Advanced Airway Management in Emergency Care Settings

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Disclosures

I have nothing to disclose.

Objectives

At the completion of this presentation, the participant will be able to:

- Review key components of the airway assessment to help predict the difficult airway.
- Modify current airway management practices to include positioning, passive oxygenation and proper preoxygenation techniques.
- Recall the indications and benefits of push dose pressors during intubation.
- Modify plans of care to support hemodynamic stability during and after intubation.

Assessment of the Airway

Is it patent?

Any abnormal sounds?

Is the patient vocalizing?

Is there an obstruction or potential obstruction?

- Tongue
- Dentures/Teeth
- Vomit, Blood
- Edema
- Foreign bodies

Assessment of Breathing

Rate

Quality

Depth

Accessory Muscle Use

Breath Sounds

Chest Wall Integrity

Pulse Oximetry

Capnography

Mental Status

Indications for Intubation

Apnea

Airway Obstruction

Airway Protection

Respiratory Insufficiency/Failure

Hemodynamic Instability

USE A Checklist

doi: 10.1016/j.amj.2023.12.010
doi: 10.1186/s13049-014-0041-7

Airway Checklist
- Pre-Planning & Roles Confirmed
- Drug Selection & Appropriate Dosing
- Failed Airway Plan Verbalized

Preparation
- Hemodynamics Optimized
- Equipment & IV/IO in Place

Pre-Oxygenation & Position
- High Flow O_2 & NO DESAT
- HOB Elevated to 30°

Equipment/Procedure
- BVM, OPA, PEEP Valve
- ETT & Bougie Ready
- Suction ON & Consider SALAD
- Back Up Devices Immediately Available

Intubation
- SpO_2 Bail Out Threshold Set
- Progressive VL with Visualization Through Cords

Placement Confirmation
- $ETCO_2$ Attached & Lung Sounds Confirmed

Post Intubation Management Plan
- ETT Secured & OG Tube Inserted
- Analgesia & Sedation
- Long Term Paralytic Considered

P’s of RSI

Preparation

Pre-oxygenate

Pre-intubation optimization

Paralysis with Sedation

Positioning

Passing the tube

Proof of placement

Post intubation management

Preparation

Always assume this patient will be a difficult airway and have a full stomach

Will you be able to perform a successful surgical airway, if needed?

Prepare equipment

Do an airway assessment

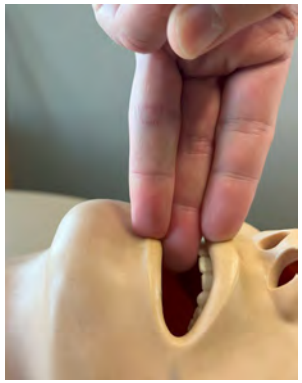
LEMON

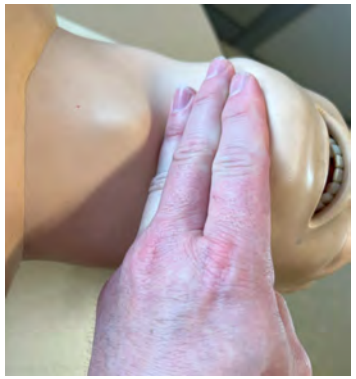
commons.wikimedia.org/wiki/File:Pitt-rogers-danks_syndrome.jpg (CC BY 2.0)

Look at face and neck anatomy, is it normal?

Evaluate the 3-3-2 rule

- 3 of the patient's fingers between their upper and lower incisors
- 3 fingers along the mandible from the chin posteriorly
- 2 fingers from the laryngeal prominence to the floor of the mouth





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LEMON

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Evaluate the 3-3-2 rule

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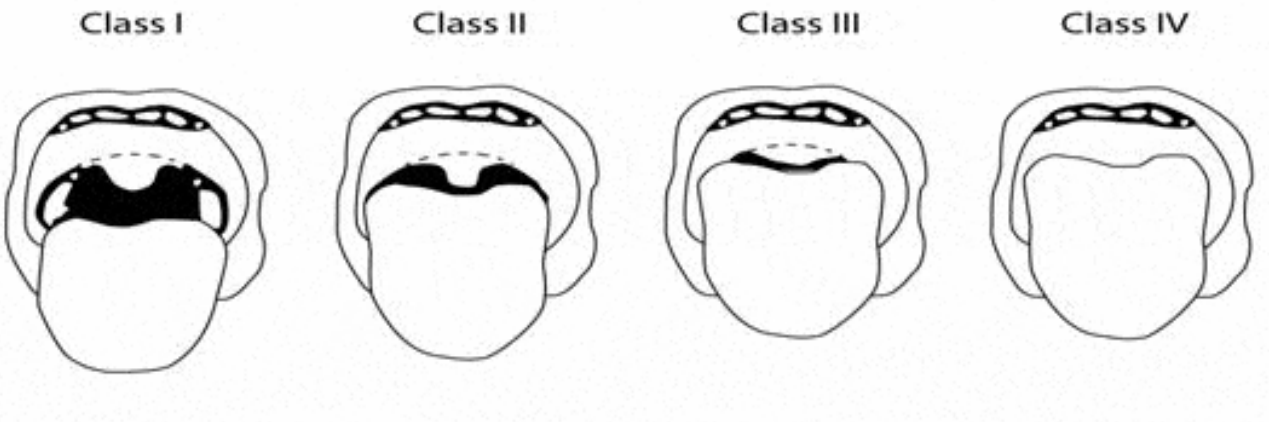
Mallampati

Obstruction, is there one present?

