you're in the esophagus → pull out + try again + enhance position + call for help.



# Endotracheal Intubation

## Rapid Sequence Induction

→ Indications: Used to prevent lung aspiration in all emergency cases, GERD, full stomach, last meal less than 6-8 hours, emergency cesarean suction, pyloric stenosis, slow gastric emptying.

→ Technique:

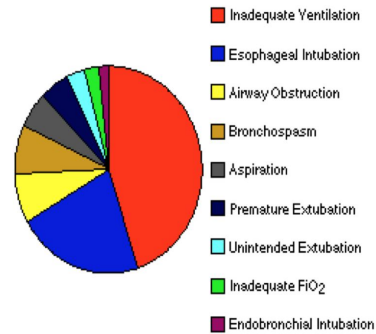
- ◆ First prepare your equipment (laryngoscope, endotracheal tube, suction, monitors, end-tidal CO<sub>2</sub>).
- ◆ Preoxygenation (for 3 mins).
- ◆ IV induction with sux (Suxamethonium) the fastest muscle relaxant or propofol.
- ◆ Cricoid pressure (ask your assistant to press for 1 min).
- ◆ Intubate, inflate the cuff, confirm the position of the tube.
- ◆ Release cricoid and fix the tube (after confirmation).



Cricoid Pressure

## Complications

1. Inadequate ventilation.
  2. Esophageal intubation.
  3. Airway obstruction (secretions).
  4. Bronchospasm (light anesthesia).
  5. Aspiration.
  6. Trauma.
  7. Stress response (especially in patients with chronic diseases).
- Be sure fully anesthetized + fully hypnotised Muscle relaxant



## Problems with ETT & Cuff

- Too long: endobronchial intubation (right bronchus: because it is straighter).
- Too short: accidental extubation we want it between the vocal cords and carina.
- Too large: trauma to surrounding tissues.
- Too narrow: increased airway resistance.
- Too soft: kinks (patient bite).
- Too hard: tissue damage.
- Prolonged placement: vocal cord granulomas, tracheal stenosis. (when > 2 weeks)
- Poor curvature: difficult to intubate so we have to put a stylet inside the tube.
- Cuff insufficiently inflated: allows leaking and aspiration.
- Cuff excessively inflated: pressure necrosis in mucosa.

# Difficult Airway

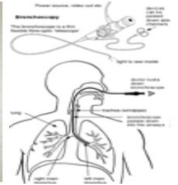
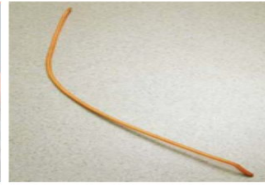
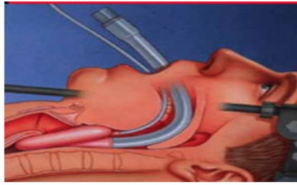
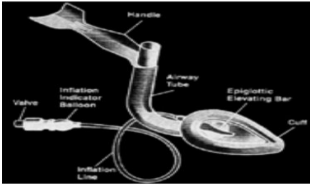
## Cause

Congenital (all of the syndromes; down syndrome) or Acquired (RA,OA,DM,obesity)

## Difficult Intubation

- Mallampati grade 4
- Treacher-Collin syndrome

## Difficult Airway Gadgets



## Rigid Fiberoptic Scope



Bullard



Wu Scope



Upsher

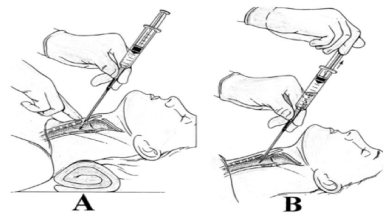


Glide Scope

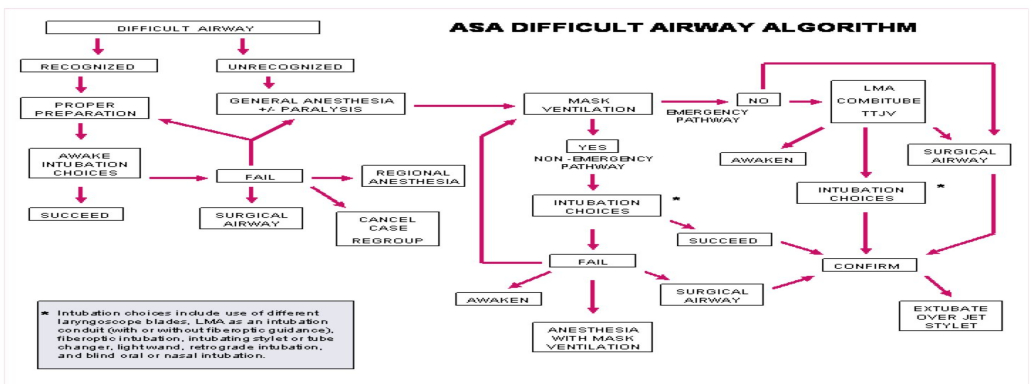
- In conventional methods of intubation I have to find the airway myself and intubate, while in rigid fiberoptic it goes and finds the airway itself to intubate easily especially in difficult intubation.

