Chapter 37
Advanced Airway Techniques

Overview
- Sellick Maneuver
  - Purpose
  - Anatomic Location
  - Technique
  - Special Considerations
- Advanced Airway Management of Adults
  - Orotracheal Intubation
  - Esophageal Tracheal Combitubes
  - Tracheal Suctioning
- Advanced Airway Management of Children and Infants
  - Nasogastric Tubes
  - Orotracheal Intubation

Sellick Maneuver
- Developed for use during intubation of patients in the operating room to prevent passive regurgitation related to medication-induced paralysis
- Should be used in an unresponsive patient without a cough or gag reflex to help prevent passive regurgitation and aspiration during endotracheal intubation
Sellick Maneuver

- **Anatomic location**
  - Cricoid cartilage is circumferentially cartilaginous
  - The cricoid cartilage is inferior to the cricothyroid membrane
  - The depression below the thyroid cartilage (Adam’s apple) is palpated
    - This corresponds to the cricothyroid membrane

Sellick Maneuver

- **Technique**
  - A third provider should find the cricoid cartilage
  - Apply firm posterior pressure just lateral to the midline with the thumb and index fingers
  - Maintain until the patient is intubated

Sellick Maneuver

- **Special considerations**
  - Verify correct anatomy to avoid damage to other structures
  - Difficult to locate in the child and small adult
  - Available personnel
  - Time
Advanced Airway Management of Adults

- Orotracheal intubation
  - Most effective means of controlling a patient’s airway
  - Complete control of the airway
  - Minimizes risk of aspiration
  - Allows for better oxygen delivery
  - Allows for deeper suctioning

Orotracheal Intubation

- Indications
  - Inability to ventilate the apneic patient
  - Patient who is unresponsive to any painful stimuli
  - Patient with no gag reflex or coughing
  - Inability of the patient to protect his own airway

Orotracheal Intubation

- Equipment
  - Body substance isolation
  - Endotracheal tubes
    - Assorted sizes of endotracheal tubes should be present
Orotracheal Intubation

- Equipment
  - Endotracheal tubes
    - Average sizes
      - Adult male: 8.0-8.5 mm ID
      - Adult female: 7.0-8.0 mm ID
      - Helpful to have one tube larger and one tube smaller than estimated available

*Emergency rule: 7.5 fits an adult in an emergency.*

- Components
  - 15-mm adapter—allows attachment of bag-mask
  - Pilot balloon—verifies that cuff is inflated
  - Cuff—holds approximately 10 cc of air
  - Murphy’s eye—small hole on left side across from the bevel that decreases chance of obstruction

Length of tube for adult—33 cm

Helpful hints—average adult
- 15 cm to the carina
- 20 cm teeth to sternal notch
- 25 cm teeth to carina
- Teeth and tube at 22
Orotracheal Intubation

**Equipment**

- **Stylet**
  - Malleable metal that is inserted into the endotracheal tube to provide stiffness and shape of the tube
  - Consider lubrication to allow for easy removal
  - Once inserted, the stylet should be used to form a “hockey stick” shape for the endotracheal tube
  - Should not be inserted beyond the Murphy’s eye
  - Best if kept ¼” from the cuff, or proximal end of Murphy’s eye

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Orotracheal Intubation

**Equipment**

- **Laryngoscope handle**
  - Battery-powered—spare batteries
  - Locking bar

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Orotracheal Intubation

**Equipment**

- **Laryngoscope blades**
  - Straight blade
    - Assorted sizes: 0-4
    - Lifts the epiglottis to allow visualization of the glottic opening and vocal cords
    - The straight blade is preferred in children and infants
Orotracheal Intubation

- Equipment
  - Laryngoscope blades
    - Curved blade
      - Assorted sizes: 0–4
    - Inserted into the vallecula to allow visualization of the glottic opening and vocal cords

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Orotracheal Intubation

- Equipment
  - Assembly
    - Notch on blade locks onto locking bar of laryngoscope handle
    - Lifting the blade up locks it into place and illuminates light

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Orotracheal Intubation

- Equipment
  - Check light. It should be “bright, white, and tight”
  - Spare bulbs should be available—assorted sizes for each blade
  - Water-soluble lubricant—applied to the endotracheal tube for ease of insertion and to the stylet for ease of removal
Orotracheal Intubation

- Equipment
  - Syringe (10 cc)
    - Used to test the cuff prior to insertion of the endotracheal tube
    - Following the verification of integrity of the pilot balloon, the syringe should remain attached
    - Used to inflate the cuff once tube has been placed

