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Advanced Emergency Trauma Course

Airway and Ventilator Management

Presenter: Daniel Wachter, MD

Ghana Emergency Medicine Collaborative

Patrick Carter, MD • Daniel Wachter, MD • Rockefeller Oteng, MD • Carl Seger, MD

Essentials of Emergency Airway Management

- Know the anatomy.
- Learn the equipment.
- Learn the techniques - 1^0 and 2^0.
- Develop judgment.

Airway Compromise in Emergency Patients

- **Common Etiologies:**
  - Cardiac failure and arrest
  - Respiratory failure (primary)
  - Neurological diseases
  - Multiple trauma, head injury, burns
  - Toxicological emergencies

Indications for Emergency Airway Intervention

Zen (flickr)

What are the indications?

Indications for Emergency Airway Intervention

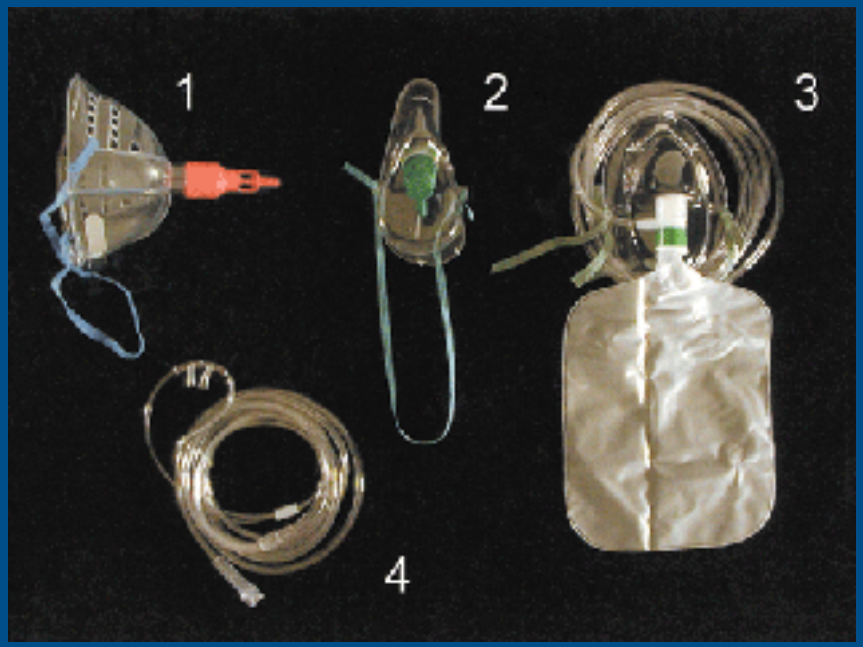
- To correct hypoxemia (oxygenate) or hypercarbia (ventilate).
- To provide a patent, secure airway.
- To facilitate other interventions in critically ill patients (prophylactic).
- *Anticipate need for intubation based on clinical course and likelihood of deterioration.*

Emergency Airway Management

- Options
  - Patency maneuvers
  - Non-invasive ventilation
  - Endotracheal intubation with or without induction and paralytic agents
  - Nasotracheal intubation
  - Adjunct airways
  - Surgical airway

O_2 Delivery Devices

- Venturi Mask
- Hudson Mask
- Nonrebreather
- Nasal Cannula



www.rcsed.ac.uk/ journal/vol46_5/fig-2.gif

O_2 Delivery Devices

- BiPAP/CPAP

PD-INEL Source Undetermined

Rarely works in critical airway cases – is patient DNI?

O_2 Delivery Devices

- Endotracheal tube

PD-INEL Source Undetermined

Patient Risk Factors for Airway Compromise

- Why are these guys scary airway patients?
  - External anatomy
  - Airway Anatomy

Spoony Mushroom (flickr)

http://commons.wikimedia.org/wiki/File:Glidescope_02.JPG

External Anatomy

- Difficult Bag/Mask Ventilation
  - Edentulous
  - Obese
  - History of Snoring/Sleep Apnea
  - Beard
  - Age > 55
  - Anatomically abnormal facies
  - Facial/neck trauma
  - Obstructive airway disease
  - 3rd trimester pregnancy

External Anatomy

- Difficult Intubation
  - Neck trauma
  - Prominent incisors
  - Receding mandible
  - Cervical spine immobilization
    - Eg. bamboo spine, fusion
  - Short, thin neck
  - Anatomically abnormal facies
  - Morbid obesity

Airway Anatomy

- Must know the anatomy cold
  - Anatomic relationship:
    - Tongue
    - Vallecula
    - Epiglottis
    - Vocal Cords

Source Undetermined

Review of Airway Anatomy

- Nasopharynx
- Oropharynx
- Hypopharynx
- Larynx – Laryngoscopic view
  - Must have this burned into your brain in order to be an airway expert