## Management

- Expected from history, examination
- Secure airway **while awake** under LA
- Unexpected different options
- Priority for maintenance of patent airway and oxygenation
- **Worst case scenario: can't intubate or ventilate > LMA**
- Transtracheal Jet Ventilation: if other methods failed



Transtracheal Jet Ventilation





# Management

## Ventilation

- Spontaneous ventilation  $SpO_2$ ,  $ETCO_2$  = hypoventilation
- Controlled ventilation
- Pressure cycled and volume cycled ventilator
  - ◆ Tidal volume 10 mls/kg (the ideal 6-8 ml/kg)
  - ◆ Respiratory rate to maintain normocarbida 10-12 in adults, 20-30 in pediatrics
  - ◆ I:E ratio (normal 1:2) to allow the lung to be empty from the gas; to avoid pneumothorax by air trapping. For asthma and COPD patients increase the time of expiration, for example, inspiration 3 seconds, and expiration 6-8 seconds
  - ◆ Bronchial asthma alveoli is fragile
  - ◆ PEEP positive end expiratory pressure (normal 5, increase it to 7-10 in obese).

## Recommendations

- Adequate airway assessment to pick up expected D.A to be secured awake.
- Difficult intubation cart always ready.
- Pre oxygenation as a routine.
- Maintenance of oxygenation not the intubation should be your aim.
- Use the technique you are familiar with.
- Always have plans B,C,D in unexpected D.A.

## Extubation

### General Guidelines:

- Check that neuromuscular function and hemodynamic status is normal
- Check that the patient is breathing spontaneously with adequate rate and tidal volume
- Allow patient to breathe 100% O<sub>2</sub> for 3-5 minutes
- Suction secretions from pharynx
- Deflate cuff, remove ETT on inspiration (vocal cords abducted)
- We prefer that the patient is fully awake when you extubate
- Ensure patient breathing adequately after extubation
- Ensure face mask for O<sub>2</sub> delivery available
- Proper positioning of patient during transfer to recovery room, e.g. sniffing position, side lying.

# Oxygen Delivery System

## Nasal Cannulae

- Inspired oxygen concentration (normal room air oxygen is 21%) is dependent on the oxygen flow rate, the nasopharyngeal volume and the patient's inspiratory flow rate.
- Increases inspired oxygen concentration by 3-4%. = 1 liter
- Oxygen flow rates greater than 3 liters are poorly tolerated by patients due to drying and crusting of the nasal mucosa. Start with 2 liters



1L/min:	21%to24%
2L/min:	25% to 28%
3L/min:	29%to32%
4L/min:	33%to36%
5L/min:	37% to 40%
6L/min:	41%to44%

## Face Masks

Three types of facemask are available:

### 1. Open

- Are the most simple of the designs available.
- They do not provide good control over the oxygen concentration being delivered to the patient causing variability in oxygen treatment.
- A 6l/min flow rate is the minimum necessary to prevent the possibility of rebreathing.
- Maximum inspired oxygen concentration ~ 50-60%.

### 2. Venturi

- They should be **used in patients with COPD/emphysema** where accurate oxygen therapy is needed.
- If you put venturi mask for COPD patient you have to check arterial gas for hypercapnia (hypercapnia is a risk for respiratory failure type 2 so you have to intubate if it happened)
- Arterial blood gases can then be drawn so correlation between oxygen therapy for hypoxemia and potential risk of CO<sub>2</sub> retention can be made.
- Masks are available for delivering 24%, 28%, 35%, 40%, 50%.
- Don't increase FiO<sub>2</sub> concentration

### 3. Non-rebreathing. eg, Hudson's face mask

- Have an attached reservoir bag and one-way valves on the sides of the facemask.
- With flow rates of 10 liters an oxygen concentration of 95% can be achieved.
- These masks provide the highest inspired oxygen concentration for non-intubated patients.
- Highest O<sub>2</sub> concentration:** non-rebreathing + bag

## Extra but imp

LMA™ Size	Patient Selection Guidelines	Maximum Cuff Inflation Volume (ml)
1	Neonate/ infants up to 5 kg	4
1½	Infants 5-10 kg	7
2	Infants/ children 10-20 kg	10
2½	Children 20-30 kg	14
3	Children 30-50 kg	20
4	Adults 50-70 kg	30
5	Adults 70-100 kg	40
6	Adults over 100 kg	50

## Practice Questions

**Q1: Which one of the following would you start with in a patient with COPD that needed oxygen therapy?**

- A. Nasal cannula
- B. Hudson's face mask
- C. Venturi face mask
- D. Endotracheal intubation

**Q2: Which one of the following is a reliable and commonly used method for confirming correct position of ETT?**

- A. Continuous capnography
- B. Esophageal detector device
- C. Bronchoscopy
- D. CXR

**Q3: Which one of the following is the most reliable indicator of difficult airway?**

- A. Prominent upper incisors
- B. Morbid obesity
- C. Short neck
- D. previous history of difficult intubation

**Q4: A patient with a mallampati score of 2. What does that indicate?**

- A. Only the hard palate is seen
- B. The hard palate, soft palate, base of uvula is seen
- C. The hard and soft palate are seen
- D. The hard palate, soft palate, uvula and tonsils are seen

**Answers:**

**Q1: C | Q2: A | Q3: D | Q4: B**

# Thank You

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Special thank you to 436  
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