Neck mobility

Mallampati

Low Utility with Emergent Airway Management



Mallampati class:	I	II	III	IV
Photographic example:				
Visualized intraoral anatomy:	Soft palate, fauces, uvula, anterior and posterior pillars	Soft palate, fauces, uvula	Only soft palate, base of uvula	The hard palate but not the soft palate
Implications:	Generally associated with an easy intubation	Generally associated with an easy intubation	Potential for intubation difficulty	Potential for intubation difficulty

*Based on references 16–19, 21. The Mallampati classification compares tongue size with the oropharyngeal space. To correctly perform the test, the patient must fully open the mouth and extend the tongue.

HEAVEN

doi.org/10.1186/s13049-019-0614-6
doi.org/10.1016/j.jemermed.2017.12.005
doi.org/10.1016/j.amj.2017.04.001

Hypoxemia – $SpO_2 \leq 93\%$ at the time of initial laryngoscopy

Extremes of size – pediatric patient ≤ 8 years of age or clinical obesity

Anatomic challenges – any structural trauma or abnormality or foreign body that is anticipated to limit laryngoscopic view

Vomit/blood/fluid – clinically significant fluid noted in the pharynx/hypopharynx prior to laryngoscopy

Exsanguination – suspected anemia, either chronic or acute, raises concerns about limiting safe apnea times

Neck mobility issues – limited cervical range-of-motion

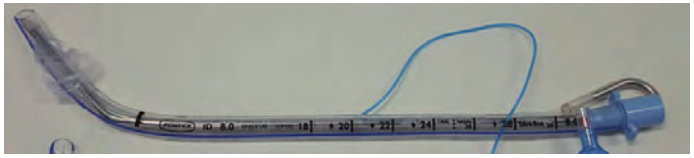
Pediatrics

Anatomical Differences

- Larynx is more anterior and cephalad
- The epiglottis is U shaped and protrudes more
- The narrowest portion of the airway is at the cricoid cartilage

Sizing ET tubes

- Weight based resuscitation tape
- (Age / 4) + 3.5 = cuffed tube size
- The patient's little finger or nare



www.researchgate.net/publication/313781180_Stylet_angulation_for_routine_endotracheal_intubation_with_McGrath_videolaryngoscope

Preparation

Equipment

- Laryngoscope &/or **Videoscope**
- ETT
- Stylet &/or **Bougie**
- BVM w/ OPA & PEEP valve
- Suction
- $ETCO_2$ device
- Securing device
- Back up device(s)

Position the patient

- C-Spine control, if needed
- Head of bed up
  - Towel rolls, blankets, pillows under the shoulders/neck, if needed

Monitoring equipment

- ECG
- NIBP
- SpO_2
- $ETCO_2$

Pre-oxygenation

Elevate HOB

High flow O_2 via NRB for 3-5 minutes provides a nitrogen washout of the lungs

Avoid positive pressure ventilation, if possible

O_2 15L via N/C (NO DESAT, ApOx)

- HFNC may be better

If needed, consider NiPPV or BVM w/ PEEP

What is your SpO_2 goal?

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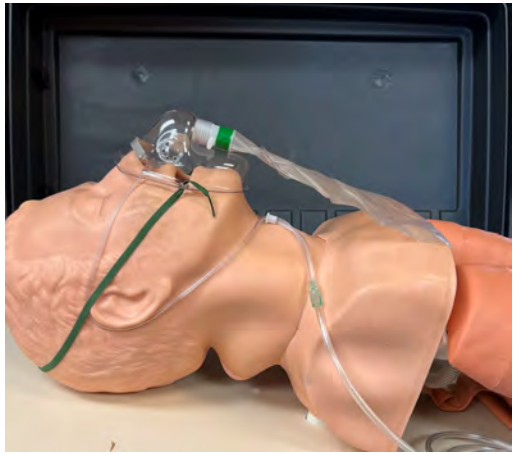


doi: 10.1016/j.annemergmed.2011.10.002
doi: 10.1111/acem.12931
doi: 10.1097/00000542-200506000-00009

Airway Adjuncts

Size – measure from the corner of the mouth to the angle of the mandible

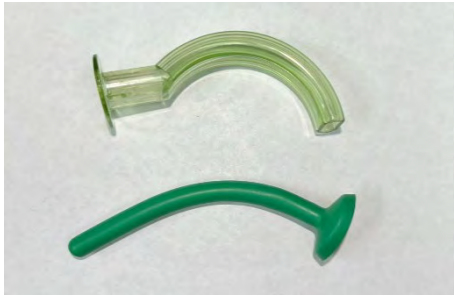
Insertion – depress tongue with a tongue blade or rigid suction, insert over tongue

Contraindications

Size – measure from the nose to the angle of the mandible

Insertion – lubricate, then insert beveled edge against the nasal septum

Contraindications



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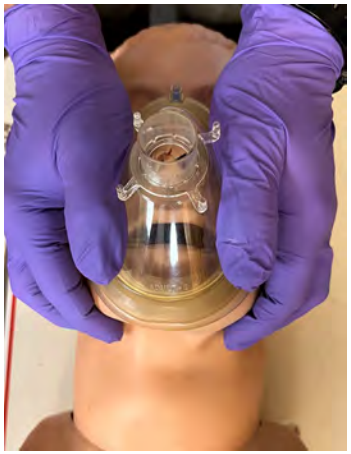
BVM – Which is Best?

Least Effective

It Works



The BEST

Image Credits:
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doi: 10.1007/s12630-019-01394-9

ROMAN

Patients who are Difficult to Mask Ventilate

- Radiation/Restriction (poor lung compliance)
- Obese/Obstruction/OSA
- Mask seal/Male/Mallampati
- Age > 55 years
- No teeth

How Should the Patient be Positioned?