Airway Anatomy

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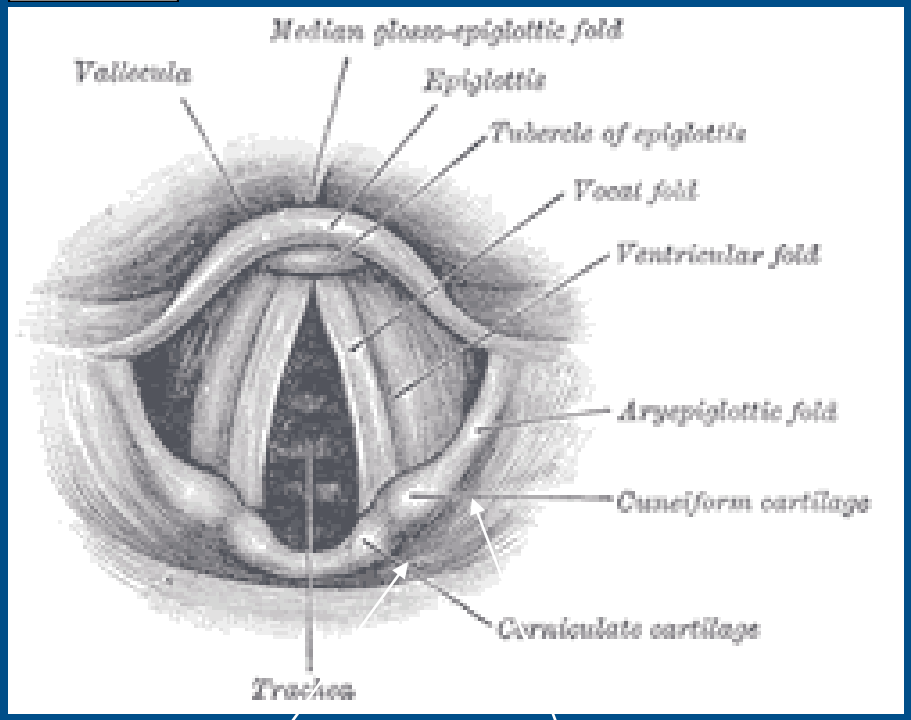
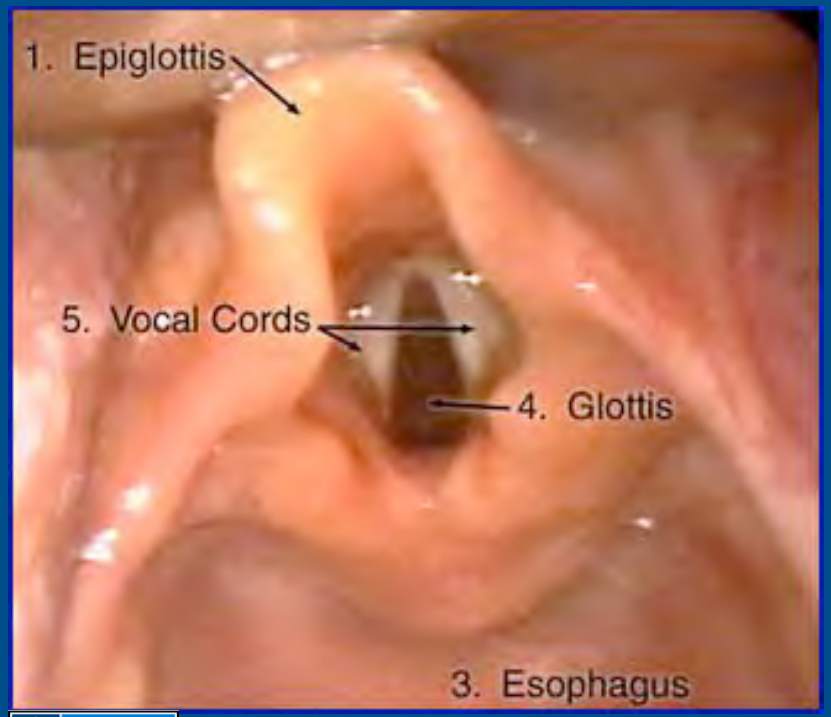
www.medword.com/ pics/Anatomy/Fig956.gif



arytenoids & aryepiglottic folds



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www.aap.org/nrp/ images/CDIMAGE4.JPG

Airway Anatomy

- You MUST know the anatomy
- May be distorted……..

PD-INEL www.bgsm.edu/voice/ images

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http://www.childrensmemorial.org/cme/online/article.asp?articleID=179

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http://www.childrensmemorial.org/cme/online/article.asp?articleID=179

Figure 5—Reinke's edema of the true vocal folds.

