Endotracheal Intubation

INTRODUCTION
Endotracheal intubation is commonly done in the emergency department for various reasons: trauma, burns, shock, airway protection, etc. Preparation and planning is just as important as the procedure itself. You should always anticipate a difficult airway and have other tools or rescue devices at the bedside in case you are not able to intubate the first attempt. This cannot be over emphasized as failure to manage an airway has ominous consequences.

The most common approach is RSI (rapid sequence intubation) with direct laryngoscopy, but there many other means of securing an airway: delayed sequence intubation, glidescope, C-MAC, bougie, intubating LMA, nasotracheal intubation, cricothyroidotomy, etc.

The following will be a discussion of direct laryngoscopy and video laryngoscopy. Many of the tips and techniques described are taken from Dr. Levitan’s lectures. He describes laryngoscopy instead as epiglottoscopy where by simply finding the epiglottis you will be able to identify the rest of the larynx (i.e. vocal cords). He also emphasizes the ear-to-sternal notch position and using high flow apneic nasal oxygenation to prevent desaturating during intubation (NODESAT).

ANATOMY
GOALS OF THE PROCEDURE
- To safely secure a definitive airway without complications (i.e. hypoxia)

INDICATIONS
- Failure to oxygenate
- Failure to ventilate
- Inability to protect airway
- Anticipated loss of airway (facial burns, angioedema)
- Severe Sepsis or Shock – reduce work of breathing

CONTRAINDICATIONS
- Absolute
  - None unless there is significant oral facial trauma requiring cricothyroidotomy instead
- Relative
  - Hypoxia (perform BVM instead to raise O2 sat prior)
  - Limited mouth opening
  - Upper airway distortion or swelling
  - Kyphosis (extreme curvature of upper back)
  - Copious blood or secretions

COMPLICATIONS
- Hypoxic brain injury
- Cardiac arrest
- Aspiration
- Upper airway trauma
- Dental trauma

EQUIPMENT
- BVM attached to wall oxygen
- Non-Rebreather mask & nasal cannula (for preoxygenation)
- Laryngoscope with blades (x2 incase one fails) – Macintosh and/or miller blades
- Endotracheal tube with stylet x2 (anticipated size and one below)
- Nasal and oral airways
- Colorimetric EtCO2 detector
- 12-mL syringe (check ETT balloon)
- Yankauer Suction (x2 if upper GI bleed or vomiting)
- Tape or ETT securing device
- Paralytic and Induction medications (i.e. succinylcholine/etomidate)
- **Backup/Rescue Devices (any or all of these at bedside)**
  - Bougie
  - LMA
  - Video laryngoscopy (glidescope, C-MAC)
  - Cricothyroidotomy kit/supplies
STEPS
Preparation/Positioning

1. *If the patient is breathing*, preoxygenate using a BOTH a non-rebreather mask and high flow nasal cannula; the nasal cannula will stay on during intubation for apneic oxygenation
   a. NRB @ 15L/min
   b. Nasal Cannula @ 15L/min
2. *If the patient is apneic*, ventilate them with a BVM until their saturation is 100% (if possible) while using high flow nasal oxygenation via nasal cannula @15L/min
3. Position the patient in the ideal intubating position (if possible); if the patient is severely dyspneic you may not be able lay them flat until right before RSI
   a. *Ear to sternal Notch with sniffing positioning* (Figure C)
      i. Normal adult patients may just need the head their head elevated a few centimeters or the bed elevated slightly
      ii. Morbidly obese patients especially need their head elevated using a ramp of towels or pillows