Ear-to-Sternal Notch

www.emdocs.net/novel-tips-airway-management (CC BY 4.0)

Why is Pre-ox so Important?

Davis, Hwang, & Dunford (2008)

- EMS - Lower SpO_2 values were associated with a faster rate of SpO_2 decline, with an inflection point occurring at 93%. The rate of desaturation to hypoxemia with intubation attempts initiated with $SpO_2 \leq 93\%$ was much higher than with $SpO_2 > 93\%$ (100% vs. 6%, $p < 0.01$).

Bodily et al. (2016)

- ED - 1 in 3 patients undergoing RSI experienced a desaturation for a median duration of 80 seconds. Preintubation $SpO_2 < 93\%$ (OR 5.1; 95% CI 2.3 - 11.0), multiple intubation attempts (OR 3.4), and prolonged intubation time (OR 2.7) are independently associated with oxygen desaturation.

Pre-intubation Optimization

How are their hemodynamics?

Shock Index (SI) – Adults

- HR / SBP
- 0.5-0.6 = normal
- > 1 = critical shock state

Shock Index, Peds Adjusted (SIPA)

- Ages 4-16
- Max HR / minimum SBP
- Compared to normal values for age

"Resuscitate before you Intubate"

- Volume/Blood
- Injury management
  - Pelvis
  - Tension pneumothorax
- Push dose pressors
  - Epinephrine 5-20 mcg IV *
  - Phenylephrine 100-200 mcg IV *

*** = off label use**

Premedications

Lidocaine 1.5 mg/kg IV *

- Most no longer recommend or use
- May blunt sympathetic response & ICP spike
- Must be given at least 3 mins prior to induction

Fentanyl 1 mcg/kg IV *

- May blunt sympathetic response in stable patients

Atropine 0.02 mg/kg IV

- Peds < age 1 to prevent bradycardia
- Minimum dose 0.1 mg

*** = off label use**

Induction

Etomidate

- 0.3 mg/kg IV
  - Consider half dose in shock states
- Ultra short acting hypnotic
- Onset: < 1 minute
- Duration: 3-5 mins
- Minimal, if any effect on cardiovascular system
- May reduce ICP
- May suppress cortisol secretion, not intended for repeated doses
- May cause trismus

Induction

Ketamine *

- 1-2 mg/kg IV; 2-4 mg/kg IM
- Onset: 1-5 mins
- Duration: 5-30 mins
- Dissociative agent with analgesic properties
- Catecholamine release
  - Bronchial relaxation
- May consider administration with atropine or glycopyrrolate to help with increased salivation
- Contraindicated with ischemic events and hypertensive crisis
- May cause emergence nightmares, administration with a benzodiazepine may limit this effect

*** = off label use**

Etomidate v. Ketamine

Wunsch et al. (2024)

doi: 10.1164/rccm.202404-0813OC

1,689,945 patients who were intubated and admitted to an ICU for mechanical ventilation

43.7% received etomidate, with propensity score matching to ketamine

Hospital Mortality

- Etomidate v. ketamine, 21.6% v. 18.7%
- Absolute risk difference, 2.8%, 95% CI, 2.1% - 3.6%
- aOR 1.28, 95% CI 1.21 - 1.34
- Use of corticosteroids did not impact mortality

Upchurch et al. (2017)

doi: 10.1016/j.annemergmed.2016.08.009

968 trauma patients requiring intubation in the ED

- Etomidate = 526
- Ketamine = 442

Hospital Mortality

- Etomidate v. ketamine, 17.3% v. 20.4%
- aOR 1.41, 95% CI 0.92-2.16
- Similar ICU-free and ventilator-free days in each group

Induction

Propofol *

- 1.5 mg/kg IV
- Onset: < 1 min
- Duration: 3-5 mins
- Should be avoided in hypotensive or unstable patients
- No longer contraindicated with egg or soy allergies
- **May be associated with more complications when used for emergent RSI**

Midazolam *

- 0.1 mg/kg IV/IM
- Onset: 1-5 mins
- Duration: 2-6 hrs
- Associated with higher risk for hypotension and respiratory depression

*** = off label use**

Neuromuscular Blockade (NMB)

Succinylcholine

- 1-2 mg/kg IV; 3-4 mg/kg IM
- Onset: 1-2 minutes
- Duration: 8-10 minutes
- Depolarizing muscle paralytic
- May cause bradycardia in pediatrics
- Avoid in patients with history of malignant hyperthermia and known or suspected hyperkalemia
  - Chronic renal disease
  - Major burns > 24 hours old
  - Major crush injuries

Neuromuscular Blockade (NMB)

Rocuronium

- 0.8-1.5 mg/kg IV/IM
- Onset: 1-2 minutes
- Duration: 20-40 minutes
- Nondepolarizing muscle paralytic
- Alternative to succinylcholine

Keep It Simple

1.5 mg/kg for IV induction

- Ketamine
- Propofol
- Succinylcholine
- Rocuronium

Now Let's Do This

Do a Time Out

Re-run a checklist

What are your back up plans?

What is your bail out point?