Airway Assessment

- Deciding who needs *active* airway management
  - History of prior difficulty intubations
  - Physical Exam Features
    - Obesity
    - Short neck
    - Macroglossia
    - Micrognathia
    - Large teeth
    - Small Mouth
  - Clinical Condition
    - Stable vs. Unstable
    - Active Bleeding
    - Vomiting
    - Need for procedures
    - Other Interventions

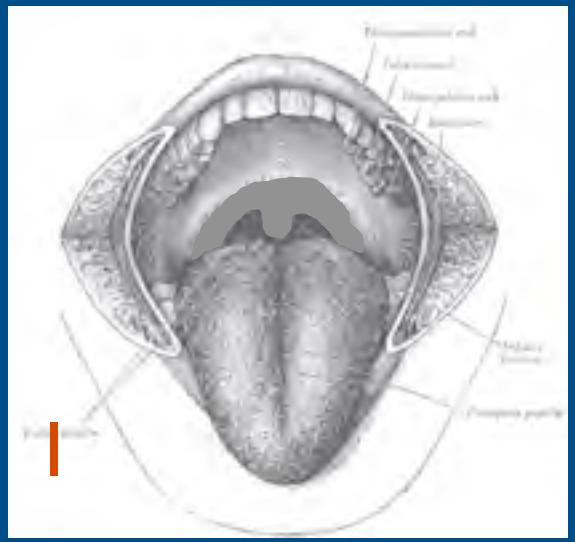
Physical Assessment of Airway Status

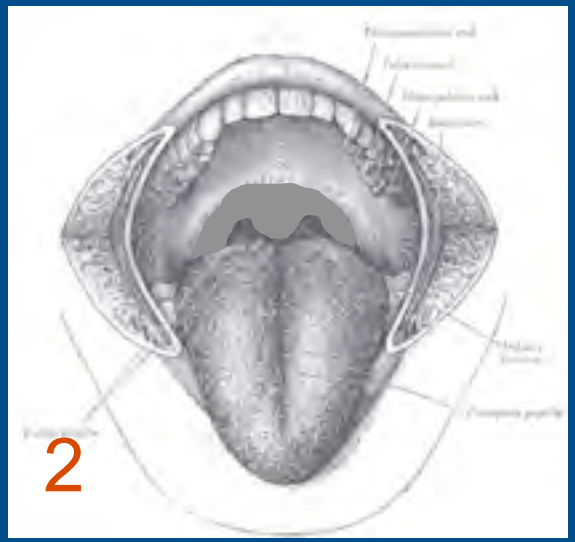
- Vital Signs
  - Respiratory Rate, O2 sat, Blood Pressure, Heart rate
- Mental Status
  - Agitation, Somnolence, Coma
- Airway Patency
  - Secretions, Stridor, Obstruction, Edema
- Ventilation
  - Breath Sounds, Accessory Muscle use, Retractions, Rales, Wheezing

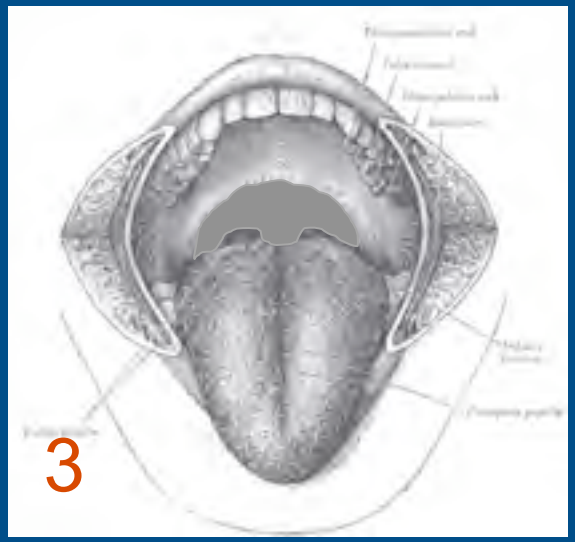
Airway Assessment Techniques

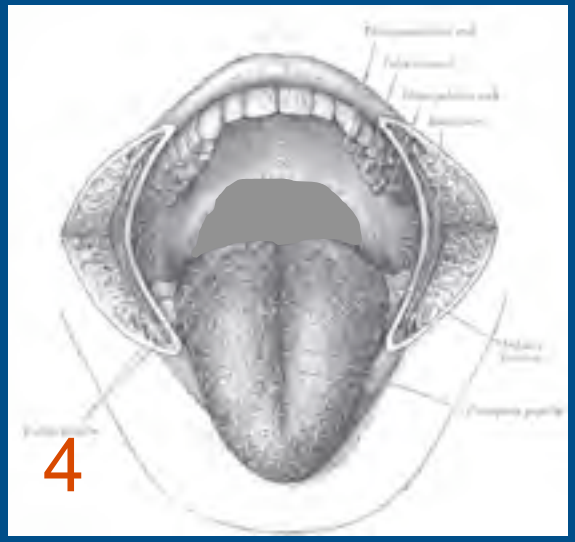
- Mallampati Score
- Mouth Opening
  - 3 fingers between incisors
- Thyromental Distance
  - > 6 cm = “3 fingers”
  - Predicts laryngoscopic geometry
- Adequate Neck Extension
  - Assuming no trauma
- Evaluate for obstruction