4. Make sure the bed is raised to your position of comfort
5. Prepare and check all your airway equipment
   a. ETT with stylet in place
   b. Check your ETT balloons
   c. Check the light source on your laryngoscopes
   d. Ensure suction and rescue airway devices are within reach
6. When adequately preoxygenated, administer your drugs for RSI (i.e. succinylcholine and etomidate)
Procedure
1. Place the head in the sniffing position by placing your right hand on the occiput and extending the head and flexing the neck (if not a c-spine airway)
   a. If a trauma airway have another provider hold inline c-spine stabilization
2. Hold the laryngoscope in your left hand and open the patients mouth with your right hand using a scissor technique
   a. If they have dentures remove them
3. Introduce the laryngoscope into the right side of the patient’s mouth, sweeping the tongue to the left side of the mouth
4. *Slowly* advance the blade down the midline until you see the epiglottis and posterior cartilages
5. If using a Macintosh blade, place it in the vallecula and then lift up and away from you (towards opposite side of the room) to visualize the vocal cord
   a. DO NOT rock backwards on the teeth
6. If using a Miller blade, place it under the epiglottis and lift up and away to visualize the vocal cords
   a. *See trouble shooting section below for difficulty visualizing cords*
7. Once the cords are in view, do not take your eyes off them and instruct someone to hand you the ET tube
8. Pass the ET tube under direct visualization through the right side of the mouth through vocal cords and then another 3-4 cm
   a. If having difficulty passing the ET tube into the mouth, have someone provide “fish hook” pull on the right corner or the mouth to increase space
   b. *Proper tube depth = 3x ETT size*
9. Remove the stylet and inflate the ETT balloon, secure the tube
10. Confirm proper placement with EtCO2, auscultation of both lungs and over the epigastrium, and with Chest X-ray

VIDEO LARYNGOSCOPY
C-MAC System
- Blades have the same angle a standard Macintosh blade that allow you to use it like exactly like direct laryngoscopy (DL) with direct visualization
- Allows you or an observer see what you should be seeing with direct visualization making it good for novice intubators

GlideScope/ McGrath/D-Blade Systems
- The Basics
  - Have sharply angulated, nonchanneled and narrow-flanged blades
  - Blade follows the natural curvature of the upper airway to look around the tongue and provide excellent visualization of the glottis
  - Does NOT allow for direct laryngoscopy by direct visualization
  - Another difference between direct laryngoscopy is it uses a rigid curved stylet which allows you navigate the curvature of the blade without direct visualization
This provides some difficulty for those that don’t use video laryngoscopy often as it requires different technique

- **Common Indications**
  - Anterior airways
  - Trauma c-spine airways
  - Difficult or failed airways (i.e. angioedema)

- **Contraindications**
  - Blood or secretions (may decrease visualization of camera)
  - Limited mouth opening

- **Procedure**
  1. Prepare similar to direct laryngoscopy
  2. Optimal positioning is the head in *neutral position*
  3. Place video laryngoscope with your left hand and place in patient’s mouth with the scissor technique under direct visualization (don’t look at the screen yet)
    a. *Insert directly in the midline tongue, no sweeping of tongue like DL*
  4. Slowly advance the blade along the midline while watching the video monitor until the epiglottis is seen
  5. Place the blade in the vallecula and gently lift to identify the vocal cords
  6. Pass the ET tube into the mouth into the posterior pharynx under direct visualization
  7. Now look up at the video monitor and watch the tip of the tube appear
  8. Insert the tube through the vocal cords while watching the monitor
  9. DO NOT advance the tube further than cords (unlike DL) and instead have an assistant remove the rigid stylet from the tube
    a. You may be able to pop the stylet off using your right thumb
  10. With the stylet out, now pass the remainder of the tube approx. 3-4 cm past the vocal cords
    a. *Passing the tube with the rigid stylet will damage the trachea*
  11. Confirm placement similar to direct laryngoscopy

**TROUBLE SHOOTING**

- **Trouble visualizing the vocal cords?**
  - *Bimanual Laryngoscopy* (will help with an anterior airway)
    - With your right hand, push down or manipulate the thyroid cartilage to see if the cords come down into view
    - If you get a good view, instruct someone to place their hand in the same position to take over while you continue to intubate
  - Advance the blade further as you may not be deep enough
  - Pull the blade back as you may be too deep and passed the larynx
  - Advancing a bougie

- **If all these techniques fail**
  - Pull out and bag the patient
  - Reconsider head positioning and other airway devices (i.e. video laryngoscopy)
PROCEDURE VIDEO
  o http://vimeo.com/17542057
    o Dr. Weingart gives great step by step approach to the entire procedure
  o https://www.youtube.com/watch?v=ooiw6zpCJbI
    o Great demonstration of both Mac, Miller and Bougie intubation

DEEP DIVES
Further Reading:

