Editing file

Airway Management and equipment

Objectives:

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

Color index:

- Red: important /
- Black: content slides
- Gray: extra
- Green: dr. Notes

IMPORTANT

Reviewd by
Noura & Alhanouf

Anesthesia 438 teamwork

Airway control

All of them are temporary used to prepare for intubation in case of emergency situations to secure and open airway and facilitate ventilation and oxygenation of the patient

Manually

Jaw thrust

Head tilt- chin lift

The most imp thing to cause airway obstruction in a comatose patient is the tongue, due to muscle hypotonia.
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 in all trauma patients as we are suspecting spinal (cervical) injury.

Oropharyngeal airway

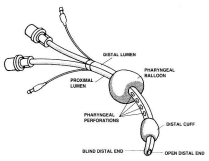
-Size: from the tip of the mouth to the angle of the mandible (you have to choose the size properly)
-It's plastic, hard insertion
-Ends at the base of the tongue
-the patient must be comatose (based on Glasgow coma score).
-Insert it directly or indirectly with the use of laryngoscope
-Cannot be tolerated by semi-conscious patients as it causes: gag reflex, regurgitation and laryngospasm

Nasopharyngeal airway

-Size: from tip of nostril to angle of mandible
-it's rubber, easy insertion
-can be tolerated by semi-conscious
-contraindications:
1- basal skull fracture (how to know? Otorrhea CSF from ear or bulging raccoon eyes)
2- bleeding disorders or on anticoagulant

Esophageal-Tracheal Combitube

-Consists of two tubes fused together
-Not used in real life
-The distal end inserted blindly in the esophagus
-Ventilation occur through the holes in the sides
-Used in emergency cases because it is easily inserted.



LMA laryngeal mask airway

There are many sizes so make sure to choose the proper size: (Female: 3 / male: 4)
-Easy blind insertion with no need for laryngoscope
-Ends at the pharyngeal area & deliver O_2 to larynx & trachea
-Latex-free, hence can be used in patients having latex allergy
-Used to open airway in cases of difficult ventilation or intubation
-Criteria for use:
1- Patient has to be comatose to avoid gag reflex, regurgitation and laryngospasm
2- NOT used in high risk aspiration patients including laparoscopic procedures
-Risks for aspiration include: full stomach like in trauma patients (not fasting), pregnancy, obese patients.
-Useful in low risk aspiration patients in day surgeries with propofol
-No need for skills or muscle relaxants
-Why we inflate? To provide good seal for vocal cords and protect from aspiration and regurgitation

Extra: but imp

LMA™ Size*	Patient Selection Guidelines	Maximum Cuff Inflation Volume[ml]
1	Neonates/ 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

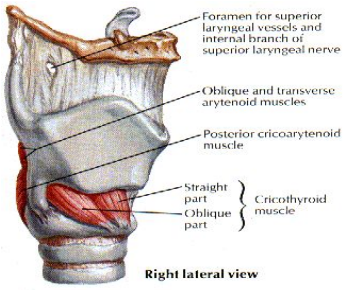
Ambu bag

Give 100% oxygenation
Used with all of the above instruments
We use it in case of **emergency**

C-E maneuver

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

Airway anatomy



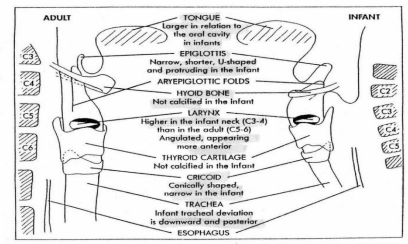
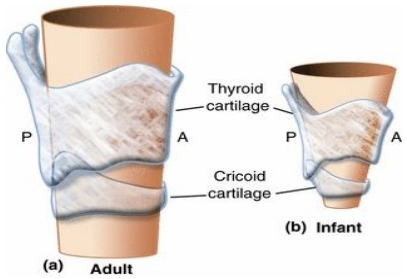


Figure 1. Comparison of adult and infant airway anatomic differences. (*From* Ho M: The Pediatric Airway. *In* Bell C, Hughes C, Oh T (eds): The Pediatric Anesthesia Handbook. St. Louis, Mosby Year Book, 1991, p 130. *Adapted from* Cote CJ, Todres ID: The Pediatric Airway. *In* Ryan JF, et al (eds):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



Indication for endotracheal intubation [1]

- Resuscitation (CPR).
- Positive pressure ventilation (GA)
- Pulmonary toilet
- Prevention of lung soiling
- Patent airway (coma or near coma)
- Respiratory Failure (CO_2 retention)

Management [2]

IMPORTANT

I-History: previous history of difficulty is the best predictor Inquire about:
Nature of difficulty / No of trials / Ability to ventilate bet trials / Maneuver used / Complications
II-Snoring and sleep apnea .
III-Predictors of DMV (obese) .