Mallampati Classification



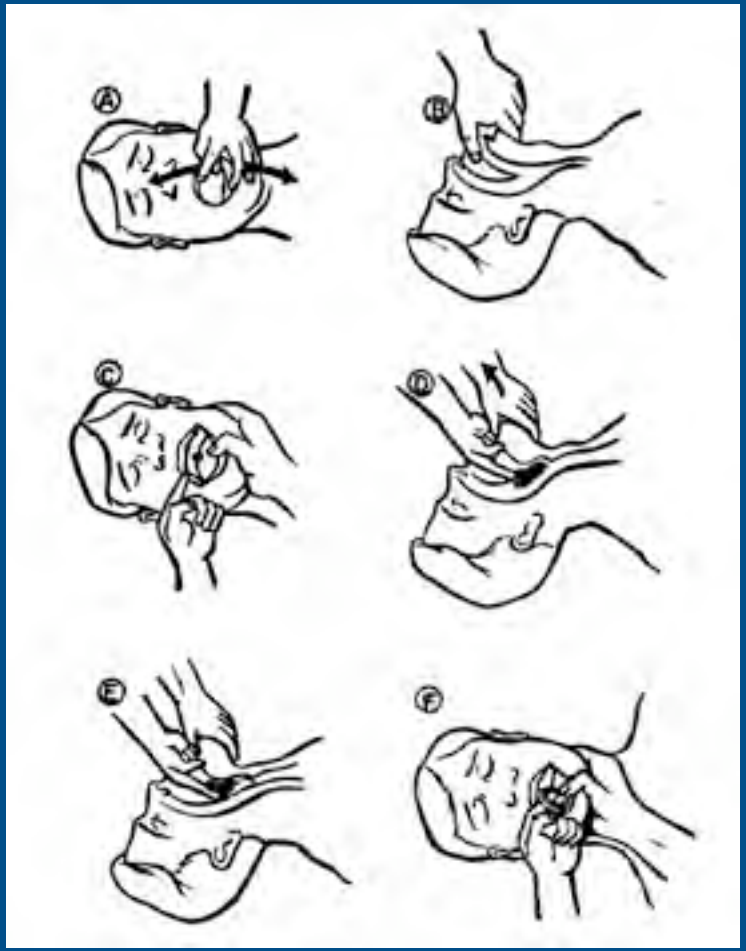






Airway Management Techniques Patency Maneuvers

- Finger sweep of oropharynx



Airway Management Techniques Patency Maneuvers

- Heimlich maneuver or chest thrusts

Airway Management Techniques Patency Maneuvers

- Head tilt with chin lift, or jaw-thrust maneuver

Source Undetermined

Airway Management Techniques Patency Maneuvers

- Suctioning of upper airway

PD-INEL www.anesth.uiowa.edu/

Oral Airway

- Prevents tongue from occluding airway
- Requires absent gag reflex
- Can be used as a bite block
- Place carefully over the tongue
- If patient can tolerate oral airway, they likely need to be intubated

Nasal Airway Device

- Pliable
- Good for sonorous patients
- Lubricate tip; place in most patent nostril
- Go in the inferior and medial portion of the nostril and horizontal to the hard palate

Bag-Valve-Mask Ventilation

- Very important skill to know
  - May provide temporary or definitive airway management.
- One person - importance of a good seal.
- Two person technique more effective.
- In EMS setting may be as useful as endotracheal intubation.

Bag-Valve-Mask Ventilation

Source Undetermined

Oral Endotracheal Intubation

- The BASICS:
  - Use of laryngoscope to provide visualization.
  - Passage of a plastic air conduit through the vocal cords and into the trachea.
- Very difficult (and inadvisable) to do without pharmacological aids
  - Except in patients who are in cardiorespiratory arrest, deeply comatose, or neonates.

Learn the equipment

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Source Undetermined

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Source Undetermined

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Source Undetermined

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Source Undetermined

Equipment and Preparation

- Laryngoscope handle and blade
- Endotracheal tube
- Bag-Valve-Mask
- Suction - large bore
- Meds and good IV line
- Monitor, O2 sat

Laryngoscope Blades

- Miller Blade - (straight blade) -lifts the epiglottis.
- MacIntosh Blade (curved) - placed in vallecula and tilts epiglottis anteriorly.

Ignis (Wikipedia)

Kalumet (Wikipedia)

Laryngoscope Blades

- Age and Blade Size and Type:
  - Premature Infant - 0 Miller
  - Term Infant - 1 Miller
  - Up to Age 2 - 2 Miller or Mac
  - Older children (age > 12), small adults - 3 Miller or Mac
  - Larger adults - 4 Miller or Mac

