Advanced Practice Procedures

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Notes:

These procedures should be practiced by all students in the cadaver lab if available.
Advanced Practice Procedural Reference

1) **Airway**
   a) Nasogastric tube insertion
   b) Laryngeal mask airway (LMA)
   c) Esophageal-Tracheal CombiTube™
   d) King LT™
   e) Intubating LMA
   f) Orotracheal intubation
   g) Tracheal tube introducers
   h) Lighted stylet (Trachlight™)
   i) Rapid sequence intubation (RSI)
   j) Nasotracheal intubation
   k) Needle cricothyrotomy with transtracheal jet ventilation
   l) Surgical cricothyrotomy
   m) Tube thoracostomy
   n) Esophageal intubation detectors

2) **Trauma**
   a) Suturing
   b) Pericardiocentesis
   c) Needle decompression
   d) Chest tube insertion
   e) Field amputation
   f) Escharotomy
   g) FAST exam
3) **Vascular Access**
   a) Intraosseous needle insertion
      i) Jamshidi / Cook™
      ii) F.A.S.T.™
      iii) Bone Injection Gun (BIG)™
      iv) EZ-IO™
   b) Insertion of a rapid infusion catheter
   c) Venous cut down
   d) Accessing a subcutaneous vascular access device (SVAD)
   e) Subclavian central venous line placement
   f) Arterial line placement

4) **Foley catheter insertion**
Airway

Nasogastric tube

1. Equipment needed
   a. Gloves, goggles, face mask
   b. NG tube
   c. 20 cc syringe

2. Technique
   a. Don gloves, goggles, and face mask
   b. Measure NG tube on patient and mark level of insertion
   c. Lubricate 6 – 8 inches of distal end of NG tube with water-soluble lubricant
   d. If providing BVM ventilations, consider period of hyperventilation prior to NG tube insertion
   e. Remove NPA or OPA if one is being utilized
   f. Chose nostril that is clear of debris, not being utilized for NPA
   g. Insert NG tube into nare, advancing straight back parallel to palate
   h. Continue with insertion until depth marker is at level of the nare
   i. Withdraw plunger on 20 cc syringe, attach to proximal end of NG tube, and auscultate over the epigastrium while rapidly depressing plunger
      i. Auscultation of air rushing into stomach indicates gastric placement
   j. Withdraw plunger, aspirating air from stomach
      i. Gastric contents may also be aspirated
      ii. Repeat as needed
   k. Detach syringe from NG tube
      i. Air collecting air should “vent” out of NG tube
      ii. Periodic syringe aspiration or air may be necessary if NG tube clogs
      iii. Secure NG tube to nose with tap
Laryngeal mask airway (LMA)

1. Equipment needed
   a. Gloves, goggles, face mask
   b. LMA
   c. Syringe appropriate for LMA size

2. Technique (LMA “Unique” and “Classic”)
   a. Don gloves, goggles, and face mask
   b. Deflate mask by aspirating pilot balloon, and assure that the deflated cuff flips backwards
   c. Apply water-soluble lubricant to anterior and posterior surfaces of cuff
   d. If no c-spine injury is suspected, place patient in sniffing position
   e. Open the mouth using the scissor method
   f. Hold LMA directed caudally with index finger resting in the cuff-tube junction
   g. Insert LMA into patient’s mouth, advancing LMA as far back in the mouth as possible while pressing it against the hard palate
   h. When inserted as far as your finger will reach, use opposite hand to grab LMA tube and push unit further caudad and into its seated position in the larynx
   i. Using a syringe, inflate the cuff with the appropriate amount of air for the size LMA used
   j. Ventilate through LMA with BVM, observing for chest rise and fall and auscultating for breath sounds
   k. If an air leak is audible, inflate cuff with additional small increments of air until leak ceases
   l. If air leak does not cease, ensure that tube of LMA protrudes from the midline of the mouth, carefully reposition the neck, or remove the LMA and use the next largest size
**Esophageal-Tracheal CombiTube™**

1. Equipment needed
   a. Gloves, goggles, face mask
   b. CombiTube™
   c. (2) Appropriate sized syringes
      i. Packaged with CombiTube™
   d. BVM
   e. 100% oxygen source capable of delivering 15 lpm flow

2. Technique
   a. Don gloves, goggles, and face mask
   b. Inspect CombiTube™ cuffs for symmetry and integrity, deflating cuffs fully after inspection
   c. Apply water-soluble lubricant to distal tip and deflated cuff
   d. With head and neck in neutral position, perform jaw lift with nondominant hand
   e. Holding CombiTube™ in dominant hand, insert device into airway, allowing curve of device to follow the natural curve of the airway
   f. Continue advancing device until alveolar ridge is between imprinted teeth marker located at the proximal end
   g. Attach the pharyngeal cuff syringe to the blue pharyngeal pilot balloon and inflate pharyngeal cuff with air volume appropriate for size device used
      i. 41 Fr = 100 ml
      ii. 37 Fr = 85 ml
      iii. Note: it is not uncommon for the device to rise out of the mouth slightly during pharyngeal cuff inflation
          1. No readjustment is necessary
   h. Attach the distal cuff syringe to the white distal cuff pilot balloon and inflate distal cuff with volume of air appropriate for size device used
      i. 41 Fr = 5 – 15 ml
      ii. 37 Fr = 5 – 12 ml
   i. Attach BVM and ventilate patient through the longer blue connecting tube while confirming endotracheal tube placement
      i. Observe for chest rise and fall and auscultate for lung and lack of epigastric sounds.
      ii. ETCO₂ detection if patient has a pulse
      iii. Proof of pulmonary ventilation indicates esophageal placement of CombiTube™
iv. Absence of proof of ventilation indicates tracheal placement of CombiTube™

1. Remove BVM, attach to shorter white connecting tube, ventilate, confirm pulmonary ventilation

j. If no evidence of pulmonary ventilation observed, deflate cuffs, withdraw CombiTube™, ventilate with BVM and face mask, reattempt

k. If evidence of pulmonary ventilation exists, further secure CombiTube™ at lip with tape

King LT™

1. Equipment needed
   a. Gloves, goggles, face mask
   b. King LT(S)-D™
   c. Syringe appropriate for King LT(S)-D™ size