Orotracheal Intubation

- Equipment
  - Securing device
    - A number of securing devices are available, including tape and commercial devices
    - Medical direction should approve taping technique or use of commercial device
    - Should have oral airway or similar device as a bite block

Orotracheal Intubation

- Equipment
  - Suction unit
    - Readily available to clear any fluid or particulate debris
    - Large-bore catheter is needed to suction during intubation
      - A French catheter can be used for endotracheal intubation
  - Towels
    - Helpful to raise the patient’s shoulders or occiput to align the patient’s airway
**Insertion Techniques—Adult**

- Take body substance isolation precautions
- Ensure adequate artificial ventilation by bag-mask and oxygen
- Patient must be hyperventilated at a rate of 24 breaths/min prior to any intubation attempt

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**Insertion Techniques—Adult**

- Assemble and test all equipment, including preparation for securing the tube
- Align the patient’s head to ensure ease of visualization
  - Unless trauma is suspected, tilt the head, lift the chin, and attempt to visualize the cords
  - If unable to visualize the cords, raise the patient’s shoulder 1” (may be more based on age). Attempt visualization again

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**Insertion Techniques—Adult**

- If trauma is suspected, the patient must be intubated with the head and neck in a neutral position using in-line stabilization
**Insertion Techniques—Adult**

- Holding the laryngoscope handle in your left hand, insert laryngoscope blade into right corner of mouth.

- With a sweeping motion, lift tongue up and left out of the way.

**Insertion Techniques—Adult**

- Insert blade into proper anatomical landmark:
  - Curved—vallecula
  - Straight—lifts epiglottis

- Lift scope up and away from the patient.

- Use great care to avoid using the teeth as a fulcrum.

**Insertion Techniques—Adult**

- Application of the Sellick maneuver during attempts at visualization may be beneficial.

- Cricoid pressure should be used if you suspect that the patient may vomit.

- Thyroid pressure should be used to assist in visualizing.
Insertion Techniques—Adult

- Visualize the glottic opening and the vocal cords. Do not lose sight of the vocal cords.
- With right hand gently insert endotracheal tube until the cuff just passes the vocal cords. Note markings on tube at upper teeth or gum line and record.

Insertion Techniques—Adult

- Remove laryngoscope blade and extinguish the lamp.
- Remove the stylet, if used.

Insertion Techniques—Adult

- Inflate the cuff with 5-10 cc of air and remove syringe.
Insertion Techniques—Adult

- Continue to hold the endotracheal tube until secured
- Have partner attach the bag-mask and deliver artificial ventilation

Insertion Techniques—Adult

- Confirm placement
  - Rise and fall of patient’s chest
  - Carbon dioxide detectors
  - Auscultate breath sounds

Insertion Techniques—Adult

- Confirm placement
  - Begin over epigastrium
    - No sounds should be heard during artificial ventilation
  - Listen to the left apex
  - Compare with the right apex
    - Breath sounds should be bilaterally equal
  - Listen to the left base
  - Compare to the right base
    - Breath sounds should be bilaterally equal
Insertion Techniques—Adult

- Confirm placement
  - If breath sounds are bilaterally equal, and no sounds are heard in the epigastrium, the endotracheal tube should be secured in place using tape or a medical director–approved commercial device
  - The patient should then be artificially ventilated at an age-appropriate rate
  - Remember to note the distance that the tube has been inserted
  - An oral airway may be inserted to act as a bite block

- If breath sounds are diminished or absent on the left, a right mainstem intubation has most likely occurred
  - Deflate cuff and gently withdraw the tube while artificially ventilating and auscultating over the left chest
  - Take care not to completely remove the endotracheal tube

Insertion Techniques—Adult

- Confirm placement
  - Compare the right and left breath sounds
  - If bilaterally equal, follow the previous directions regarding inflation of the cuff, securing the tube, and artificially ventilating the patient
**Insertion Techniques—Adult**

- Confirm placement
  - If sounds are only present in the epigastrium, an esophageal intubation has occurred

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**An unrecognized esophageal intubation is fatal**

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**Insertion Techniques—Adult**

- Confirm placement
  - Deflate cuff and remove the tube and hyperventilate the patient for an additional 2–5 minutes prior to your second and final attempt
  - Be sure to reassess breath sounds after every major move
Video Clip: Intubation by Direct Laryngoscopy

