Chapter 34: Advanced Airway Management

Case History
Your EMS system allows EMT-Basics to intubate. You respond to a 42-year-old woman in cardiopulmonary arrest. You attach the AED and shock the patient three times without successful conversion and start CPR.

Responsibilities
EMTs who intubate have a responsibility to achieve and maintain skill.
- Preparation
- Practice
- Reinforcement
- Continued evaluation

Important to Remember
Advanced and alternate airway skills do not stand alone as patient management tools. They are integrated with other basic airway management techniques.

- Manually opening the airway
- Suctioning
- Airway adjuncts

Sellick Maneuver – Purpose
- For use in unresponsive patients without a cough or gag reflex
- Prevents regurgitation and aspiration
- Used during endotracheal intubation

Sellick Maneuver
Cricoid Cartilage -- Anatomic Location
- Circumferentially cartilaginous
- Cricoid cartilage is inferior to the cricothyroid membrane
  - Palpate depression below thyroid cartilage (Adam’s apple).
Sellick Maneuver -- Special Considerations
- Verify correct anatomy to avoid damage to other structures.
- Difficult to locate in the child and small adult
- Excessive pressure may cause tracheal obstruction.
- Use only when sufficient personnel are available.

Orotracheal Intubation - Purpose
Most effective means of controlling airway
- Complete control of the airway
- Minimizes risk of aspiration
- Allows for better oxygen delivery
- Allows for deeper suctioning

Orotracheal Intubation - Indications
- When adequate artificial ventilation cannot be achieved by other methods
- Patient who is unresponsive to painful stimuli
- Patient with no gag reflex or coughing
- Inability of the patient to protect his or her own airway
- When prolonged artificial ventilation is required

Orotrachal Intubation – Complications
- Esophageal intubation
- Inadequate ventilation and oxygenation
- Soft tissue trauma
- Right mainstem bronchus intubation
- Vomiting
- Bradycardia and dysrhythmias
- Self-extubation
- Tube dislodgement

Personal Protective Equipment include Gloves, Mask, Goggles

Equipment
- Laryngoscope
- Handle
- Blade
- Straight (Miller)
- Curved (MacIntosh)
- Light
- Batteries
Straight Blade
- Straight blade is preferred in infants
  - Provides greater displacement of the tongue
  - Provides better visualization of the glottis
- Assorted sizes 0-4
- Lifts the epiglottis to allow visualization

Straight Blade Position – Blade’s tip displaces epiglottis

Curved Blade
- Preferred in adults and older children
- Broader base and flange provide displacement of the tongue.
- Assorted sizes 0-4
- Inserted into the vallecula to allow visualization

Curved Blade Position – Blade’s tip in vallecula

Equipment - Endotracheal Tubes
- Vary in size (2.5 to 10.0 mm)
- Average adult: Female: 7.0 mm • Male: 8.0 to 8.5 mm
- Helpful to have one tube larger and one tube smaller than estimated available

Equipment - Styllet
- Malleable metal tube
- Inserted into endotracheal tube to provide stiffness and shape
- Hockey stick formation facilitates tube insertion
- Lubricate for easy removal.
- Insert no further than ¼” from Murphy’s eye.

Equipment - Water-Soluble Lubricant
- Applied to the cuffed end of endotracheal tube for ease of insertion
- Applied to styllet for ease of removal

Other Equipment
- Syringe 10 ml
- Securing device
- Suction
- Towels
Orotracheal Intubation - Procedure

Preventilate the Patient

Procedure - Assemble and Test Equipment
- Laryngoscope - Lock blade onto bar.
- Check light
  - Should be a "bright, white, steady, tight light"
  - Spare bulbs should be available.
- Endotracheal tube
  - Check cuff for leaks.
  - Deflate cuff after checking it.

Align head to Ensure Visualization

Insert Blade

Visualize Glottic Opening
Sellick maneuver may help

Procedure - Insert and Inflate Endotracheal Tube
Procedure – Auscultate
- Begin over epigastrium.
  - No sounds should be heard during artificial ventilation.
- Listen at the apex and base of the lungs.
  - Compare left and right.
  - Breath sounds should be equal bilaterally.