2. Technique
   a. Don gloves, goggles, and face mask
   b. Apply water-soluble lubricant to anterior and posterior surfaces of cuff
   c. If no c-spine injury is suspected, place patient in sniffing position
   d. Open the mouth using the scissor method
   e. Hold the King LT(S)-D™ at the connector with dominant hand
   f. With non-dominant hand, hold mouth open and apply chin lift (if no suspected spinal injury)
      i. Use modified jaw thrust for suspected spinal injury
   g. Using a lateral approach, introduce tip into the corner of the mouth
   h. Advance the top behind the base of the tongue while rotating tube back to midline so that the blue orientation line faces the chin of the patient
   i. Without exerting excessive force, advance the tube until the base of the connector is aligned with teeth or gums
   j. Inflate cuffs to 60 cm H₂O or enough to create a seal
      i. Typical inflation volumes
         1. King LT-D™
            a. Size #2 is 25 – 35 ml
            b. Size #2.5 is 30 – 40 ml
            c. Size #3 is 45 – 60 ml
            d. Size #4 is 60 – 80 ml
            e. Size #5 is 70 – 90 ml
2. King LTS-D™
   a. Size #3 is 40 – 55 ml
   b. Size #4 50 – 7 ml
   c. Size #5 is 60 – 80 ml
   k. Attach the bag valve mask to the King LT(S)-D™ and ventilate the patient
   l. When using the King LTS-D’s™ gastric access lumen, use a lubricated 18 Fr catheter

\textit{Intubating LMA}

1. Equipment needed
   a. Gloves, goggles, face mask
   b. Intubating LMA
   c. Syringe sufficient for size intubating LMA used
   d. BVM
   e. 100% oxygen source capable of delivering at least 15 lpm

2. Technique
   a. Don gloves, goggles, and face mask
   b. Deflate mask by aspirating pilot balloon, and assure that the deflated cuff flips backwards
   c. Apply water-soluble lubricant to anterior and posterior surfaces of cuff
   d. If no c-spine injury is suspected, place patient in sniffing position
   e. Hold device by handle in dominant hand, open the mouth with non-dominant hand using the scissor method
   f. Insert device into oral cavity, ensuring that the curved silicone covered tube portion is in contact with the chin and the mask tip is flat against palate
   g. Rotate mask into position in pharynx with a circular motion, maintaining firm pressure against the palate and posterior pharynx
   h. Insert device until resistance is felt and only the metal end of the silicone-covered tube protrudes from the airway
   i. Inflate cuff while holding device by metal handle firmly in dominant hand
   j. Attach BVM and ventilate with 100% oxygen while listening for air leaks, observing for chest rise and fall, and auscultating lung sounds
   k. If air leak is present, additional volume can be added to cuff, or mask can be manipulated for better seal
      i. Handle can be used to lift mask anteriorly against glottic inlet
ii. Mimic motion used with laryngoscope during laryngoscopy
i. Continue to ventilate with 100% oxygen while endotracheal tube is prepared
   i. Goal should be 100% SaO₂
m. Inspect and inflate endotracheal tube cuff to verify cuff symmetry and integrity
n. Fully deflate and lubricate cuff with water soluble lubricant
o. Disconnect BVM and pass endotracheal tube through LMA tube with black vertical line on endotracheal tube facing intubator
p. Insert endotracheal tube to 15 cm mark on tube, indicating that the endotracheal tube tip is about to exit the mask
q. If not doing so already, lift mask by lifting up on LMA handle
   i. Lifts mask against glottic inlet
r. Advance endotracheal tube through glottic opening
s. Inflate tube cuff and confirm endotracheal intubation
t. Deflate cuff on intubating LMA
u. Intubating LMA can be left in place during emergent situations and removed later
v. To remove intubating LMA and keep endotracheal tube endotracheal tube in place, remove BVM and 15 mm adapter from endotracheal tube
w. While stabilizing endotracheal tube with one hand, remove intubating LMA by withdrawing over endotracheal tube
   i. Stop withdrawal when proximal end of intubating LMA tube is even with proximal end of endotracheal tube
x. Insert stabilizing rod to hold endotracheal tube in place then resume withdrawing intubating LMA from mouth
   i. Stop withdrawal when intubating LMA mask is out of mouth
y. Stabilize endotracheal tube by grasping tube at patient's teeth, then remove stabilizing rod
z. With stabilizing rod removed and while continuing to hold endotracheal tube at patient's teeth, finish withdrawing intubating LMA from over endotracheal tube, taking care not to damage pilot balloon
aa. Reconfirm endotracheal tube placement

Orotracheal intubation

1. Equipment needed
   a. Gloves, goggles, face mask
b. Backup airway device
c. Laryngoscope  
   i. Handle  
   ii. Blade
d. Endotracheal tube
e. Stylet
f. 10 cc syringe
g. Tube securing device
h. Esophageal detector

2. Technique

a. Don gloves, goggles, and face mask
b. Place the patient in the sniffing position
c. Ensure that the patient is being ventilated properly with a BLS airway adjunct and BVM with 100% high-flow oxygen and Sellick’s maneuver being performed
d. Prepare your intubation equipment, including suction and backup airway device
e. Communicating with the providers providing BVM ventilations, cease BVM ventilations while continuing to apply Sellick’s maneuver, and move into position at the patient’s head
f. Using your right hand, open the airway utilizing the scissor technique
g. Holding the laryngoscope in your left hand, insert the blade into the right side of the patient’s mouth, lift the jaw, and sweep the tongue to the left
h. Identify the airway anatomy, and manipulate the laryngoscope and anatomy as needed to visualize the glottis
i. If needed, manipulate the larynx to assist in visualizing the glottis
j. With the glottis under direct visualization, pass the endotracheal tube through the vocal cords
k. Remove the stylet and inflate the distal cuff
l. Confirm tracheal placement of the tube  
   i. If patient perfusing, end-tidal carbon dioxide detection gold standard  
   ii. If patient in full cardiac arrest, use esophageal detector device, auscultation, and visual methods of placement confirmation  
   iii. Secure endotracheal tube with tape or commercial device
Tracheal tube introducers

1. Equipment needed
   a. Gloves, goggles, face mask
   b. Intubating stylet
   c. Laryngoscope
   d. Endotracheal tube
   e. 10 cc syringe
   f. BVM
   g. 100% oxygen source capable of delivering 15 lpm