Position the patient

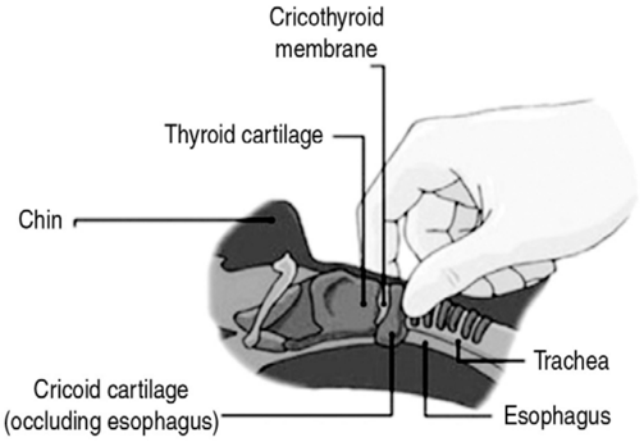
Give meds

Wait

Open c-collar and do manual inline, if applicable

Oral Intubation

- Cric Pressure (Sellick's Maneuver)



www.researchgate.net/figure/Sellick-maneuver-The-application-of-pressure-to-the-cricoid-cartilage_fig3_309818535 (CC BY-NC 3.0)

- ELM (External Laryngeal Manipulation)

www.emcurious.com/blog-1/2014/11/19/modified-bimanual-laryngoscopy (CC BY 4.0)

Suction

Always lead with suction

Suction

Assisted

Laryngoscopy

Airway

Decontamination

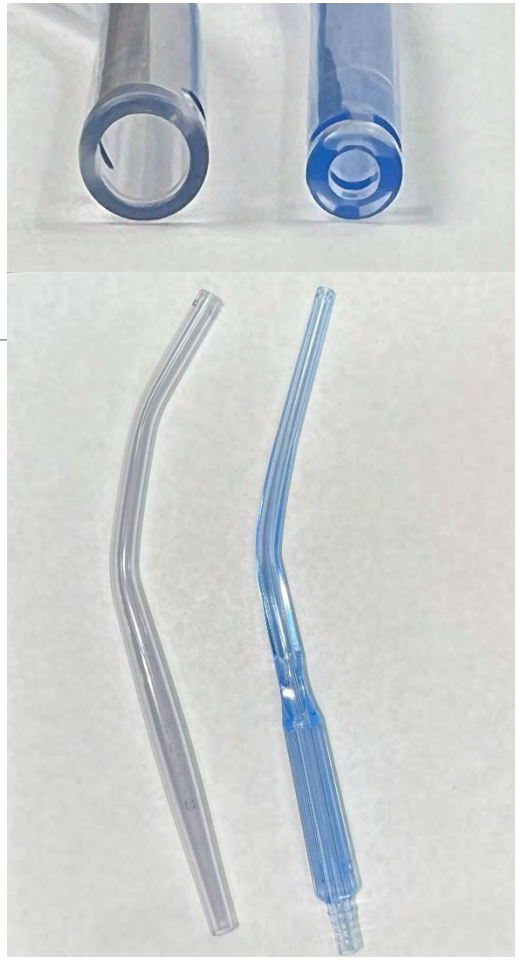
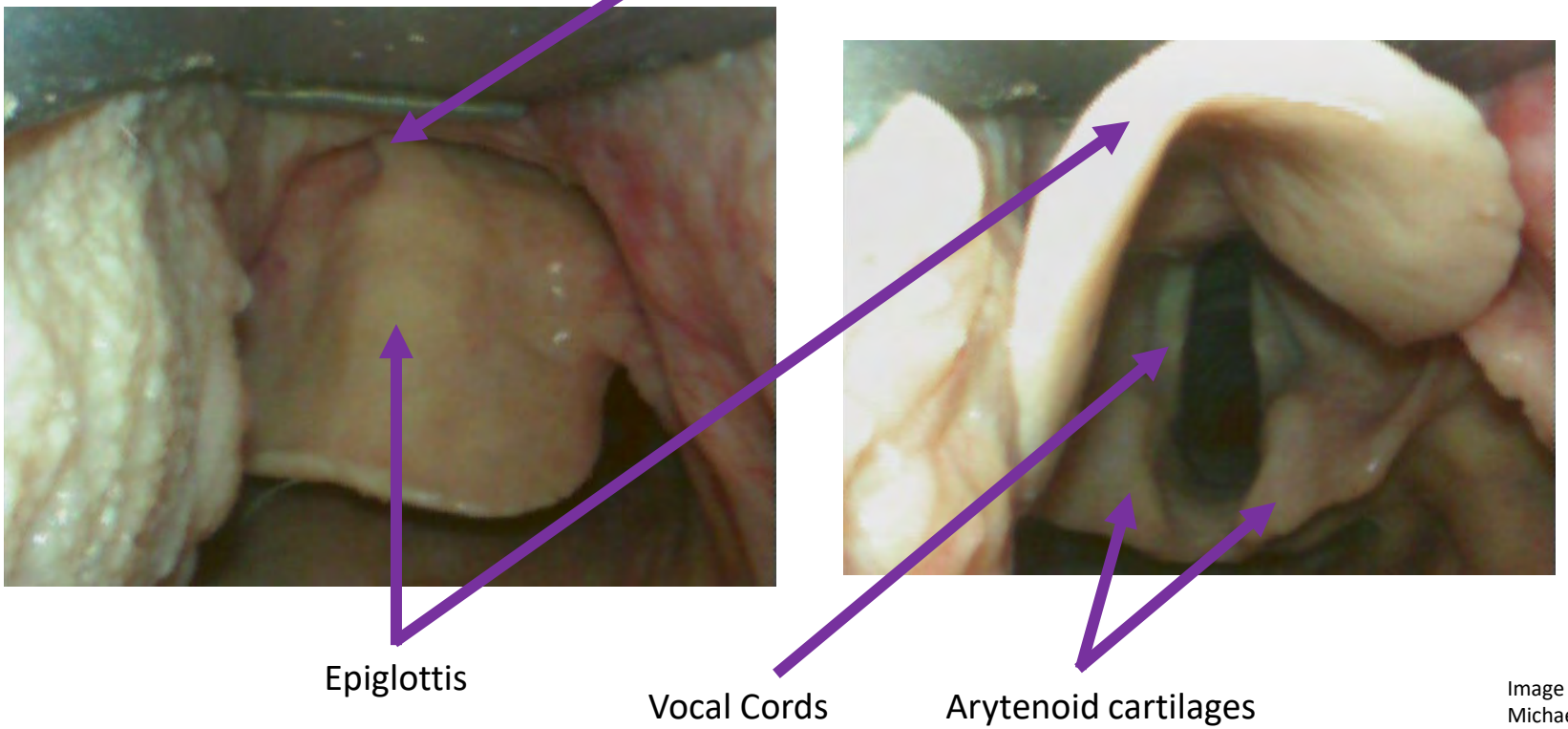