Endotracheal Tube Sizing

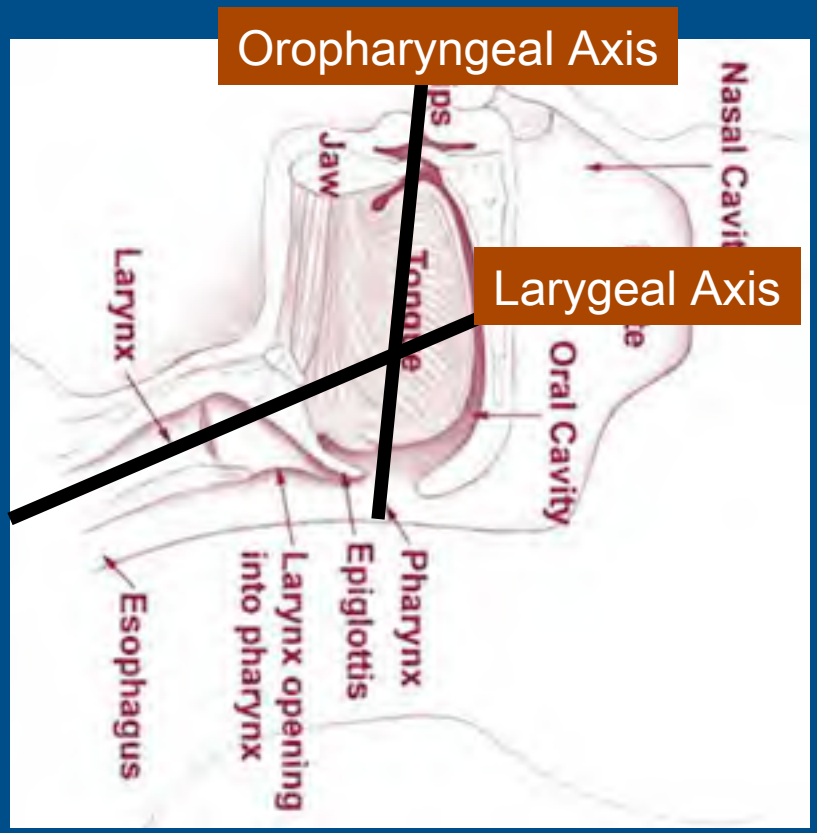
- Premature - 2.5 mm
- Term - 3.0 mm
- Age 6 months - 3.5 mm
- Age 1 year - 4.0 mm
- Formula: 4 + age/4 = tube size
- “Age 8 is enough for a cuff”

Endotracheal Intubation
The Mechanics

- Adequate bed height and patient positioning.
- Open mouth and remove dentures.
- Hold blade in left hand!
- Sweep tongue from right to left.
- Avoid the teeth.
- Airway can be externally manipulated by person holding cricoid pressure. BURP maneuver.

Endotracheal Intubation The Mechanics

- Position patient
  - Align oropharyngeal & laryngeal axis - Very important!



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National Cancer Institute: Head & Neck Overview

Endotracheal Intubation
The Mechanics

- Scissor mouth
- Blade L hand

Endotracheal Intubation
The Mechanics

- Sweep tongue
- Avoid teeth

Endotracheal Intubation The Mechanics

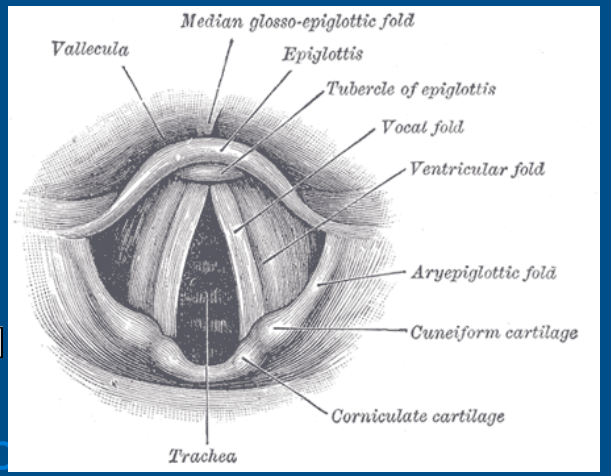
- Elevate epiglottis - lift in axis of laryngoscope handle.

http://www.cpp.usmc.mil/schools/fmss/_borders/intub8.jpg

Endotracheal Intubation
The Mechanics

- Visualize vocal cords
- Insert ETT
- Secure ETT
- Withdraw stylet
- Inflate cuff
- Confirm placement

PD-INEL Source Undetermined



PD-EXP Gray's Anatomy (Wikipedia)

Endotracheal Intubation The Mechanics

- KEY POINTS
  - Position the patient correctly
  - When you see the cords, do not look away; have assistant give you everything you need.
  - Place the tube, remove stylet, inflate cuff.
  - Hold the tube until secured.
  - Tube depth in centimeters = Tube number x 3; or F - 21 cm, M - 23 cm at mouth corner.

Rapid Sequence Induction (RSI) Endotracheal Intubation

- Use of drugs to improve intubating conditions by eliminating patient resistance and providing muscular relaxation.
- Co-administration of a potent sedative and a neuromuscular blocking agent.
- Given in rapid sequence to decrease time of unprotected airway.
- Assumes full stomach in emergency patient.