2. Technique
   a. Don gloves, goggles, and face mask
   b. Preoxygenate patient with BVM and face mask with 100% oxygen
   c. Prepare laryngoscope
   d. Inspect endotracheal tube cuff for symmetry, integrity, then deflate cuff and lubricate with water soluble lubricant
   e. Place patient in sniffing position
   f. Open mouth using scissor technique
   g. Insert laryngoscope, lift mandible, attempt to visualize glottic structures
      i. You must be able to visualize the epiglottis to perform procedure
   h. Holding endotracheal introducer in right hand, attempt to slide tip of introducer under epiglottis and into trachea
   i. Distal tip must be kept upright, midline, and immediately under epiglottis
   j. Important to appreciate orientation of curved tip of introducer
   k. Use 10 cm markings on introducer to orient yourself with tip direction
      i. They are printed on same side tip is angled
   l. When in trachea, move tip of introducer back and forth over tracheal rings, feeling for “clicking” sensation
      i. “Clicking” felt in 65 – 90% of cases
      ii. Failure to feel “clicking” does not necessarily indicate esophageal placement
      iii. Device resting on surrounding anatomy may dampen sensations
   m. Continue to advance introducer in trachea, introducer should stop advancing between 24 and 40 cm as it reaches the carina
      i. Inability to insert full length of the introducer indicates esophageal placement
n. While maintaining the best possible view with the laryngoscope, have an assistant feed the endotracheal tube onto the introducer, advancing endotracheal tube to just above the epiglottis

o. Take over control of the endotracheal tube, and advance distal tip under epiglottis and into trachea

p. If distal tip of endotracheal tube becomes hung up on any of the glottic structures, rotate the endotracheal tube 180° first to the right, then to the left while attempting to advance

q. Inflate balloon cuff, then withdraw intubating stylet

r. Attempt to ventilate with BVM while confirming endotracheal tube placement

*Lighted stylet (Trachlight™)*

1. Equipment needed
   a. Gloves, goggles, face mask
   b. Trachlight™
   c. Endotracheal tube
   d. 10 cc syringe
   e. BVM
   f. 100% oxygen source with 15 lpm flow capability

2. Technique for orotracheal intubation
   a. Don gloves, goggles, and face mask
   b. For orotracheal intubation, remove 15 mm adapter from proximal end of the endotracheal tube, cut tube at 25 cm mark, reattach 25 mm adapter
      i. Makes device easier to maneuver in airway
      ii. Do not cut tube if nasotracheal route used
   c. Inspect ET cuff for symmetry, integrity, then deflate cuff and lubricate with water soluble lubricant
   d. Snap stylet into wand connector
      i. While squeezing release arm, slide connector onto rear of handle so groves on either side are engaged
   e. Lubricate wand with water soluble lubricant
   f. Slide tracheal tube over wand and secure its 15 mm connector into the tube clamp, securing with lever
   g. Insert wand into endotracheal tube with lighted tip just proximal to end of tube
i. To advance/withdraw lighted tip in tracheal tube, squeeze release arm on wand connector and adjust

h. Bend the ET-Trachlight™ combination to 90° proximal to the endotracheal tube cuff at area labeled “BEND HERE”
   i. Bend more proximal or distal for very large or small patients, respectively
   ii. Externally, length after bend should correspond to distance from angle of jaw to cricothyroid membrane

i. Lubricate tip of tracheal tube with water soluble lubricant

j. Switch lamp on to ensure that lighted tip is working properly and that green “BATT ON” indicator is on

k. With patient in neutral position, lift tongue and jaw and insert tube / Trachlight™ from the right to the back of the tongue

l. Position tube / Trachlight™ to midline and gently advance tip up, behind tongue, until glow noted at laryngeal prominence

m. When glow noted at midline, gently advance tip 1 – 2 cm until resistance is felt
   i. Glow from tip should be noted just below laryngeal prominence and be smaller and brighter
   ii. Tip has now passed through vocal cords and is pressed against the anterior wall of the trachea

n. While securing tube at the lip, retract stylet approximately 10 cm

o. Finish positioning the tube by advancing until glow is seen in the suprasternal notch
   i. Tube tip is now positioned approximately between the vocal cords and the carina

p. While continuing to secure tube at lip, release clamp lever and remove Trachlight™

q. Inflate the tracheal tube cuff, attach the BVM and ventilate, and confirm tube placement

**Rapid sequence intubation (RSI)**

1. Equipment needed
   a. Gloves, goggles, face mask
   b. Two patent IV access sites
   c. Monitoring equipment
   d. Cardiac monitor
   e. Blood pressure monitor
   f. Pulse oximeter
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Advanced Practice Procedures: 1

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Advanced Practice Procedures: 1

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Backup airway

Laryngoscope

Two working handles

Two each curved, straight blades

Endotracheal tubes

Two each curved, straight blades

Endotracheal tubes

Anticipated size

Stylet

Hypodermic syringes

Size and quantity dependent on medicates utilized

Medications

Exact medications dependent on scenario

"L.O.A.D."

Induction/sedative agent

Neuromuscular blocking agent

Endotracheal tube securing device

2. Technique (with timeline)

Don gloves, goggles, and face mask.

Prepare all necessary airway equipment and medications and position patient in area that best facilitates RSI procedure (10 minutes prior to paralysis)

Backup airway

Laryngoscope

Endotracheal tube

Premedications

Induction/sedative agents

Neuromuscular blocking agent(s)

Tube confirmation devices

Patient monitoring equipment

Cardiac monitor, BP, SaO₂

Ensure patent IV access (at least one, two are preferred)

Preoxygenate patient by appropriate means as determined by their mental status, level of consciousness, and respiratory drive (5 minutes prior to paralysis)

Goal = 100% SaO₂

Administer appropriate pretreatment medications IVP (3 minutes prior to paralysis)
i. “L.O.A.D.”
ii. Defasciculating agent if succinylcholine used
n. Immediately administer neuromuscular blocking agent (paralysis induced)
o. Apply Sellick’s maneuver as patient loses consciousness, and place patient in sniffing position (paralysis – 20 seconds post paralysis)
p. After time appropriate for neuromuscular blocking agent used, check patient’s jaw for flaccidity and perform intubation (paralysis + 45 – 60 seconds)
q. Confirm tracheal placement of tube with end-tidal carbon dioxide detection, provide ventilation with 100% oxygen (paralysis + 60 – 90 seconds)
r. Auscultate lung sounds bilaterally to rule out mainstem intubation (paralysis + 60 – 90 seconds)
s. Secure endotracheal tube with tape or commercial device (paralysis + 60 – 90 seconds)