Insertion Techniques—Adult

- Complications
  - Stimulation of the airway may cause slow heart rates
  - Soft tissue trauma to lips, teeth, gums, airway structures
  - Prolonged attempts may lead to inadequate oxygenation
  - Right mainstem intubation
  - Esophageal intubation
  - Vomiting
  - Self-extubation

Esophageal Tracheal Combitubes

- In some situations, you may not be able to place an endotracheal tube
- The esophageal tracheal Combitube can be used to manage the airway when intubation is not possible
Esophageal Tracheal Combitubes

- **Indications**
  - Adult patients with no gag reflex
  - Patients older than 16 years and taller than 5 feet
    - A smaller version of the Combitube is available for patients between 4 and 5 feet in height
  - Ideal for patients in whom endotracheal intubation is not possible due to problems visualizing the airway
  - Well suited to patients in whom BVM ventilation is difficult due to anatomic considerations because a mask seal is not required

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Esophageal Tracheal Combitubes

- Should not be used on patients with esophageal disease, since heavy bleeding could occur

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Esophageal Tracheal Combitubes

- **Equipment**
  - The Combitube is a dual-lumen device with two ventilation ports— one designed for use if the Combitube is passed into the esophagus, one for use if the Combitube is passed into the trachea
Esophageal Tracheal Combitubes

- **Equipment**
  - If the tube passes into the esophagus, the first port is used and air escapes the distal end through multiple small holes.
  - If the tube passes into the trachea, the second tube is used for ventilation and functions as an endotracheal tube.

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Esophageal Tracheal Combitubes

- **Equipment**
  - The Combitube has two cuffs:
    - The first cuff is designed to contain 100 mL of air and helps anchor the tube into the pharynx.
    - The smaller distal cuff is filled with 10-15 mL of air to help seal the tube against the walls of the trachea of esophagus.
    - No mask is required to ventilate the patient, which is one of the main advantages of the use of the Combitube over BVM ventilation.

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Esophageal Tracheal Combitubes

- **Insertion techniques**
  - Place the patient’s head in the neutral position.
  - Open the mouth and lift the jaw by grasping the tongue and jaw and lifting up.
  - Insert the Combitube into the airway until the teeth markers are between the teeth.
Esophageal Tracheal Combitubes

- Insertion techniques
  - Inflate the pharyngeal cuff with 100 mL of air
  - Inflate the distal cuff with 10-15 mL of air
  - Ventilate through the clear port and assess breath sounds

- If breath sounds are present, the tube is in the esophagus and you should continue to ventilate through this port.

- If no breath sounds are heard, switch to the blue port and ventilate while assessing for breath sounds.
  If breath sounds are heard, the tube has been placed into the trachea. Continue ventilating through this port.
Esophageal Tracheal Combitubes

- Complications
  - Incorrectly assessing the location of the tube and ventilating through the wrong port
  - Incorrectly identifying the tube placement can be a fatal error

Tracheal Suctioning

- Purpose
- Technique
Advanced Airway Management of Children and Infants

- Nasogastric tubes
  - Decompress stomach and proximal bowel in response to obstruction or trauma
  - Gastric lavage
  - Upper gastrointestinal ingestion or bleeding
  - Administration of medications and nutrition
Nasogastric Tubes

- Indications
  - Inability to artificially ventilate the infant or child because of gastric distention
  - Unresponsive

- Contraindications
  - Presence of major facial, head, or spinal trauma
  - Orogastric technique is preferred

- Complications
  - Tracheal intubation
  - Nasal trauma
  - Emesis
  - Passage into the cranium in cases of basilar skull fractures
Nasogastric Tubes

**Equipment**
- Nasogastric tube, assorted sizes
  - Newborn/infant: 8.0 French
  - Toddler/preschool: 10.0 French
  - School-age: 12 French
  - Adolescent: 14-16 French
- 20-cc syringe
- Water-soluble lubricant
- Emesis basin
- Tape
- Stethoscope
- Suction unit—suction catheters

**Insertion procedure**
- Prepare and assemble all equipment
- Measure tube from tip of nose, around ear to below the xiphoid process
- Lubricate distal end of tube
- If trauma is not suspected, place patient supine, with head turned to left side
- Pass tube along the nasal floor
- Check placement of tube by:
  - Aspirating stomach contents
  - Auscultation over epigastrium while injecting 10-20 cc of air into the tube
  - Secure tube in place
Anatomic and physiologic considerations
- Mouth and nose
  - in general all structures are smaller and more easily obstructed than in adults
- Pharynx
  - child’s tongue is proportionately larger and takes up more space in the mouth than an adult’s

Trachea (windpipe)
- children have narrower tracheas that can be obstructed more easily by swelling
- Cricoid cartilage
  - like other cartilage in the child, the cricoid is less developed and less rigid
  - it is the narrowest part of the child’s airway
Special Considerations for Intubation

- Difficult to create a single, clear visual plane from the mouth through the pharynx to the glottis for orotracheal intubation.
- Because the cricoid ring is the narrowest part of the child's airway, sizing of the endotracheal tube must be selected based on the size of the cricoid ring rather than the glottic opening.