History:

- Present complaint
- Medical hx: DM, HTN, hypothyroidism/goiter, RA, SLE, COPD, bronchial asthma, bronchiectasis
- Surgical hx [3]
- Last meal
- Drugs [4] and Allergies [5]

l- History, look for: Predictor factors from hx that can indicate difficult intubation: obesity, congenital anomalies, facial trauma, burn, submandibular/neck mass, systemic diseases: Rheumatoid arthritis with limited flexion/extension of the neck, scleroderma with limited mouth opening, respiratory disease: asthma, COPD, bronchiectasis, cancer.
II-Vital signs, body weight, temperature
III-Examination : LEMON
IV-Baseline investigations : CBC, FBG, lipid profile, LFT, ECG, CXR
V-If need further investigations or consultation: PFT, HBS
VI-Set a plan

You have a trauma case presented to ER with GCS of 4 (comatose), what will you do for him? First open airway & provide O_2 by ambu bag and ask for oropharyngeal airway as patient is comatose, then ask for intubation to secure the airway

1- 1) Emergency: comatose or loss of consciousness, respiratory distress due to cardiac, trauma, or respiratory 2) Elective: during procedures in OR

2- Difference between airway management and airway assessment? Management: complete Hx, physical exam, investigations, and plan. Assessment: physical exam & clinical status of the patient

3- Previous hx of anesthesia complications: Prolonged apnea after anesthesia (cholinesterase enzyme deficiency), Negative-pressure pulmonary edema post extubation, hx of high fever post anesthesia (Malignant hyperthermia)

4- Some drugs are stopped before surgery such as hypertensive medications as they might cause hypotension, if they are in steroids, we give them a stress dose

5- We have to check for paracetamol allergy because we give Pt large doses of paracetamol post op

Management cont..

To assess airway use **LEMON**

LEMON Airway assessment method

L	Look externally (Facial trauma, large incisors, beard or moustache, large tongue
E	Evaluate the 3-3-2 rule - Incisor distance: 3 FB - Hyoid-mental distance: 3 FB - Thyroid-to-mouth distance: 2 FB
M	Mallampati Score ≥ 3
O	Obstruction : Presence of any condition like epiglotitis, Peritonsillar abscess, trauma
N	Neck Mobility (Limited neck mobility)

L — Look for any obvious anomaly

Morbid obesity (BMI), Skull, Face, Jaw , Mouth, teeth , Neck,

Start with general inspection of pt status: dysmorphic features, distressed, sitting comfortably, upright position or lying down, cyanosis, pale, using accessory muscles, breathing way (intubated, spontaneous), good mouth opening, loose teeth, neck masses, obese, obvious congenital anomalies.

Dental hygiene is very important because we're doing manipulation around the mouth with laryngoscope and tubes, very bad hygiene might lead to bleeding, easy to fracture teeth.

E — Examination

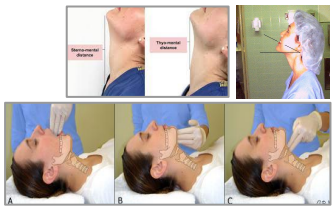
The 3 joints movements: A-O joint atlanto-occipital (15-20 degrees) Presence of gap bet Occiput and C1 is essential/The cervical spine (range>90)/T.M joint temporomandibular: Subluxation 1 finger

- Mouth opening: 3 fingers can enter.

In hyperextended neck from thyroid to chin examine:

- Thyromental distance [1] > 6.5cm.
- Sternomental Distance [2] >12.5cm.
- **3-3-2 rule:**
  - 3 fingers in mouth
  - 3 fingers fit from mentum to hyoid cartilage
  - 2 fingers fit from the floor of the mouth to the top of thyroid cartilage.

IMPORTANT



M — Mallampati [3]

abnormal findings: (short mandible, big tongue)

Mallampati test: While patient in sitting position ask him to open mouth & protrude tongue

Based on the hypothesis that when the base of the tongue is disproportionally 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.

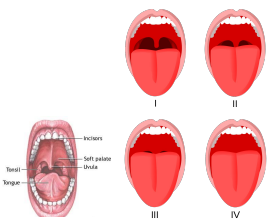
Simple easy test, correlates with what is seen during laryngoscopy or Cormack-Lehane grades, but

1- moderate sensitivity and specificity (12% false +ve).