Emergency Induction Agents
Etomidate

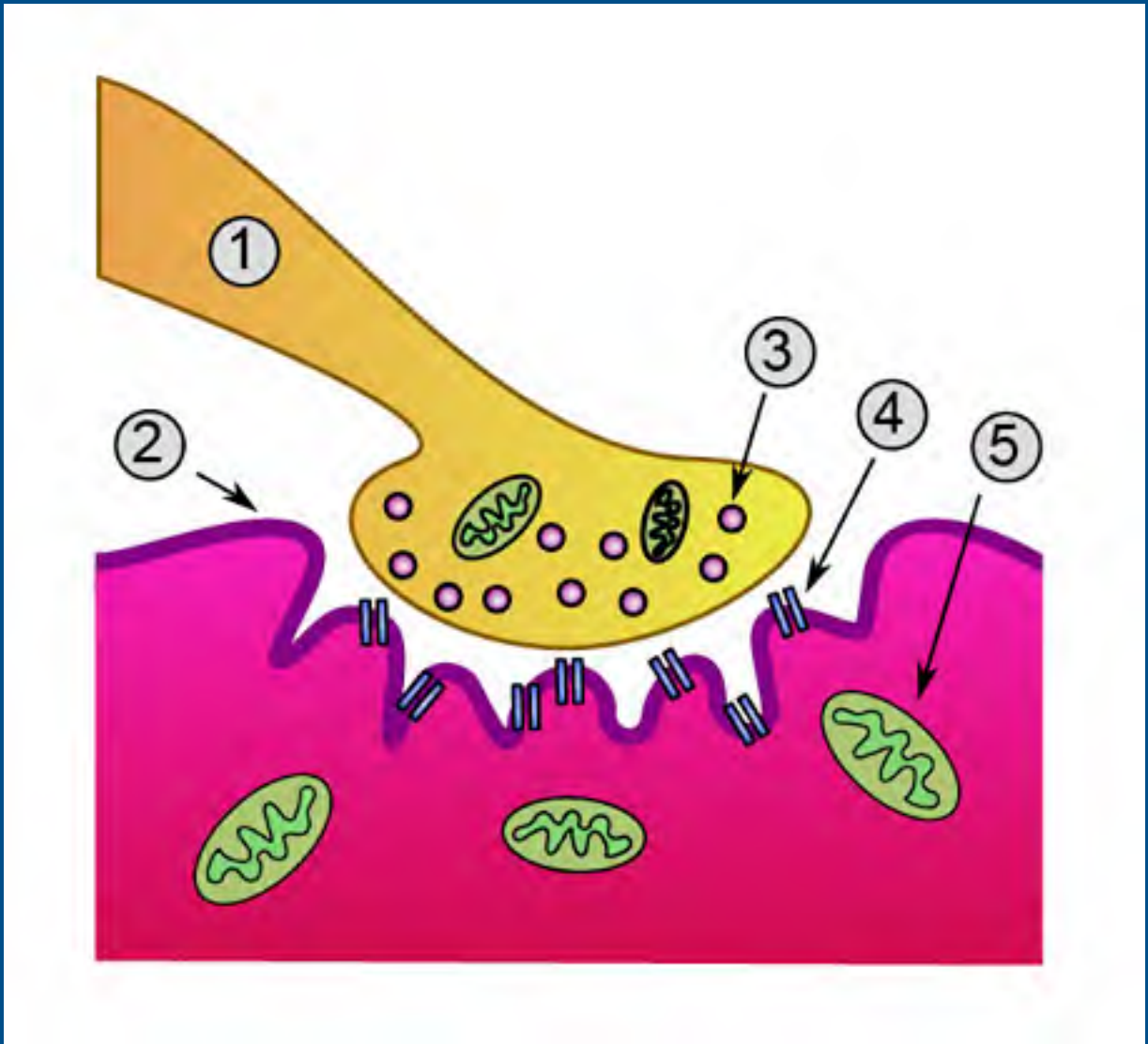
- 0.2-0.3 mg/kg IV
- Decreases intracranial pressure and intragastric pressure.
- Minimal hemodynamic effects.
- Can lead to adrenal suppression after one dose - unclear clinical significance.

Emergency Induction Agents Ketamine

- 1-2 mg/kg IV
- Dissociative anesthetic, like PCP.
- Catecholamine release leads to increased BP and HR and bronchodilation, increased secretions.
- Good for asthma, bad for head injury or MI.

RSI Paralytics - Succinylcholine

- 1.5 - 2 mg/kg IV
- Fasciculation and skeletal muscle paralysis within 45 seconds.
- Potential side effects
  - Bradyarrhythmias
  - Increased IG, IO, and IC pressure
  - Increased potassium
  - Malignant hyperthermia
  - Prolonged paralysis.



- Depolarizing – Binds to Nm receptor, opens Na channel causing depolarization.
- Non-Depolarizing – Competes with Ach, does not activate Nm receptor

RSI Paralytics
Non-Depolarizing Agents

- E.g. Rocuronium 1 mg/kg IV
- Good choice if there is a clear contraindication to succinylcholine.
- Non-depolarizing agents are usually used to maintain paralysis rather than as RSI agents.