Nasotracheal intubation

1. Equipment needed
   a. Gloves, goggles, face mask
   b. Water-soluble lubricant
   c. Endotrol™ endotracheal tube
   d. 10 cc syringe
   e. BAAM™
   f. BVM
   g. 100% oxygen source capable of at least 15 lpm flow

2. Technique
   a. Don gloves, goggles, and face mask
   b. Inspect endotracheal tube cuff for symmetry and integrity, then deflate cuff and lubricate with water soluble lubricant
   c. Place BAAM™ on proximal end of endotracheal tube
   d. Place patient’s airway in neutral position
   e. Insert endotracheal tube into patient’s nare, directing tube posteriorly while keeping it horizontal to palate
   f. If resistance is felt as tube contacts posterior nasopharyngeal wall, pull proximal trigger to direct distal tip inferiorly
   g. Listen for whistling of BAAM™ as distal tip approaches glottis
h. Direct distal tip to glottic opening with rotation of proximal tube and use of proximal trigger
i. When distal tip is located just above glottic opening, instruct patient to inhale deeply, then insert tube into trachea
j. Inflate distal cuff of endotracheal tube, then remove 10 cc syringe from pilot balloon
k. Attach BVM and assist patient’s ventilations
l. Confirm tracheal placement by noting whistling from BAAM™, and auscultating for lung sounds with BVM ventilation
m. If patient is breathing and no whistling noise is noted from BAAM™, esophageal intubation is likely
n. Confirm proper insertion depth by auscultating breath sounds bilaterally
o. Secure endotracheal tube with tape or commercial device

Needle cricothyrotomy with transtracheal jet ventilation

1. Equipment needed
   a. Gloves, goggles, face mask
   b. High-pressure oxygen source
   c. High-pressure oxygen tubing
   d. Oxygen regulator/delivery device
      i. Capable of delivering 50 psi
   e. Flow valve
   f. Transtracheal catheter
   g. 10 cc syringe
2. Technique
   a. Don sterile gloves, goggles, face mask
   b. Prepare equipment
      i. Attach transtracheal catheter to 10 cc syringe
      ii. Assemble oxygen tubing, regulator, flow meter
      iii. Identify laryngeal landmarks
         1. Thyroid cartilage, cricoid cartilage, cricothyroid membrane
      iv. If time permits, prepare the neck with antiseptic solution
         1. If patient conscious, consider use of local anesthesia
            a. Infiltrate skin of and subcutaneous tissue of anterior neck with 1% lidocaine
v. While standing at patient's side, immobilize larynx with nondominate hand
vi. With dominant hand, insert needle caudad through cricothyroid membrane along long axis of trachea while providing mild negative pressure on syringe plunger

1. Syringe will easily fill with air when needle enters trachea
vii. If patient is conscious, 1% lidocaine may be placed in syringe prior to cricothyroid membrane puncture and administered to trachea as anesthesia to suppress cough reflex
viii. Advance remainder of catheter over needle into tracheal lumen

1. Catheter hub should come to rest on skin surface
ix. Do not advance needle further into trachea after placement confirmed
x. Remove needle and connect catheter to jet ventilation system via the Luer lock
xi. While manually securing catheter hub at skin surface, provide ventilations at a 1:3 inspiratory:expiratory ratio

*Surgical cricothyrotomy*

1. Equipment needed: No-drop method
   a. Sterile gloves, goggles, face mask
   b. Antiseptic solution
   c. Scalpel with No.11 blade
   d. Tracheal hook
   e. Trousseau™ dilator
   f. Cuffed, nonfenestrated, No.4 tracheostomy tube
2. Technique: No-drop method
   a. Don sterile gloves, goggles, face mask
   b. Identify laryngeal landmarks
      i. Thyroid cartilage, cricoid cartilage, cricothyroid membrane
   c. If time permits, prepare the neck with antiseptic solution
   d. If patient conscious, consider use of local anesthesia. Infiltrate skin of and subcutaneous tissue of anterior neck with 1% lidocaine.
      i. Airway anesthesia accomplished with 1% lidocaine administered via transcricothyroid membrane administration
e. Identify laryngeal landmarks
      i. Thyroid cartilage, cricoid cartilage, cricothyroid membrane
f. While standing at patient’s side, immobilize larynx with nondominate hand  
g. Make 2 cm vertical incision through skin covering larynx at midline, avoiding the deeper structures underneath  
h. Re-identify the cricothyroid membrane  
i. Incise the membrane with a vertical incision across the lower half of the membrane  
   i. Incision across lower half decreases likelihood of lacerating the superior cricothyroid artery and vein  
j. Insert tracheal hook, and apply cephalad traction to the inferior aspect of the thyroid cartilage  
k. Pass traction off to an assistant  
l. Insert Trousseau™ dilator minimally into incision, orienting the blades vertically, between the cricoid and thyroid cartilages  
m. Ensure that the dilator is not inserted too deeply into the trachea, as it will impede placement of the tracheostomy tube  
n. Open dilator, enlarging the cricothyroid membrane incision  
o. Insert the tracheostomy tube, between the blades of the Trousseau™ dilator  
   i. To facilitates tube insertion, the Trousseau™ dilator is rotated caudad so that the blades orient longitudinally in the airway  
p. Inflate cuff and confirm tube placement  
   i. Lung sounds, ETCO$_2$ detection  

3. Equipment needed: Rapid four-step method  
   a. Sterile gloves, goggles, mas  
   b. Antiseptic solution  
   c. Scalpel with No.20 blade  
   d. Tracheal hook  
   e. Cuffed, 6.0 endotracheal tube  