Recommended FOAM and other videos
  o EMCrit
    o Airway Management with Richard Levitan, MD (MUST WATCH)
      § A must watch to truly understand the anatomy of the airway!
      § Video Lecture (~1 hr)
        • http://hwcdn.libsyn.com/p/7/0/2/7026746a79747901/EMCrit-20120401-70-Levitan-Sinai-Lecture.mp4?c_id=4415960&expiration=1416612339&hwt=a5bc27866317edc8cf196890d5039d0e
      § Lecture Slides
    o Debate: Has video laryngoscopy killed the direct laryngoscopy
      • http://emcrit.org/podcasts/has-video-laryngoscopy-killed-the-dl-star/
    o Intubation Checklist
    o Delayed Sequence Intubation
      • http://emcrit.org/dsi/
  o Life in the Fastlane
    o Direct vs Video Laryngoscopy
      • http://lifeinthefastlane.com/ccc/direct-versus-video-laryngoscopy/
    o Own the Airway!
      • http://lifeinthefastlane.com/own-the-airway/
    o Rapid Sequence Intubation
      • http://lifeinthefastlane.com/ccc/rapid-sequence-intubation/

Airway Pearls
  § Pediatric Airway
    o ET Tube Size
      Uncuffed tube size = \([\text{Age(yr)} + 4]/4\)
      Cuffed tube size = \([\text{Age(yr)} + 3]/4\)
    o Tube depth = 3x ET tube size
    o Children’s proportionately large head naturally places them in sniffing position, so towel under occiput rarely needed
Sometimes towel under the shoulders may be necessary to place them in proper position
- Traditionally taught that Miller preferred given the floppy epiglottis but use what you are most comfortable
- Airway differences vs adult
  - Larynx lies higher and more anterior
  - Larger tongue
  - Shorter neck

**Yes or No: Cricoid Pressure (Sellick’s Maneuver)?** → **NO**
- Evidence shows it interferes with ventilation and ventilation!
  - Reduces tidal volumes
  - Increases peak inspiratory pressure
  - Prevents goo air exchange
  - Worsens visualization of the larynx
  - Decreases successful insertion of and intubation through LMAs
- Does not decrease risk of aspiration as once thought
- Do not use routinely

**External Laryngeal Manipulation, Bimanual Laryngoscopy & BURP**
- External Laryngeal manipulation by the laryngoscopist (bimanual laryngoscopy) *superior* to having assistant apply anterior neck pressure
  - Because direction and amount of force is variable
- BURP sometimes works well but sometimes worsens view
- Levitan’s studies showed bimanual laryngoscopy was more effective than both BURP and cricoid pressure for optimizing laryngeal exposure

**Passing the tube**
- Ideal stylet malleable bent at the end
  - Angles >35 degrees shown to make ETT more difficult to pass
  - Fish hook can provide better overall visualization

**Tracheal Tube Introducer (Bougie)**
- Helpful when the laryngeal inlet cannot be visualized or limited
- When using:
  - Use laryngoscope in normal fashion to obtain your best view
  - Pass the via a 60-degree distal bend under the epiglottis and direct it anteriorly
  - If you pass the cords and are in the trachea until it stops, you’ll feel the rigid tracheal rings
  - *While keeping your laryngoscope in* have an assistant pass the ET tube over the bougie and see it pass through direct visualization into the larynx
- If having trouble passing the tube:
  - Rotate the tube 90 degrees counterclockwise to avoid having the tip of the ET tube get caught on the laryngeal structure
- Bougie can also be used to exchange an ET tube if the balloon pops

**LEMON Law** (Mnemonic for predictors of difficult airway)
- Look externally
- Facial trauma
- Beard
- Large tongue

- **Evaluate the 3-3-2 rule**
  - Incisor distance—3 fingerbreadths
  - Hypoid-mental distance—3 fingerbreadths
  - Thyroid-to-mouth distance—2 fingerbreadths

- **Mallampati**
  - Mallampati score >3

- **Obstruction**
  - Presence of epiglottitis, PTA, trauma, etc

- **Neck mobility**

**SOAP ME (Mnemonic RSI checklist)**

- **Suction**
  - Yankauer suction, if GI bleed or vomit x2

- **Oxygen**
  - BVM
  - NRB
  - Apneic oxygenation with NC @15L/min

- **Airway**
  - Oral and nasal airway
  - 2 ETT (size and one size below) w/ balloon checked & stylet
  - Rescue devices (bougie, LMA, glidescope)

- **Positioning**
  - Ear-to-sternal notch
  - Ramped up if obese

- **Monitors & Meds**
  - RSI meds (sedative & paralytic)
  - Post-intubation sedation

- **EtO2 & other Equipment**
  - Continuous EtCO2 or qualitative color-change device
  - Bougie
  - 2 laryngoscopes with lights checked (mac 3 &4)
  - Video laryngoscope plugged in
### Table 4. RSI Sedation Agents.