RSI Pretreatment Medications

- Lidocaine 1.5 mg/kg IV
  - Head injury and MI - recommended, not essential
- Fentanyl 3 mcg/kg IV
  - Head injury and MI. - recommended, not essential.
- Atropine 0.02 mg/kg IV for kids < 5 y/o
  - Decrease succinlycholine-related bradycardia.

RSI - the Seven P's

- Prepare t-10
- Preoxygenate t-5
- Pretreatment t-3
- Paralysis after sedation
- Protect - Sellick's maneuver
- Place tube
- Post-intubation check

Confirming Endotracheal Tube Placement

- See tube go through cords.
- Watch for tube condensation.
- Pulse oximetry and end tidal CO2 detector.
  - Do not rely on capnometry in arrest/shock states
- Auscultate stomach and lungs.
- Chest X-ray for tube positioning in trachea.

Emergency Airway Success Rates

Method	Intubations (%)	Success Rate
RSI	67	99%
Oral, sedation	7	92%
Oral, no meds	18	93%
Nasotracheal	7	86%

from the NEAR II study (National Emergency Airway Registry)

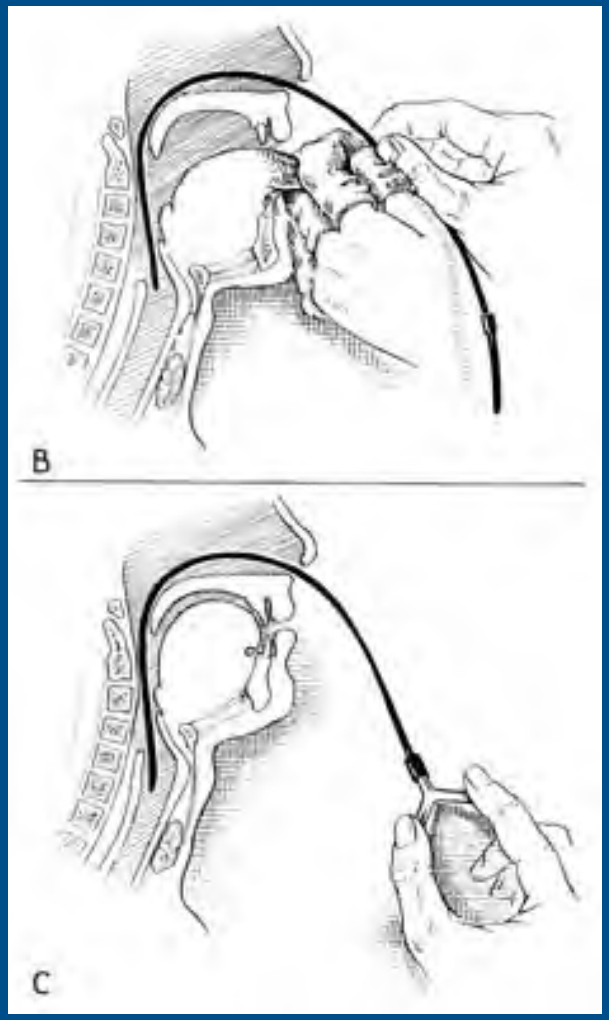
Alternatives to Standard Endotracheal Intubation

- Nasotracheal intubation
- Intubating laryngeal mask airway (LMA)
- Transtracheal Jet Ventilation (TTJV)
- Others
  - Retrograde, Digital, Lighted stylet, Fiberoptic-assisted.
- Cricothyrotomy or Tracheostomy
- ALL require advanced/additional training

Nasotracheal Intubation

- Pt. cooperative and upright.
- Good for oxygenation and ventilation problems - CHF, asthma, COPD
- Anesthetize nose, lubricate tube, use tube 0.5 - 1 mm smaller than for oral use
- Most patent nare, go medial and inferior, listen, advance - timing and rhythm are key.

Nasotracheal Intubation



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http://commons.wikimedia.org/wiki/File:Chapter5figure69b-nasotracheal_intubation.jpg