4. Technique: Rapid four-step method  
   a. Don sterile gloves, goggles, face mask  
   b. Identify laryngeal landmarks  
      i. Thyroid cartilage, cricoid cartilage, cricothyroid membrane  
   c. If time permits, prepare the neck with antiseptic solution  
   d. If patient conscious, consider use of local anesthesia. Infiltrate skin of and subcutaneous tissue of anterior neck with 1% lidocaine
i. Airway anesthesia accomplished with 1% lidocaine administered via transcricothyroid membrane administration

e. While standing at the head of the bed, immobilize larynx with nondominate hand

f. Identify laryngeal landmarks
   i. Thyroid cartilage, cricoid cartilage, cricothyroid membrane

g. If exact location of cricothyroid membrane cannot be determined, a vertical skin incision should be made to facilitate anatomy identification

h. Incise skin and cricothyroid membrane simultaneously with a single horizontal incision, leaving the scalpel blade in the trachea

i. Instrument control of airway required at all times

j. Insert tracheal hook into trachea, parallel to scalpel blade on caudad surface

k. Rotate hook caudad, then apply gentle caudad traction to cricoid ring

l. Remove scalpel from trachea

m. Use tracheal hook to lift trachea closer to skin incision
   i. Up and away direction, as in laryngoscopy

n. Insert the endotracheal tube into the trachea

o. Inflate cuff and confirm placement

p. Lung sounds, ETCO₂

**Tube thoracostomy**

1. Equipment needed
   a. Gloves, goggles, gown, and face mask
   b. “Thoracostomy tray”
      i. Sterile towels
      ii. Gauze pads
      iii. Basin
      iv. Betadine™ or other antiseptic solution
      v. 10-20 ml syringes and assorted needles
      vi. No. 10 scalpel
      vii. (2) Large clamp (Kelly™)
      viii. Large, straight (suture) scissor
      ix. Large, curved (Mayo™) scissor
      x. Needle holder
xi. No. 0 or 1-0 suturing silk on large needle
xii. Thoracostomy tube

2. Technique
   a. Don gloves, goggles, gown, and face mask
   b. Prepare drainage system according to manufacturer’s guidelines
   c. Prepare suction
   d. Patient condition permitting, elevate head of bed 30-60°
   e. Restrain arm on affected side over patient’s head
   f. Patient condition permitting, administer sedative and/or local anesthesia an insertion site
   g. Prepare insertion site with Betadine™ or other antiseptic solution
   h. Anesthetize insertion site with generous amount of 1% lidocaine
      i. 5 – 20 cc minimum
   i. Measure and clamp thoracostomy tube
   j. Using No. 10 scalpel, make 3 – 4 cm transverse incision through skin and subcutaneous tissue over middle of rib located one intercostal space below the rib the thoracostomy tube will pass over
   k. Blunt dissection performed with Kelly™ clamp or scissors by pushing forward while closed then spreading tip and pulling back
   l. Penetrate parietal pleura, spread distal points open
   m. Using gloved finger, probe track to verify that pleura has been entered and that no solid organs are present
   n. Keeping finger in track to act as guide, insert thoracostomy tube into chest cavity, directing tip with Kelly forceps
   o. Insert to level of marker clamp, assuring that all tube fenestrations are within the chest cavity
   p. Attach thoracostomy tube to previously assembled water seal or suction setup prior to releasing clamp
   q. Confirm thoracostomy tube placement
   r. Secure thoracostomy tube
Esophageal intubation detectors

1. Equipment needed
   a. Gloves, goggles, face mask
   b. Inserted endotracheal tube
   c. Esophageal detector

2. Technique
   a. Don gloves, goggles, and face mask
   b. Perform intubation
   c. After tube has been placed, stylet removed, and bulb inflated, attach device to proximal end of tube, utilizing 15 mm adapter
      i. Bulb-style device: squeeze bulb, place on proximal end of tube while continuing to squeeze
      ii. Syringe-style device: attach syringe to proximal end of tube with plunger fully depressed
      iii. Attempt to aspirate air from the endotracheal tube with esophageal detector device
**Trauma:**

*Chest decompression*

1) Administer 100% oxygen, and ventilate the patient if necessary.
2) Locate anatomic landmarks and quickly prepare the area to be punctured with an iodine-based solution.
3) Insert a large-bore (ie, 14-gauge or 16-gauge) needle with a catheter into the second intercostal space, just superior to the third rib at the midclavicular line, 1-2 cm from the sternal edge.
   a) To avoid injury to the internal thoracic artery.
4) Use a catheter or needle > 4.5 cm long, and hold it perpendicular to the chest wall when inserting.
   a) Some patients may have a chest wall thickness greater than 4.5 cm, and failure for the symptoms to resolve may be attributed to inadequate needle length.
5) Once the needle is in the pleural space, listen for the hissing sound of air escaping, and remove the needle while leaving the catheter in place.
6) In loud environments such as the back of an ambulance or in an aircraft, the procedure can be performed with a 10 cc syringe filled with 5 cc’s of saline attached to the needle.
   a) As the needle punctures into the pleural space you will be able to observe bubbles in the syringe confirming the placement and treatment.
7) Secure the catheter in place, and install a flutter valve.
   a) The efficacy of flutter valves has been questioned in the pre-hospital setting, many new texts are not recommending not using a flutter valve because it is not effective.
8) Half of all catheters placed will occlude or kink requiring another needle decompression if symptoms return.
   a) If this occurs, the new needle can be placed next to the occluded needle.
9) Prepare the patient for tube thoracostomy.

*Tube thoracostomy*

1) Locate anatomic landmarks, and administer a local anesthetic.
2) Prepare the area with an iodine solution.
3) Create a 3-cm horizontal incision in the skin, over the fifth or sixth rib along the midaxillary line.
4) Use a curved hemostat and dissect through the soft tissue and down to the rib.
5) Push the hemostat just over the superior portion of the rib, avoiding the intercostal neurovascular bundle that runs under the inferior portion of the next most superior rib.
6) Puncture the intercostal muscles and parietal pleura
7) Maintain the intrapleural position by inserting a finger along side of the hemostat, and remove the hemostat
8) Insert the chest tube over the finger into the pleural space
   a) A clamp may suffice for guiding the thoracostomy tube into place on the proximal end
9) Look for condensation in the tube as a sign of correct placement and air evacuation
10) Connect the thoracostomy tube to an underwater seal apparatus and suction
11) Suture the tube in place, dress the wound, and tape the tube to the chest
12) Obtain a follow-up chest x-ray to assess tube positioning and lung reexpansion
13) Tension pneumothorax may also persist if there is an injury to a major airway, resulting in a bronchopleural fistula
   a) In this case a single chest tube is cannot cope with the major air leak
   b) Two, three or occasionally more tubes may be needed to manage the air leak
   c) A thoracotomy is usually indicated to repair the airway and resect damaged lung