Image Credits:
Michael Gooch

doi: 10.1016/j.resplu.2020.100005
doi: 10.1016/j.amj.2019.10.005
doi: 10.5811/westjem.2016.9.30891

Anatomy



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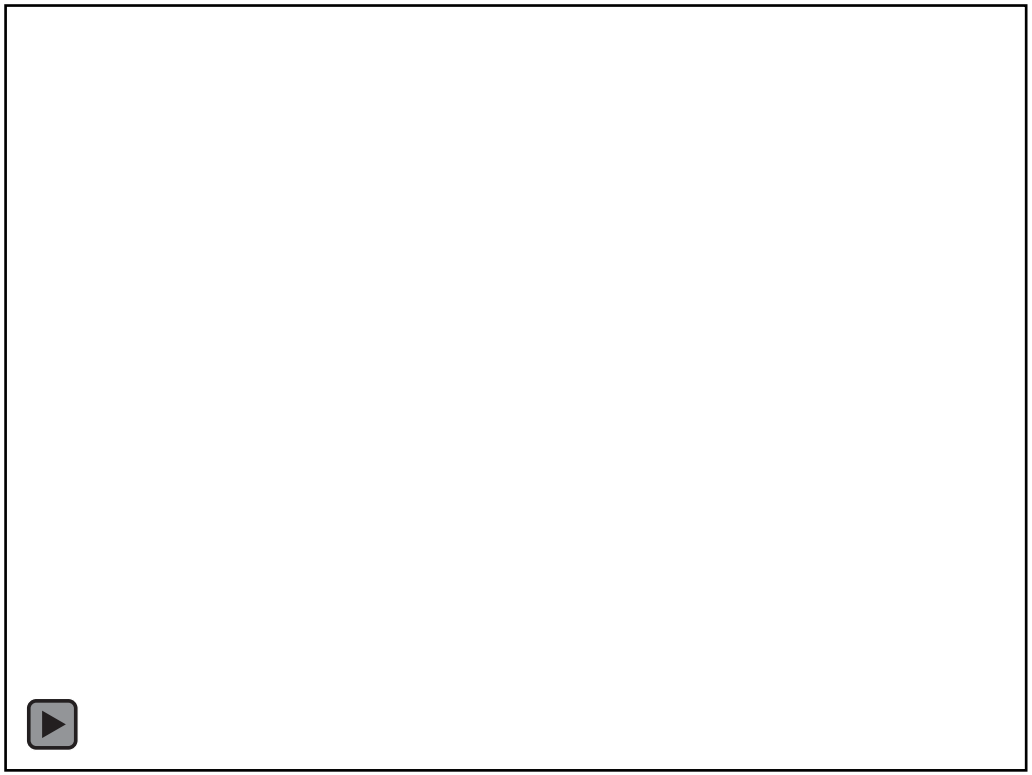
Progressive Laryngoscopy



Video Credit:
Michael Gooch

Why Do Progressive Laryngoscopy?

To Avoid This

Image Credits:
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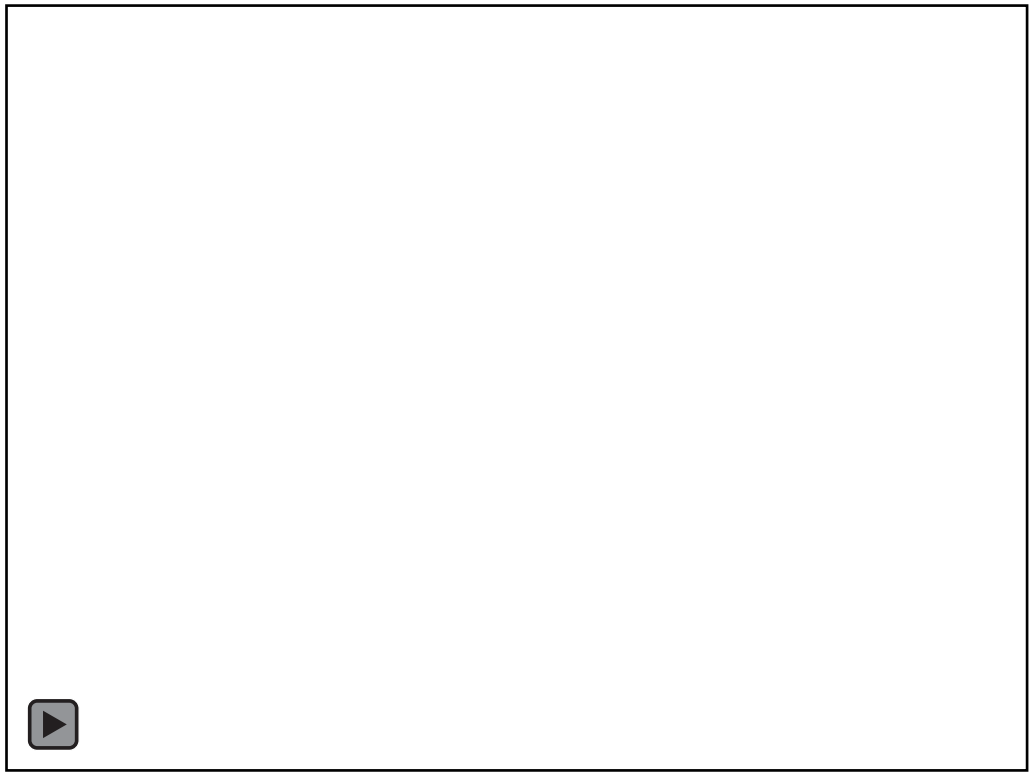
Bougie Intubation