<table>
<thead>
<tr>
<th>Agent</th>
<th>Dose</th>
<th>Onset</th>
<th>Duration (minutes)</th>
<th>BP</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methohexital</td>
<td>1-1.5 mg/kg</td>
<td>Less than 1 minute</td>
<td>5-7</td>
<td>May cause hypotension.</td>
<td>Rapid onset.</td>
<td>Respiratory depression. Can cause seizures.</td>
</tr>
<tr>
<td>Midazolam</td>
<td>0.1-0.4 mg/kg</td>
<td>1-2 minutes</td>
<td>30-60</td>
<td>+/-</td>
<td>Marked amnestic effect. Profound anticonvulsant. Little hemodynamic effect.</td>
<td>Dose required for sedation may vary markedly. Paradoxical excitation in some children.</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>2-10 mcg/kg</td>
<td>60 seconds</td>
<td>About 30</td>
<td>May cause hypotension.</td>
<td>Reversible with naloxone.</td>
<td>Chest wall rigidity, +/- ICP, lowers seizure threshold.</td>
</tr>
<tr>
<td>Etomidate</td>
<td>0.2-0.4 mg/kg</td>
<td>15-30 seconds</td>
<td>1-5</td>
<td>Fairly neutral.</td>
<td>Short duration, ICP, little hemodynamic effect.</td>
<td>Seizures ±</td>
</tr>
<tr>
<td>Propofol</td>
<td>1-3 mg/kg</td>
<td>15-30 seconds</td>
<td>10-15</td>
<td>Fairly neutral, but may cause hypotension.</td>
<td>Short onset/duration, anticonvulsant.</td>
<td>Hypotension</td>
</tr>
<tr>
<td>Ketamine</td>
<td>1-2 mg/kg</td>
<td>1 minute</td>
<td>5-10</td>
<td>Usually increases pressure.</td>
<td>Most useful in the asthmatic patient, due to bronchodilatation.</td>
<td>+ICP/IOP, secretions, emergence, laryngospasm. Contraindicated in head injury. Increases secretions.</td>
</tr>
</tbody>
</table>

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### Table 5. Neuromuscular Blocking Agents.

<table>
<thead>
<tr>
<th>Agent</th>
<th>Dose</th>
<th>Onset</th>
<th>Duration (minutes)</th>
<th>Special Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nondepolarizing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vecuronium</td>
<td>0.1 mg/kg</td>
<td>Clinical effects in 30 seconds, paralysis in 1-4 minutes</td>
<td>30-60</td>
<td>Priming dose may shorten onset. Aminosteroid compound.</td>
</tr>
<tr>
<td>Pancuronium</td>
<td>0.1 mg/kg</td>
<td>90-120 seconds (may take longer)</td>
<td>45-90</td>
<td>Histamine release is common. Aminosteroid compound.</td>
</tr>
<tr>
<td>Mivacurium</td>
<td>0.15-0.3 mg/kg</td>
<td>30-60 seconds, intubation conditions within 75-120 seconds</td>
<td>15-20</td>
<td>Histamine release is common. Relatively rapid onset/offset. Benzylisoquinolinium compound.</td>
</tr>
<tr>
<td>Rocuronium</td>
<td>0.8-1.0 mg/kg</td>
<td>30 seconds or less in infants and children</td>
<td>30-45</td>
<td>Rapid onset, but dose required will increase duration of paralysis. Aminosteroid compound.</td>
</tr>
</tbody>
</table>

Depolarizing

| Succinylcholine | 1-2 mg/kg IV | Within 45 seconds (rapid onset of action) | 4-5 (shortest duration of all paralysis agents) | Significant potential side effects. Only medication that can be given IM for airway control. |

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