Pericardiocentesis

1) Position the patient in a semirecumbent position at a 30- to 45-degree angle if no spinal precautions are necessary
   a) This position brings the heart closer to the anterior chest wall.
   b) The supine position is an acceptable alternative
2) Ensure that the patient has at least one established intravenous access line, is receiving supplemental oxygen, and is connected to a cardiac monitor and continuous pulse oximetry
3) If time permits, place a nasogastric tube to decompress the stomach and decrease the risk of gastric perforation
4) Identify the anatomic landmarks (xiphoid process, 5th and 6th ribs) and select a site for needle insertion
5) Select a site that is closest to the pericardial space, avoiding vital structures, such as the internal mammary artery, lungs, myocardium, liver, and vascular bundle at the inferior margin of each rib
   a) The most commonly used sites are the left sternocostal margin or the subxiphoid approach
6) Use the antiseptic solution to clean and surgically prepare the subxiphoid area
   a) If time allows, put on sterile gloves, gown, and mask, and then apply sterile drapes to delineate the surgical site
7) Infiltrate local anesthetic solution at the chosen site by first creating a skin wheal and then infiltrating the subcutaneous and deeper tissues
8) Puncture the skin using a No. 11 blade scalpel at the chosen site (between the xiphoid process and the left sternocostal margin)
9) Connect a 20-mL or 60-mL syringe to the spinal needle, and aspirate 5 mL of normal saline into the syringe
10) While advancing the needle, the occasional injection of up to 1 mL of normal saline may ensure that the needle lumen remains patent
11) If time permits, connect an alligator clip from the base of the spinal needle to the V1 lead of an ECG machine
12) Insert the spinal needle through the skin incision and direct it toward the left shoulder
13) Advance the needle and syringe until the needle tip is posterior to the rib cage
14) Maintain the needle at a 45-degree angle to the abdominal wall and 45 degrees off the midline sagittal plane
15) Slowly advance the spinal needle up to a depth of 5 cm while applying negative pressure on the syringe until a return of fluid is visualized, cardiac pulsations are felt, or an abrupt change in the ECG waveform is noted
16) If the ECG waveform shows an injury pattern (ST segment elevation), then slowly withdraw the needle until the pattern returns to normal, as this change in waveform suggests that the spinal needle is in direct contact with the myocardium
17) Withdraw as much fluid as possible; when the syringe is filled, stabilize the needle against the patient’s torso, remove the filled syringe, and replace it with another one
   a) Withdrawal of as little as 20 ml can provide immediate relief
18) An alternative setup to replacing syringes is using a 3-way stopcock and intravenous tubing, which allows the physician to aspirate pericardial fluid into the syringe and, after turning the stopcock, eject the fluid into a basin or a collection bag
19) As pericardial fluid is aspirated, the needle may move closer to the heart, and if an injury pattern appears on the ECG waveform, then the needle should be slowly withdrawn
   a) Squirt the pericardial fluid onto a 2x2 piece of gauze
      i) Intracardiac blood forms a clot, whereas pericardial aspirate should not form a clot
20) Remove the needle when fluid can no longer be aspirated
Escharotomy

1) Ensure adequate analgesia and amnesic
2) Prepare equipment
   a) Sterile field
   b) Povidone-iodine preparation solution
   c) Dressing materials
3) Position the patient supine
4) Clean the surgical site with povidone-iodine solution
5) Drape with sterile drapes
6) Create an incision in the eschar up to the level of the subcutaneous fat
   a) Be prepared for severe bleeding
   b) Severely burned limbs may require performance of fasciotomy concomitantly with the
      escharotomy
7) Carry the incision of the eschar down through to the level of the subcutaneous fat
   a) An immediate release in tissue pressure is experienced as a discernible popping sensation
8) Continue the incisions approximately 1 cm proximal and distal to the extent of the burn
9) Areas overlying joints have densely adherent skin, and the incisions should extend across joints to
    allow for decompression of neurovascular structures
   a) Take care to avoid damage to the neurovascular bundles that run superficially and near joints
10) Adequacy of the escharotomy can be tested after completion by checking capillary filling pressures,
    using a handheld Doppler, and by checking compartment pressures
    a) Improvement in flow and decrease in compartment pressures indicate that the procedure is
       adequate
    b) Persistent low Doppler signals or elevated compartment pressures indicate inadequate release
       of tissue pressure and a need for additional escharotomy incisions and, possibly, the addition of
       fasciotomy
Vascular Access:

Intraosseous - Jamshidi / Cook™

1) Identify the tibial tuberosity, just below the knee, by palpation
2) Locate a consistent flat area of bone 2 cm distal and slightly medial to the tibial tuberosity
3) Support the flexed knee by placing a towel under the calf
4) If time permits, cleanse the area with an iodine solution and drape it
5) Perform insertion using sterile gloves and technique
6) Inject local anesthetic (1% lidocaine) into the skin, into the subcutaneous tissue, and over the periosteum, especially if the patient is awake
7) Insert the IO needle through the skin and subcutaneous tissue; this should occur easily
   a) Upon reaching the bone, hold the needle with the index finger and thumb as close to the entry point as possible and, with constant pressure on the needle with the palm of the same hand, use a twisting motion to advance the needle through the cortex until reaching the marrow
   b) A 10 – 15° caudal angulation may be used to further decrease the risk of hitting the growth plate, but direct entry parallel to the bone is acceptable
8) Advance the needle from the cortex into the marrow space, at which point a popping sensation or lack of resistance is felt. Do not advance the needle any farther
9) The first indication of proper placement occurs when the needle stands up on its own
   a) At this point, remove the inner trocar, attach a syringe to the needle, and aspirate bone marrow
   b) Obtaining marrow confirms placement, however marrow may not always be aspirated
   c) If marrow is not aspirated, push a 5-mL to 10-mL bolus of isotonic sodium chloride solution through the syringe
      i) Resistance to flow should be minimal
      ii) Extravasation should not be evident
   d) If flow is good and extravasation is not evident, connect the intravenous (IV) line with a 3-way stopcock at the needle, and secure the needle with gauze pads and tape
Intraosseous - F.A.S.T. ™