Orotracheal Intubation—Infants and Children

- Indications
  - When prolonged artificial ventilation is required
  - When adequate artificial ventilation cannot be achieved by other methods
  - Clearly apneic patient
  - Unresponsive patients without cough or gag reflex

- Equipment
  - Body substance isolation precautions
  - Bag-mask with correct size mask
  - Laryngoscope handle
  - Laryngoscope blades
    - A straight blade is preferred in infants
      - Provides greater displacement of the tongue
Orotracheal Intubation—Infants and Children

- Endotracheal tubes
  - Assorted sizes of endotracheal tubes should be present
    - Average sizes
      - Best to have a chart or tape device to assist in sizing

- Endotracheal tubes
  - Infants and children
    - 3.0-3.5 for newborns and small infants
    - 4.0 up to 1 year old
    - Formula: 16 + age (in years) ÷ 4
      - Alternate sizing
        - Size of little finger
        - Nasal sizing
    - Helpful to have one tube larger and one tube smaller than estimated available

- Endotracheal tubes
  - Infants and children
    - Uncuffed tubes are used in patients <8 years
    - The circular narrowing at the level of the cricoid cartilage serves as a functional cuff
    - Cuffed tubes should be used for children >8 years
    - Should have a vocal cord marker to ensure that the tip of the tube is placed in a midtracheal position
Orotracheal Intubation—Infants and Children

- Helpful hints
  - 6 months-1 year: 12 cm midtrachea to teeth
  - 2 years: 14 cm midtrachea to teeth
  - 4-6 years: 16 cm midtrachea to teeth
  - 6-10 years: 18 cm midtrachea to teeth
  - 10-12 years: 20 cm midtrachea to teeth

Orotracheal Intubation—Infants and Children

- Equipment
  - Stylet
    - In pediatric patients the stylet should be kept just above the Murphy’s eye
  - Water-soluble lubricant
  - 10-cc syringe
  - Securing device
  - Oropharyngeal or similar device as a bite block
  - Suction unit
  - Towels

Intubation of Infant or Child

- Ensure adequate artificial ventilations by bag-mask and oxygen
- Patient must be hyperventilated at an age-appropriate rate prior to any intubation attempt
- Assemble and test all equipment
- Ensure universal precautions
- Heart rate should be continuously monitored during intubation attempts
  - Mechanical stimulation of the airway may cause slowing of the heart rate
  - If a slow heart rate is noted, the attempt should be interrupted to reventilate the infant or child

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Intubation of Infant or Child

- Follow procedures as described for adult
  - In infants and children, assess for symmetrical rise and fall of the chest. This is the best indicator as breath sounds may be misleading
  - Assess for an improvement in heart rate and skin color
  - Auscultate breath sounds
  - The patient should then be artificially ventilated at an age-appropriate rate
  - Remember to note the distance that the tube has been inserted
  - In children older than 8 years, consider a cuffed tube

Video Clip: Intubation of an Infant or Child

- The pop-off valve on the bag-mask has not been deactivated
- There is a leak in the bag-valve device
- The ventilator is delivering inadequate breaths
- Blockage of the tube with secretions
  - Can be treated with endotracheal suctioning
  - If suctioning fails, the tube may have to be removed
Intubation of Infant or Child

- Complications
  - Heart rate should be continuously monitored
  - Stimulation of the airway may cause slow heart rates
  - Soft tissue trauma to lips, teeth, tongue, gums, airway structures
  - Prolonged attempts may lead to inadequate oxygenation
  - Right mainstem intubation
  - Esophageal intubation
  - Vomiting
  - Self-extubation
  - Collapse of a lung

Summary

- Sellick Maneuver
  - Purpose
  - Anatomic Location
  - Technique
  - Special Considerations
- Advanced Airway Management of Adults
  - Orotracheal Intubation
  - Esophageal Tracheal Combitubes
  - Tracheal Suctioning
- Advanced Airway Management of Children and Infants
  - Nasogastric Tubes
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