Video Credit:
Michael Gooch

Proof of Placement

Visualize the tube passing through the cords

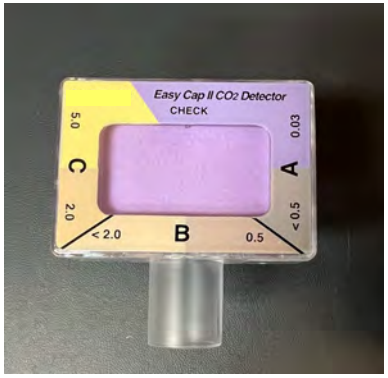
Absence of epigastric sounds

Bilateral lung sounds

$ETCO_2$ qualitative and/or quantitative measurement

Esophageal detector device

Chest wall excursion



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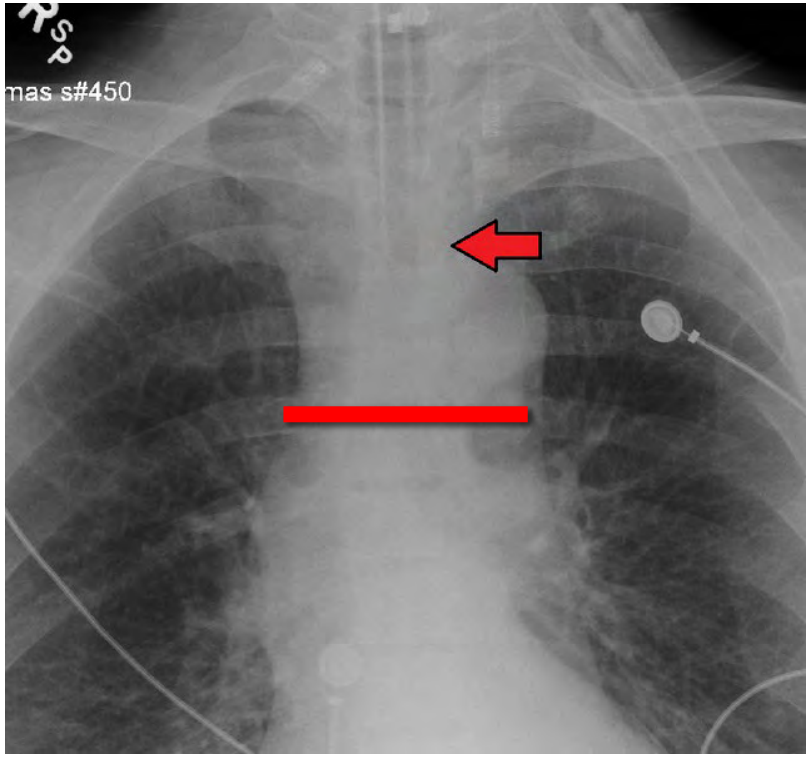
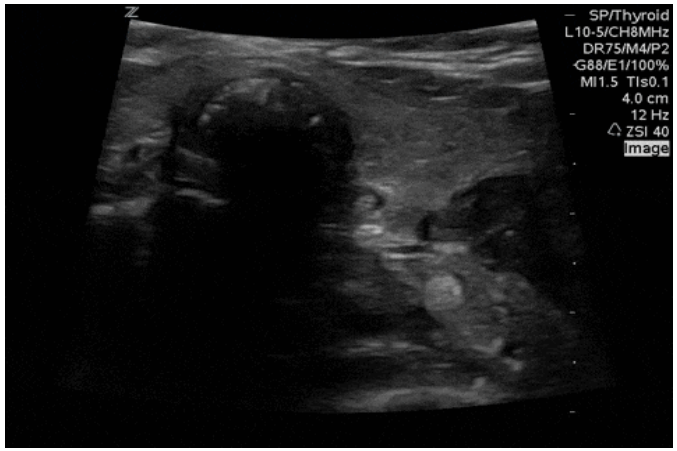
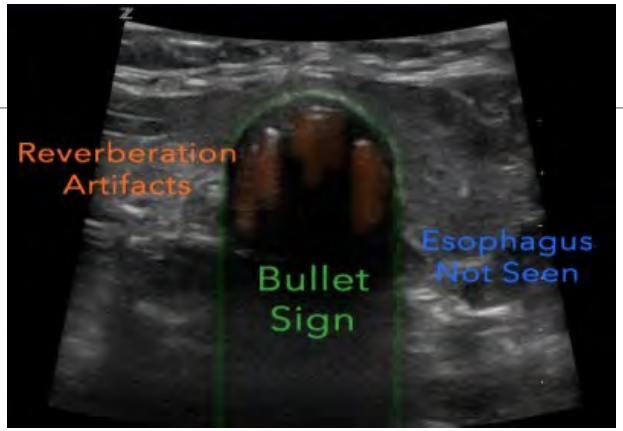
Properly Placed ETT