1) Expose the sternum and clean the site
   a) Maintain aseptic technique
2) Local anesthetic should be used if the patient is alert
3) Remove the top half of the “Target Patch” backing and locate the sternal notch with your index finger
4) Align patch notch with patient’s sternal notch ensuring that the hole in the patch (“Target Zone”) is over the patient’s midline
5) Remove the bottom half of the patch backing and press it down firmly
6) Remove the sharps cap from the device and place the cluster of needles in the “Target Zone” holding the device perpendicular to the skin at the insertion site
7) Press down, with hand and elbow in line, using firm, increasing pressure until a distinct release is heard and felt
   a) It is important that the device remain perpendicular to the skin
8) After release, pull straight back on the device (along the same line as for insertion), thus exposing the infusion tube
9) Push the used device on the foam-filled, orange sharps plug
   a) The used device is disposed of as contaminated sharps to eliminate risk of cross-contamination
10) Attach the connector tube to the infusion tube luer and to the IV line and begin infusing
11) Place protective dome over patch and press down to engage Velcro™ fastening
12) Removal
    a) Disconnect the IV line from the luer fitting and grasp the infusion tube between the luer and the patient using your fingers or forceps
    b) Pull firmly on the infusion tube to remove
    c) Remove target patch and dispose of infusion tube and target patch using appropriate techniques
Intraosseous - Bone Injection Gun (BIG)™

1) Locate the injection site
   a) 1 – 2 cm medially and 1 cm proximally to the tibial tuberosity
2) Hold bottom of the BIG firmly at a 90 degree angle to the leg
3) Squeeze and pull out the safety latch
4) Hold firmly at the bottom, pressing down with the palm of your hand
5) Pull the BIG up slowly
6) Remove the trocar needle
7) Secure with the safety latch
8) Flush with 10 – 20 cc of normal saline

Intraosseous - EZ-IO™

1) Select needle size based on patient weight
   a) 25 mm, 15 ga for patients 40 kg and greater
   b) 15 mm, 15 ga for patients 3 – 39 kg
2) Locate landmark depending on insertion site
   a) Proximal tibia
      i) Two finger widths below (distal) the patella or tibial tuberosity
         (1) Find the “flat spot” on the medial aspect of the tibial shaft
   b) Distal tibia
      i) Two finger widths above (proximal) the ankle bone on the medial side
   c) Humeral head
      i) The greater tubercle is located by having the patient place their hand on their navel and relax their shoulder and elbow against the stretcher or the back of a chair
         (1) Draw a straight line between the coracoid process and the acromion
         (2) Complete the drawing of a perfect triangle by using the previous line as the base of the triangle and extending the “point” of the triangle over the humeral head
         (3) The site is at the downward point of the triangle
3) Prime the right angle EZ connect with 2% lidocaine
4) The needle and driver shaft are magnetic
   a) With the cap open on the shuttle, direct the driver shaft to the needle attachment and the needle will magnet to the driver out of the shuttle
5) Twist the needle guard off the needle assembling by turning guard clockwise
   a) If you turn counter-clockwise the needle may separate from the hub
      i) If that happens just screw it back on
6) Penetrate the skin the bone without running the driver
7) Assure the 5mm mark is visible when the needle tip has come in contact with the bone
   a) This assures there will be enough needle length to reach the marrow cavity
   b) If the 5mm mark is not visible do not proceed, the needle is not long enough
8) Run the driver constantly with mild pressure for adult patients, no pressure with pediatric patients
    a) With pediatric patients the weight of the driver does the work
9) Stop the driver when you feel the “pop” into the intraosseous space
10) While holding the hub in place against the skin
    a) Pull the driver away from the needle (it’s a magnetic connection)
    b) Unscrew (counter clockwise) the needle from the hub and remove it
    c) Put the needle in a sharps container
    d) Look for these signs of successful insertion:
       i) Blood in the hub
       ii) Catheter stable in the bone
11) Connect the EZ Connect adapter
    a) Aspirate a small amount of blood and marrow to confirm placement
    b) Administer 2 – 4 ml of 2% lidocaine
       i) Flush should be easy
       ii) A second flush may be needed on larger patients; do the second flush with saline
    c) Check for any leakage or extravasation or fluid gathering in extremity compartments
    d) Put the IO arm band on the patient’s wrist

*Emergency Infusion Device™ (EID)  Rapid Infusion Catheter™ (RIC)*

1) Intravenous access is obtained using a 20 ga or larger catheter
2) A scalpel is then used to perform a skin nick
3) Using a Seldinger technique, a guide wire is inserted into the existing IV catheter
4) The IV catheter is removed and a dilator (blue catheter) is advanced into the vein
5) The dilator is removed and the rapid infusion catheter (sizes range from 6 Fr to 8.5 Fr and are approximately 2 inches long) is then advanced
6) The guidewire is then removed and the venous access is now equivalent to an 8 ga catheter
**Venous cutdown**

1) Position the patient supine with the foot externally rotated
2) A tourniquet can be placed above the ankle but is not necessary
3) Prepare the skin with an antiseptic solution and drape the area
4) Located the vein 1 cm anterior and 1 cm superior to the medial malleolus
5) Infiltrate the skin with local anesthetic
6) Make a 1.5 – 2 cm transverse incision over the vein
7) Bluntly dissect out the vein by opening the forceps in the line of the vein
8) Make a small stab skin incision 1 cm distal to the incision in the line of the vein
9) Free the vein from its bed for a length of 2 cm
10) Pass two ligatures around the vein  
    a) Tie the distal one, but leave the ends uncut  
    b) Hold the ends of the ligatures with the artery forceps
11) While holding the ligatures tight, make a "V" shaped incision in the anterior surface of the vein with the scissors or scalpel
12) Pass the 14 ga catheter through the inferior stab incision and through the "V" shaped incision into the vein
13) Tie the proximal ligature tightly over the cannulated vein and, if there is no bleeding, cut the ends of the ligatures
14) If bleeding occurs place a further ligature around the vein
15) Connect the catheter to the giving set and commence the infusion
16) Close the skin with sutures
17) After the infusion is finished the catheter can be removed by a firm steady pull followed by direct pressure over the site of the incision for 5 minutes
Subcutaneous vascular access device