Confirm Placement with Secondary Device
- Secure tube.
- Ventilate at an age-appropriate rate.
- Note the distance that the tube has been inserted.
- An oral airway may be inserted to act as a bite block.

- Alternative Airway Devices
  - Esophageal-tracheal combitube (ETC)
  - Pharyngotracehal lumen airway (PTL)
  - Laryngeal mask airway (LMA)

- ETC and PTL
  - Look similar to endotracheal tube but have two lumens
  - May be inserted into esophagus or trachea
  - Blind insertion

ETC and PTL Complications
- Most significant complication - ventilation through wrong port
  - Check for primary placement.
  - Obtain secondary confirmation.
- May cause damage to esophageal wall
  - Rare

ETC and PTL Contraindications
- Do not use in patients:
  - <5 feet tall
  - <14 years old
- With history of caustic ingestion
- With history of esophageal disease
- With an active gag reflex
- Remove if patient becomes conscious.
ETC and PTL Equipment
- PPE (gloves, eyewear, mask)
- Stethoscope
- Suction
- End-tidal carbon dioxide monitoring device
- Water-soluble lubricant
- Two syringes to inflate pharyngeal and distal cuffs
- Oxygen
- Securing device

Procedure – Insertion of ETC
- Hyperventilate for 30 seconds.
- Place head in neutral position.
- Insert ETC following natural curve of pharynx until teeth are between black rings.
- Inflate pharyngeal cuff.
- Inflate distal cuff.
- Confirm place through auscultation.
  - If esophageal placement, continue to ventilate through blue tube.
  - If tracheal placement, ventilate through clear tube
- Confirm with end-tidal CO2 detector.

Laryngeal Mask Airway LMA
- Used by anesthesiaology for several years.
- Increased use in emergency medicine (25%)
- Inserted into airway until tip rests at upper end of the esophagus
- Seals around glottis
- Inserted blindly
- May not protect against aspiration.
- Equivalent in some studies to endotracheal intubation
- Superior to bag-valve-mask for BLS providers in preventing regurgitation

LMA Equipment
- PPE (gloves, eyewear, mask)
- Stethoscope
- Suction
- End-tidal carbon dioxide monitoring device
- Water-soluble lubricant
- Syringe to inflate mask
- Oxygen
- Securing device
Procedure - Insertion of the LMA

- Tightly deflate the cuff so that it forms a smooth "spoon shape."
- Lubricate the posterior surface of the mask with water-soluble lubricant.
- Hold the LMA like a pen, with the index finger placed at the junction of the cuff and the tube.

Procedure - Insertion of the LMA

- With head extended and neck flexed, flatten the LMA tip against the hard palate.
- Use the index finger to push cranially, maintain pressure on the tube with finger.
- Advance the mask until definite resistance is felt at the base of the hypopharynx.
- Gently maintain cranial pressure with the nondominant hand while removing the index finger.
- Without holding the tube, inflate the cuff with just enough air to obtain a seal.
- Auscultate breath sounds.
- Check with end-tidal CO2 detector.

Orotracheal Suctioning - Indications

- Obvious secretions
- Poor compliance with the bag-valve-mask
- Gurgling sounds during ventilations

Orotracheal Suctioning - Complications

- Dysrhythmias
- Hypoxia
- Coughing
- Mucosal damage
- Bronchospasms
Procedure – Orotracheal Suctioning - Preventilate

Procedure Orotracheal Suctioning - Insert catheter and suction

Procedure Orotracheal Suctioning - After suctioning, hyperoxygenate.

Advanced Airway Management - Infants and Children
Anatomic and Physiologic Considerations

- Mouth and nose
  - Smaller structures
  - More easily obstructed than in adults

- Pharynx
  - Tongue takes up proportionally more space in the mouth.