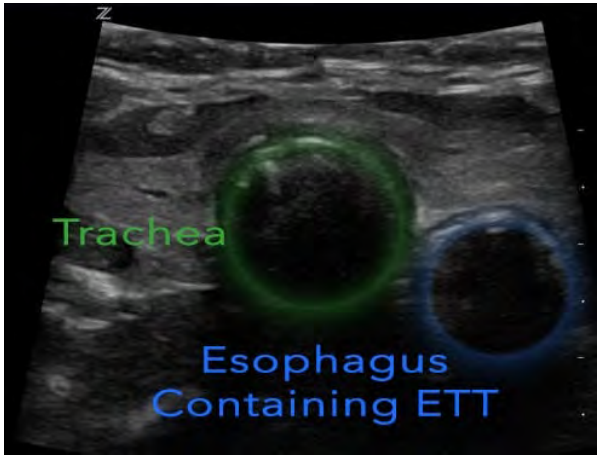
commons.wikimedia.org/wiki/File:ETtube GoodPosition.png (CC BY-SA 4.0)

Ultrasound





GOOD



BAD

rebelem.com/pocus-for-endotracheal-tube-confirmation (CC BY-NC-ND 3.0)

Troubleshooting the Airway

Displaced

Obstructed

Pneumothorax

Equipment

What if you Are Not Successful?

What is their SpO_2?

- If needed, ventilate and re-oxygenate
- Mask ventilation works
  - Do not forget the OPA/NPA & PEEP valve

Change something about your next attempt

Let the drugs wear off?

Sugammadex can be used to reverse rocuronium and vecuronium only

Consider an extraglottic device

Ask for HELP

Post Intubation Management

Secure the ETT

Long term sedation

- Midazolam
  - 0.1 mg/kg IV
  - 0.02-0.1 mg/kg/hr IV
- Ketamine
  - 1-2 mg/kg IV
  - 0.1-0.5 mg/min IV
- Propofol
  - 5-50 mcg/kg/min IV
- Lorazepam *
  - 0.1 mg/kg IV
  - Onset: 1-5 mins

Analgesia

- Ketamine *
- Fentanyl *
  - 1 mcg/kg IV
  - 0.5-1.5 mcg/kg/hr IV

*** = off label use**

Post Intubation Management

Long term paralytics – always with sedation

- Rocuronium
- Vecuronium
  - 0.1 mg/kg IV
  - Onset: 2-3 minutes
  - Duration: 30-60 minutes
- Cisatracurium
  - 1-2 mcg/kg/min IV
  - Onset: 2-3 minutes
  - Duration: 20-30 minutes after IV bolus