1) Wash hands, and palpate infusion port with clean gloves on
2) Apply mask to patient and to self
3) Open sterile gloves
4) Utilize inside of sterile glove wrapper as a sterile field
   a) Drop the following onto the sterile field:
      i) Chloraprep™
      ii) Tegaderm™ dressing
      iii) Needleless valve
      iv) Skin prep
      v) One empty sterile 10 cc syringe
      vi) One sterile Huber needle of appropriate size
5) Open second set of sterile gloves
6) Open 3 syringes of pre-filled normal saline (do not place in sterile field)
7) Remove clean gloves
8) Don sterile gloves
9) Remove cap on end of sterile Huber needle connection tubing
10) With non-dominant hand, hold sterile Huber needle connection tubing in preparation for priming
11) With dominant hand, attach prefilled syringe (which is not sterile) to Huber needle connection tubing and prime the Huber needle
12) With the non-dominant hand, lay the primed Huber needle and tubing on the sterile field
   a) The non-sterile syringe should only touch the outer area of the sterile field
13) Clamp the Huber needle connection tubing
14) Remove the syringe
15) Maintain the Huber needle and connection tubing on the sterile field at all times
16) Don new sterile gloves
17) Attach and empty sterile 10 cc syringe to the Huber needle connection tubing
18) Cleanse the skin over the port with Chloraprep™, using a scrubbing motion while cleaning in concentric circles
19) Allow Chloraprep™ to dry for 60 seconds
20) Grasp the edge of the port with the non-dominant hand to stabilize the port
21) Insert the Huber needle into the center of the port septum going through the skin at a 90 degree angle
a) Apply steady pressure until the needle touches the base of the port reservoir

22) Aspirate to check for blood return

23) Attach the needless valve to the end of the Huber connection tubing

24) Apply skin prep

25) Apply Tegaderm™ dressing

26) Flush the Huber needle connection with 20 cc of normal saline

27) Attach IV tubing

Subclavian central venous line placement

1) Explain the procedure to the patient

2) Prepare the patient
   a) Oxygen
   b) Pulse oximeter
   c) Cardiac monitor

3) Position patient in a 15 to 30 degree Trendelenburg position

4) Gather the equipment.

5) Sterilize the field

6) Prepare your equipment
   a) Flush all ports
   b) Attach end caps to the proximal and middle ports

7) Identify landmarks
   a) Palpate the subclavian as it bends at the junction of the medial third and lateral two thirds of the clavicle
   b) As the subclavian vein crosses the first rib, it lies posterior to the junction between the medial third and lateral two thirds of the clavicle
   c) The subclavian arteries are located posterior to the veins and are separated from them by the scalene muscles
   d) The right pleural dome is lower than the left and the thoracic duct is located on the left, thus making the right side preferred over the left

8) Select an insertion point

9) Anesthetize the insertion site

10) Locate the vein with the introducer needle (infraclavicular approach)
11) Insert the introducer needle 1 cm inferior to the junction of the middle and proximal third of the clavicle while aiming slightly cephalad
   a) Maintain a 5 to 10 degree angle relative to the chest wall
   b) Insert the needle with the bevel directed inferiorly
12) Locate the vein with the introducer needle (supraclavicular approach)
13) Insert the introducer needle 1 cm lateral to the SCM and 1 cm superior and posterior to the clavicle
14) Aim toward the contralateral nipple
15) Insert the needle with the bevel directed medially
16) Advance the guidewire into the vessel
17) Hold the guidewire and remove the introducer needle
18) Nick the skin with the scalpel to enlarge the puncture site
19) Triple-lumen catheter insertion:
   a) Advance the dilator over the guidewire, and then remove it
   b) Advance the catheter over the guidewire
   c) Remove the guidewire
   d) Withdraw blood from the port to confirm location within lumen of a vein
   e) Flush the line and ports with sterile normal saline
20) To insert a sheath introducer:
   a) Fully insert the dilator into the sheath introducer before advancing it
   b) Advance the dilator and sheath introducer as a unit over the wire and into the vessel
   c) Remove both the dilator and the guidewire as a unit
   d) Confirm placement and flush the line with saline
21) Final steps:
   a) Secure the catheter at the insertion site with suture
   b) Cover the site with a sterile transparent occlusive dressing
   c) Order a stat chest radiograph
Renal procedures

Foley catheter

1. Equipment needed
   a. Sterile gloves (universal precautions)
   b. Sterile drapes
   c. Cleansing solution
   d. Cotton swabs
   e. Forceps
   f. Sterile water (usually 10 cc)
   g. Foley catheter (usually 16-18 French)
   h. Syringe (usually 10 cc)
   i. Lubricant (water-based jelly or xylocaine jelly)
   j. Collection bag and tubing

2. Insertion technique
   a. Gather equipment
   b. Explain procedure to the patient
   c. Assist patient into supine position with legs spread and feet together
   d. Open catheterization kit and catheter
   e. Prepare sterile field, apply sterile gloves
   f. Check balloon for patency
   g. Generously coat the distal portion (2-5 cm) of the catheter with lubricant
   h. Apply sterile drape
   i. Hand positioning
      i. If female, separate labia using non-dominant hand
      ii. If male, hold the penis with the non-dominant hand
      iii. Maintain hand position until preparing to inflate balloon
   j. Using dominant hand to handle forceps, cleanse peri-urethral mucosa with cleansing solution
      i. Cleanse anterior to posterior, inner to outer, one swipe per swab, discard swab away from sterile field
   k. Pick up catheter with gloved (and still sterile) dominant hand. Hold end of catheter loosely coiled in palm of dominant hand
I. In the male, lift the penis to a position perpendicular to patient's body and apply light upward traction (with non-dominant hand)

m. Identify the urinary meatus and gently insert until 1 to 2 inches beyond where urine is noted

n. Inflate balloon, using correct amount of sterile water (usually 10 cc but check actual balloon size)

o. Gently pull catheter until inflation balloon is snug against bladder neck

p. Connect catheter to drainage system

q. Secure catheter to abdomen or thigh, without tension on tubing

r. Place drainage bag below level of bladder

   i. Drainage tube needs to be below the level of the bladder to prevent urine from draining back into the bladder and causing infections

s. Evaluate catheter function and amount, color, odor, and quality of urine

t. Remove gloves, dispose of equipment appropriately, wash hands

u. Document size of catheter inserted, amount of water in balloon, patient’s response to procedure, and assessment of urine

v. Frequently emptying bag to prevent the bladder from getting to full