- Trachea (windpipe)
  - Narrower and less flexible

- Less flexible
Anatomic and Physiologic Considerations

- Trachea (windpipe)
  - Narrower in children
  - Can be obstructed more easily by swelling
- Cricoid cartilage
  - Less developed and less rigid
- Diaphragm
  - Chest wall is softer and children tend to depend more heavily on the diaphragm for breathing.

Special Considerations

- Difficult to create a single, clear visual plane
  - From the mouth through the pharynx to the glottis
- Cricoid ring is the narrowest part of the child’s airway
- ET sizing based on the size of the cricoid ring rather than the glottic opening.
- Cricoid ring serves as "physiologic" cuff.

Infant and Child Endotracheal Tubes

- Uncuffed tubes for <8 years old
  - The circular narrowing at the level of the cricoid cartilage serves as cuff.
- Cuffed tubes for children >8 years old
- Should have a vocal cord marker to ensure that the tip of the tube is placed in a midtracheal position
- Best to have a chart or tape device to assist in sizing
- Infants and children
  - 3.0-3.5 for newborns and small infants
  - 4.0 up to 1 year old
- Formula
  - 16 + age in years divided by 4
- Alternate sizing
  - Size of little finger
  - Nasal sizing

Helpful Hints

<table>
<thead>
<tr>
<th>Age</th>
<th>Distance from Teeth to Mid-trachea (cm)</th>
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<tbody>
<tr>
<td>6 mo to 1 yr</td>
<td>12</td>
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<tr>
<td>2 yr</td>
<td>14</td>
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<tr>
<td>4-6 yr</td>
<td>16</td>
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<tr>
<td>6-10 yr</td>
<td>18</td>
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<tr>
<td>10-12 yr</td>
<td>20</td>
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Suction Unit
- Readily available in case of emesis
- Large-bore catheter is needed to suction during intubation.
- French catheter can be used for endotracheal suctioning.
- Towels
  - Helpful to raise the patient's shoulders or occiput to align the airway

Procedure  Intubation: Infants and Children
- Don PPE.
- Ensure adequate artificial ventilations by bag-valve-mask and oxygen.
- Hyperventilate at an age-appropriate rate before any intubation attempt.
- Assemble and test all equipment.
- Preventilate

Monitor Heart Rate
- Mechanical stimulation of the airway may cause a slowing of the heart rate.
- If a slow heart rate is noted, interrupt intubation to reventilate the infant or child.

Head Alignment
- Unless trauma is suspected:
  - Tilt the head.
  - Lift the chin.
  - Attempt to visualize the cords.
- If unable to visualize the cords:
  - Raise shoulder 2 inch or more (based on age).
  - Attempt visualization again.
- If trauma is suspected, intubate with head and neck in a neutral position using inline stabilization.

Procedure - Blade Insertion
- Curved  Into vallecula
- Straight  -- Lifts epiglottis
  - Epiglottis is made of cartilage, which is less developed than an adults.
  - More likely to block the airway
  - Will require more attention in order to visualize the airway
  - Lift up and away from the patient.
  - Use great care to avoid using the teeth as a fulcrum.
Procedure - Blade Insertion - Visualize Glottic Opening

Procedure -- Insert ET and Auscultate

Confirmation of Placement
- Assess for symmetric rise and fall of the chest.
  - Best indicator, as breath sounds may be misleading in this population
- Assess for an improvement in heart rate and skin color.

Auscultate Breath Sounds
- Begin over epigastrium.
  - Insufflation or gurgling sounds should be absent.
- Listen to the left apex and base; compare with right apex and base.
  - Breath sounds should be equal bilaterally.
- Listen at the sternal notch.

Position of Tube
- Secure tube.
  - If breath sounds are bilaterally equal
  - If no sounds are heard in the epigasium
- Inflate the cuff.
- After securing tube, reconfirm tube placement.

Secondary Confirmation
After Successful Intubation
- Ventilate at an age-appropriate rate.
- Note the distance that the tube has been inserted.
- An oral airway may be inserted to act as a bite block.