Gastric Decompression

Extraglottic Airways/Devices

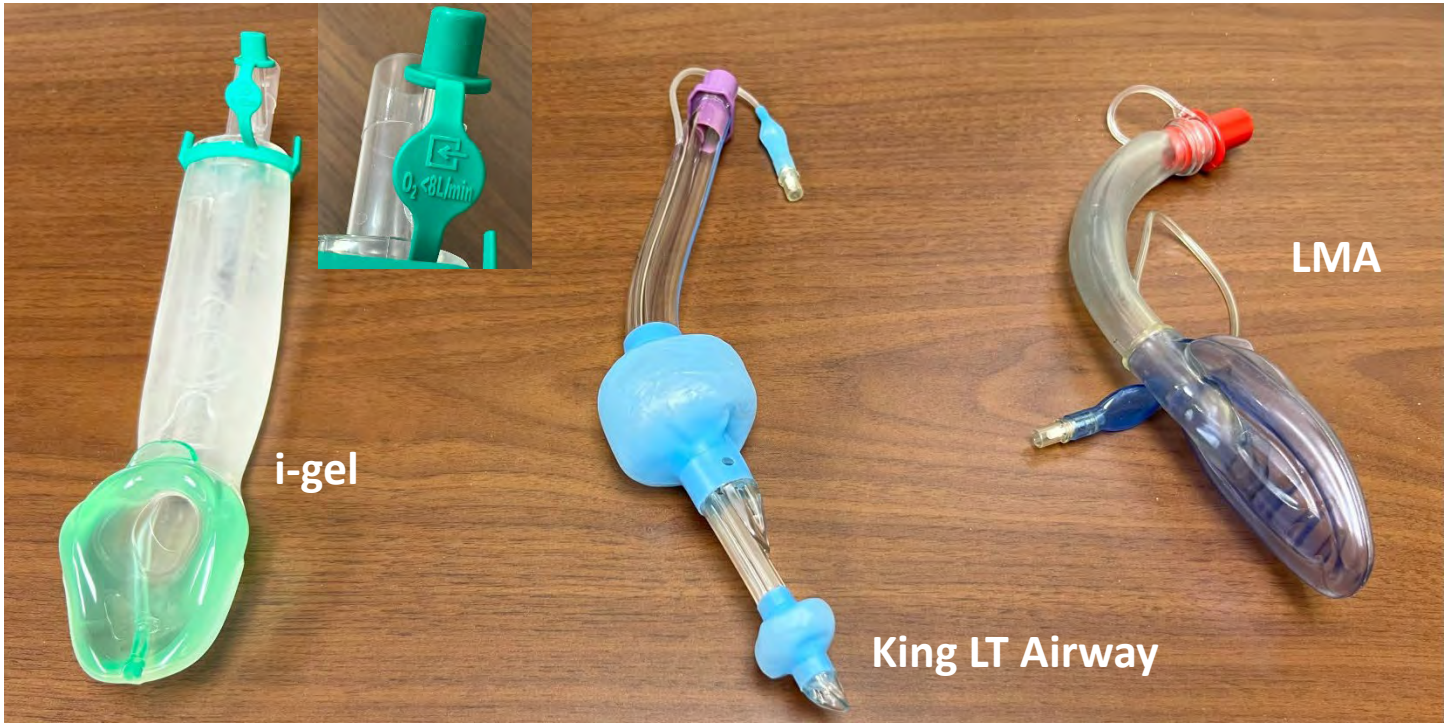


Image Credits:
Michael Gooch

RODS

Patients who may be difficult to place an extraglottic

- Restricted mouth opening
- Obstruction
- Disrupted
- Stiff lungs/c-spine

Delayed Sequence Intubation (DSI)

Weingart (2011)

Use of sedation to facilitate or improve preoxygenation

- NRB
- NiPPV

Once SpO_2 goal reached

- Re-sedate, if needed
- Give NMB agent
- Proceed with intubation

Ventilator Settings

Volume Ventilation

- Assist Control Ventilation (A/C)
  - TV and Rate are set
  - Patients can take spontaneous breaths
  - All breaths trigger the full set TV
  - Patients do best with this mode when sedated and paralyzed
- Synchronized Intermittent Mandatory Ventilation (SIMV)
  - TV and Rate are set
  - Patients can take spontaneous breaths
  - The ventilator attempts to synchronize mandatory breaths with spontaneous breaths
  - Spontaneous breaths do not receive the full set TV
  - This mode is best when patients are not paralyzed or heavily sedated

Ventilator Settings

Pressure Ventilation

- Breaths are delivered based on a set pressure
  - Most start at 20 cm H_2O
- TV varies with lung compliance
- This mode can reduce incidence of Ventilator Induced Lung Injury
- This mode does not guarantee a set minute ventilation
- Pressure Controlled Ventilation (PC)
  - Delivers an inspiration breath to a set limit
  - RR, Pressure, and inhalation time are set
  - Spontaneous breaths are assisted to reach the set pressure

Ventilator Settings

Tidal Volume (TV)

- 4-8 ml/kg of Ideal Body Weight (IBW)
- Males: IBW = 50 kg + 2.3 kg for each inch over 5 feet
- Females: IBW = 45.5 kg + 2.3 kg for each inch over 5 feet

Peak Inspiratory Pressure (PIP)

- Measurement of the pressure in the lungs at the peak of inspiration
- Set in pressure controlled ventilation
  - Should allow a TV of 6 – 7 mg/kg IBW
- In volume controlled ventilation the PIP varies with TV, PEEP, and I time

Rate

Minute Ventilation

- RR x TV
- 5-8 L/min in adults

Ventilator Settings

Which Settings Address Oxygenation?

FiO_2
- Titrate and avoid hyperoxia

Inspiratory : Expiratory Time (I:E Time)
- I time = TV / flow rate
- Normal is 1:2 or 1:3
- Patients with reactive and obstructive airway disease benefit from longer expiratory times

Positive End Expiratory Pressure (PEEP)
- Increases functional reserve capacity (FRC), by recruiting alveoli
- 5-20 cm H_20

Ventilator Induced Lung Injury (VILI)

Barotrauma

- Causes rupture of the alveoli and migration of air into extrapulmonary spaces
- May be related to high airway pressures
  - Keep plateau pressure < 30 cm H_2O
- Can lead to a pneumothorax

Volutrauma

- Results from high volumes and over distension of the alveoli – dynamic hyperinflation
- Results in microvascular injury, impaired surfactant function, and the development of pulmonary edema

Hemodynamic Concerns?

Image Credit:
Office 365

P's of RSI

Preparation

Pre-oxygenate

Pre-intubation optimization

Paralysis with Sedation

Positioning

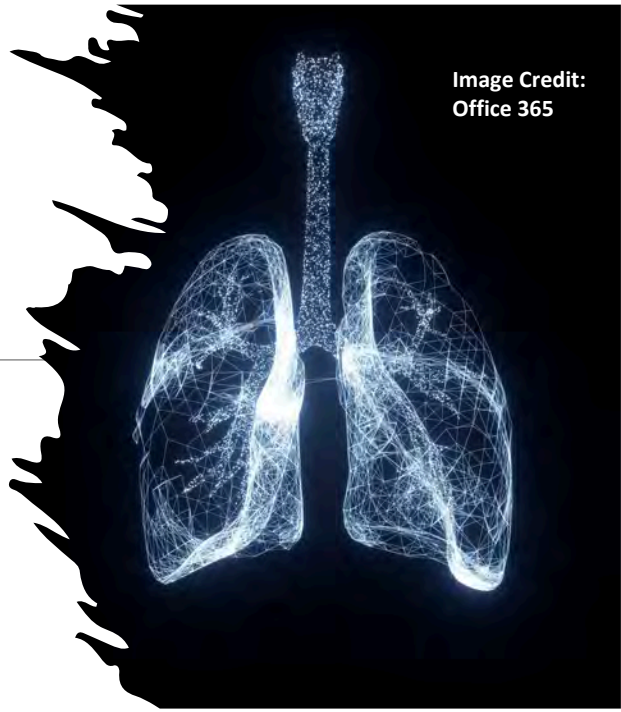
Passing the tube

Proof of placement

Post intubation management

USE A CHECKLIST!

Questions



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