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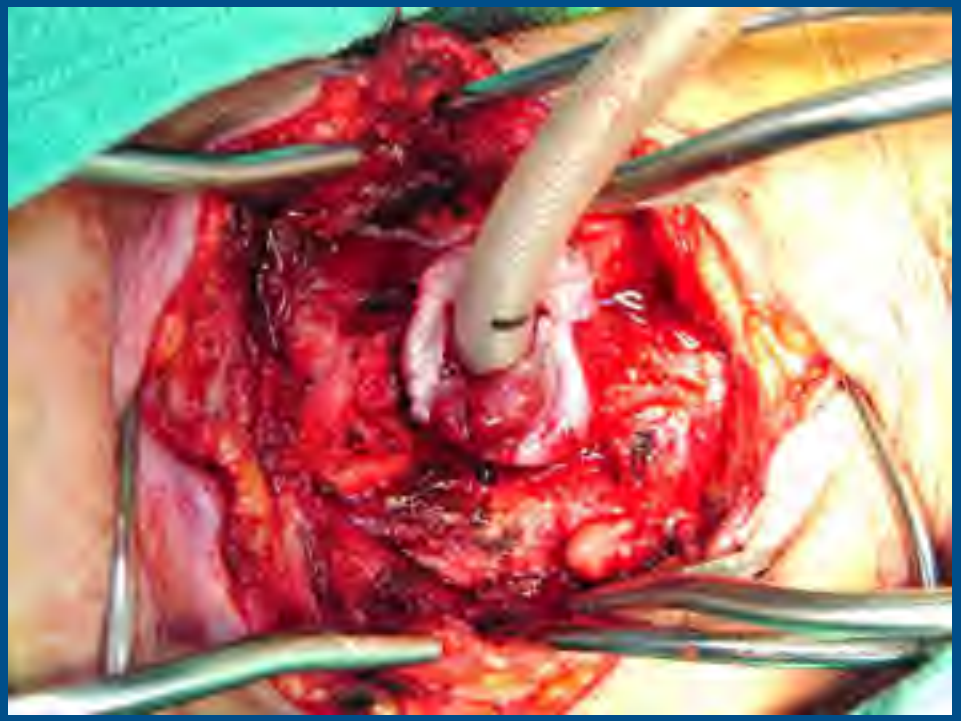
faculty.washington.edu/pcolley/

Cricothyrotomy - Indications

- Definitive airway control when nonsurgical methods fail.
- Upper airway obstruction due to trauma, edema, foreign body, infection.



Cricothyrotomy Relative Contraindications

- Age < 8 years old
- Bleeding disorder
- Infections of neck or airway
- Transection of airway

Cricothyrotomy - Procedure

- Locate cricothyroid membrane.
- Vertical skin incision 3-4 cm.
- Stabilize thyroid cartilage with hand or hook.
- Horizontal incision through inferior portion of membrane.
- Insert instrument to widen hole.
- Place tube, inflate cuff, secure.

Cricothyrotomy - Procedure

PD-INEL www.theairwaysite.com

PD-INEL www.theairwaysite.com

PD-INEL www.theairwaysite.com

Cricothyrotomy: Complications

- Early
  - Bleeding
  - Trauma to adjacent structures
  - Tube misplacement.
- Later
  - Infection
  - Subglottic stenosis.
- Loss of the airway.

Pediatric Airway Management

- Airway smaller.
- U-shaped floppy epiglottis.
- Larynx more anterior and cephalad.
- Narrowest point is cricoid cartilage.

Pediatric Airway Management

- Use Broselow-Luten tape.
- "At age 2, #2 (Mac or Miller).
- "Below age 5, atropinize."
- "8 is enough for cut and cuff."

Airway Management Case #1

- An alcohol-intoxicated man had a seizure in the park.
- Vital signs:
  - 140/100, P 120, R18, Pulse ox - 93%, room air.
- Exam: No signs of trauma; intact gag reflex; macerated tongue; sonorous respirations; clear lungs; non-focal neuro exam.
- What is the appropriate airway management?

Emergency Airway Management

- Options
  - Patency maneuvers
  - Non-invasive ventilation
  - Endotracheal intubation with or without induction and paralytic agents
  - Nasotracheal intubation
  - Surgical airway

Airway Management Case #2

- 78 y.o. male, history of MI, awakens SOB. Brought by wife to ED.
- Vital signs:
  - 210/120, P 120, R 32, Pulse ox - 88%, room air.
- Exam:
  - Diaphoretic, restless, confused, dusky, lungs very wet, positive JVD. S3 present.
- What is the appropriate airway management?

Emergency Airway Management

- Options
  - Patency maneuvers
  - Non-invasive ventilation
  - Endotracheal intubation with or without induction and paralytic agents
  - Nasotracheal intubation
  - Surgical airway

Airway Management Case #3

- A 36 y.o. woman is brought to ED by her husband after ingesting 90 Elavil tablets, “Downers”, Paxil tablets, and EtOH in a suicide attempt.
- Vital signs:
  - 90/60, P 136, R 16, Pulse ox - 96%, room air.
- Exam: Uncooperative, somewhat drowsy, hyperreflexic, lungs clear.
- What is the appropriate airway management?

Emergency Airway Management

- Options
  - Patency maneuvers
  - Non-invasive ventilation
  - Endotracheal intubation with or without induction and paralytic agents
  - Nasotracheal intubation
  - Surgical airway

Airway Management Case #4

- A 3 y.o. girl was running with a sharp toy in her mouth and fell. Sustained oropharyngeal trauma.
- Vital signs:
  - 90/65, P 145, R 36, Pulse ox - 89%, room air.
- Exam:
  - Crying, child, somewhat cyanotic, drooling, has stridor, obvious submental edema. Trachea midline.
- What is the appropriate airway management?

Emergency Airway Management

- Options
  - Patency maneuvers
  - Non-invasive ventilation
  - Endotracheal intubation with or without induction and paralytic agents
  - Nasotracheal intubation
  - Surgical airway

Special thanks to

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Brian Zink, MD

For developing slides and content

For the UM ED M4 Airway Lecture

Questions?

 Dkscully (flickr)