2- Inter observer variation.

3- Phonation increases false negative view.

IMPORTANT



O — Obstruction

- Apparent cause e.g. goitre.
- OSA (obstructive sleep apnea).
- Noisy breathing or stridor.
- Signs of upper airway obstruction [4].
- Other causes (intraoral mass)

N — Neck mobility

Prior condition: Neck instrumentation > (can't extend)

- Surgery: Anterior cervical spine fixation: limited flexion & extension might cause difficult intubation (see pic)
- Rheumatoid arthritis (Joints).
- Osteoarthritis.
- Short muscular neck .

IMPORTANT

1- if decreased: means high larynx which indicate difficult intubation but not necessarily difficult ventilation (you can't see the larynx during intubation)

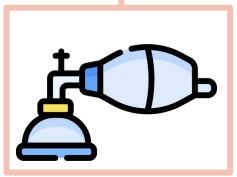
2- if decreased: short neck indicate difficult intubation, can be measured by moving the neck: flexion, extension, left and right

3- Not specific unless combined with other tests or conditions for ex: patient have a submandibular/neck mass, fractured mandible, burn, obese pt, congenital anomaly. But it's sensitive and might give false positive results (patient might be assessed as grade 3 or 4 but later during intubation appear to be very easily intubated), grade 1&2 easy intubation/grade 3&4 difficult intubation, done while in natural position

4- Upper airway obstruction = stridor, Lower airway obstruction = wheezing at the end of expiration

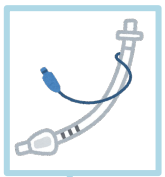
Proper equipment airway gadgets

Bag and mask, oxygen source



Airway oronasopharyngeal and LMA

Laryngoscopes different blades



ETT different sizes

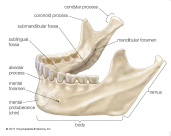
Female: 7-7.5, Male: 8-8.5, Children: up to 2.5

Suction on

in case of aspiration or regurgitation

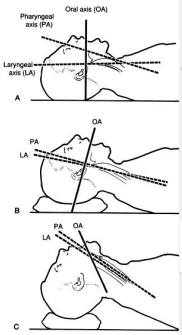
Mask ventilation [3]

- Holding the mask using C-E maneuver.
- Induction of anesthesia produces upper airway relaxation and possible collapse.



Requirement of successful intubation

- Normal roomy mandible
- Normal T-M, A-O ,and C-spine.



Positioning for successful intubation

- Alignment of 3 axes or assuming sniffing position [1].
- Any anomaly in these 3 joints: A-O, T-M or C-spine can result in difficult intubation.

Endotracheal Intubation [2]

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 [3]

IMPORTANT

- Direct visualization of ETT between cords.
- 3 point auscultation [4].
- Esophageal detector device.
- Continuous trace of capnography [5,6]
- Bronchoscopy; carina seen
- Other as bilateral chest movement, mist in the tube, CXR [7]

1- Not done in case of cervical injury and clinically it's enough if you do jaw thrust
2- Epiglottis is the landmark for endotracheal intubation.
3- Once you connect the ambu bag the bag will be inflated by air coming out of the lung and then when you start to ventilate you will notice some vapor around the tube because the air coming of the lungs is warm. After confirming the tube position fix the tube, usually at 19-20 cm in adults
4- To ensure that it's equal, bilateral and adequate air entry
5- Capnography measures end-tidal CO_2, if there's no CO_2 then most likely this is an esophageal intubation
6- Pulse oximeter/O_2 saturation is never a reliable factor because you already preoxygenate so it will be a 100% for 3-5 minutes before it start to fall
7- In children we might use CXR to confirm the tube position because in children you will hear air entry everywhere

Rapid sequence induction

Indications:

- Prevent lung aspiration in all emergency cases
  - GERD
  - Last meal less than 6-8 hours
  - Pyloric stenosis
- Full stomach [1]
- Emergency cesarean section.
- Slow gastric emptying

Technique:

01 Preoxygenation for 2-3 mins

02 IV induction with sux [2]

03 Cricoid pressure [3]

IMPORTANT

04 Intubate, inflate the cuff, confirm position

05 Release cricoid and fix the tube

Immediate Intubation complication

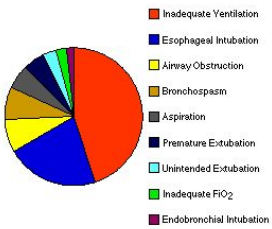
IMPORTANT

- Inadequate ventilation one side usually the right side.
- Esophageal intubation
- Airway obstruction from aspirations
- Bronchospasm asthma, secretions
- Aspiration full stomach
- Trauma to the soft palate- gum- teeth- nose.
- Stress response increased BP & HR specially in cardiac Pt and cause ischemia or infarction, you have to be quick

Late Intubation complication

IMPORTANT

- Ischemia around trachea lead to stenosis
- Granuloma formation
- Fistula formation



Problems with ETT and cuff:

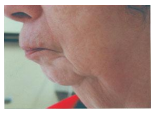
- Too long: endobronchial intubation
- Too short: accidental extubation
- Too large: trauma to surrounding tissues.
- Too narrow: increased airway resistance.
- Too soft: kinks
- Too hard: tissue damage.
- Poor curvature: difficult to intubate
- Cuff insufficiently inflated: allows leaking and aspiration.
- Cuff excessively inflated: pressure necrosis
- Prolonged placement: vocal cord granulomas, tracheal stenosis [4].

1- Pregnant, not fasting, trauma, obese, or any pt of high risk aspiration.
2- Succinylcholine, ultrashort acting depolarizing muscle relaxant
3- When you push the cricoid cartilage (continuous/complete cartilage) you close the esophagus & prevent the passage of food to the trachea
4- Mainly in ICU patients.

Difficult airway

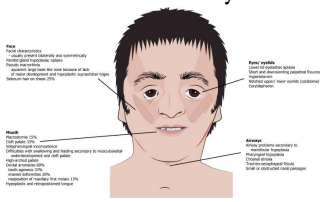
Causes

- congenital [1]
- acquired [2]

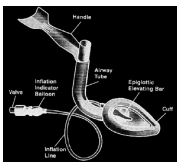


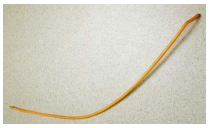
Difficult intubation

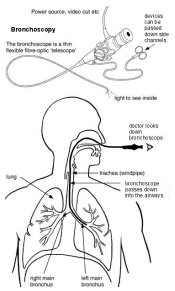
- Mallampati grade 3 & 4
- Treacher-Collin syndrome



Difficult airway gadgets

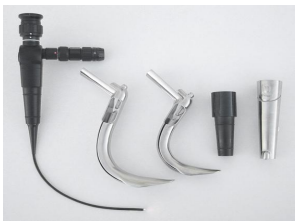






Rigid fiberoptic scopes

Bullard



Wu scope

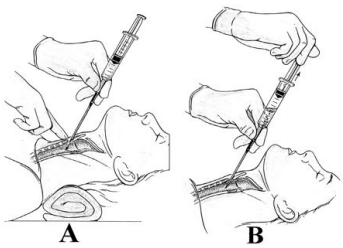
Upsher

Glidescope

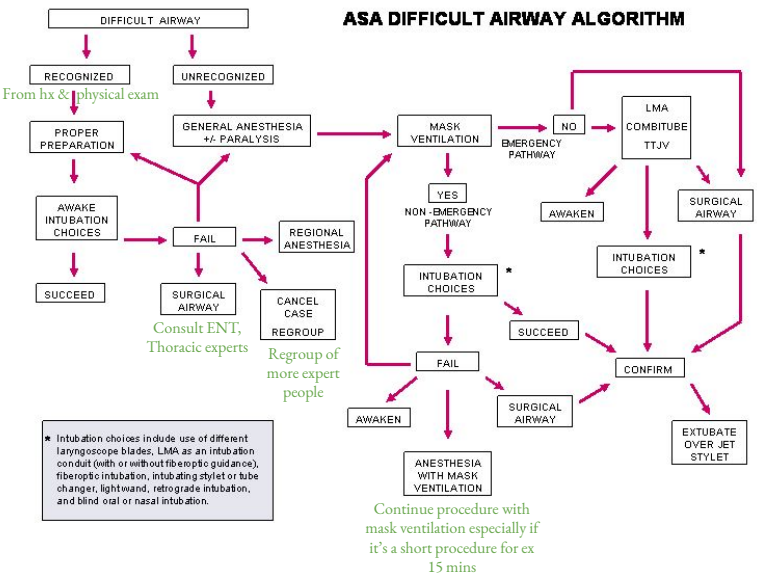
Management of difficult airway [3,4,5]

- Expected from history, examination: Secure airway while awake under LA
- Unexpected different options:

Priority for maintenance of patent airway and oxygenation



Transtracheal Jet Ventilation [6]



1- A lot of pediatric cases, Turner syndrome, Pierre Robin syndrome, Down syndrome: cervical subluxation and mouth atrophy
2- Obesity, thyroid/goiter, burn victim, trauma, submandibular mass, fractures, rheumatoid arthritis, surgical procedure around the neck
3- Use LMA, combtitue in case of difficulty
4- For thyroid/goiter we can't do it with regional anesthesia it has to be general but if it's for hernia repair and patient have difficulty intubation then we can go for regional anesthesia
5- Emergency pathway if patient is hypoxic and have both difficulty in intubation & ventilation
6- Needle puncture on the trachea connected to high resistance tube, then it will be connected to a bunch bag to provide O2.

Ventilation

- Spontaneous ventilation
- Controlled ventilation → Pressure cycled and volume cycled ventilator
  - Tidal Volume 10 mls/kg
  - Respiratory rate to maintain normocarbia
  - I:E ratio
  - PEEP

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 [1]

General guidelines ..

1 check that neuromuscular function and hemodynamic status is normal [2]

2 check that the patient is breathing spontaneously with adequate rate and tidal volume

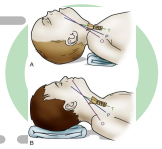
3 allow patient to breathe 100% O2 for 3-5 minutes

4 suction secretions from pharynx

5 deflate cuff, remove ETT on inspiration (vocal cords abducted)

6 ensure patient breathing adequately after extubation

7 ensure face mask for O2 delivery available



8 proper positioning of patient during transfer to recovery room, e.g. sniffing position, side lying.

1- Don't do it unless the patient is stable (Normal & adequate breathing, oxygen saturation is more than 95% , normal HR, BP and temperature and there is no surgical or medical contraindication.
2- First minimize anesthetic agent and give full muscle relaxant reversal

Oxygen delivery system

01 Nasal cannulae [1]

- inspired oxygen concentration is dependent on the oxygen flow rate, the nasopharyngeal volume and the patient's inspiratory flow rate.
- Increases inspired oxygen concentration by 3-4%.
- Oxygen flow rates greater than 3 liters are poorly tolerated by patients due to drying and crusting of the nasal mucosa

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

02 Face mask

Three types of facemask are available; open, Venturi, non-rebreathing.

Open facemasks:

- 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 [2]
- Maximum inspired oxygen concentration ~ 50-60%.

Venturi facemasks:

- They should be used in patients with **COPD/emphysema** where accurate oxygen therapy is needed.
- Arterial blood gases can then be drawn so correlation between oxygen therapy for hypoxemia [3] and potential risk of CO2 retention can be made.
- Masks are available for delivering 24%, 28%, 35%, 40%, 50%.

Non-rebreathing face masks: 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 O2 concentration: non-rebreathing + bag

1- Deliver low flow oxygen, comfortable for eating and talking especially for children and elderly patients
2- Rebreathing means that O_2 mixes with CO_2
3- Normally the body will compensate by high CO_2 and breath but for them the decrease in O_2 (hypoxia) will stimulate them to breathe, So we give them low flow O_2 (24-50%) so that we don't correct the hypoxia.

Lecture Quiz

answers: 1(B) 2(A) 3(D) 4(B) 5(A)

Question 1: What is the most significant disadvantage of the laryngeal mask airway (LMA) over an endotracheal tube?

A. Failure to provide a competent airway
B. Risk of pulmonary aspiration
C. Unreliable replacement
D. Enhanced risk of tube obstruction

Question 2: If tracheal intubation is difficult after induction of general anesthesia, the most critical factor in electing to continue attempts at oral intubation is ?

A. Availability of trained assistance
B. History of successful intubation
C. Ability to visualize the epiglottis
D. Ability to provide satisfactory mask ventilation
E. Low risk aspiration

Question 3: The very first step to aid a patient who is not breathing is to?

A. Clear the mouth
B. Administer oxygen
C. Apply positive ventilation
D. Open the airway

Question 4: When should a nasopharyngeal airway NOT be used?

A. Patient has gag reflex
B. Patient has clear fluid coming from the ears and nose
C. Patient is not yet comatose
D. Patient is labored breathing but alive

Question 5: When a patient begins to vomit, it is essential that you have a(n) _____ ready to go at the patient's side?

A. Suction unit
B. Oxygen tank
C. Blood pressure cuff
D. Pocket mask

Explanation File

Good Luck

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