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Arterial Puncture for Blood Gas Analysis (ABG)

Objectives
At the end of the session the students will:
1. Describe the indications and contraindications for obtaining an ABG.
2. Describe an Allen’s Test.
3. Demonstrate the appropriate technique for obtaining an ABG.
4. Describe the complications associated with ABGs.
5. Describe problems with the integrity of the ABG and possible erroneous results.

Anatomical Review
The radial artery runs along the lateral aspect of the volar forearm deep to the superficial fascia. The artery runs between the styloid process of the radius and the flexor carpi radialis tendon. The point of maximum pulsation of the radial artery can usually be palpated just proximal to the wrist.

Indications
Used for the evaluation of ventilation by measuring the partial pressures of oxygen (PaO$_2$) and carbon dioxide (PaCO$_2$) and the pH of arterial blood in order to assess pulmonary function. These data indicate the status of gas exchange between the lungs and the blood. The base deficit is used as a resuscitation endpoint.

Contraindications
- Infection over the radial artery
- Negative Allen test (see below)
- Coagulation defects hemophilia
- History of a clotting disorder
- History of arterial spasms following previous punctures
- Severe peripheral vascular disease
- Arterial grafts
- Arterial-venous Shunts

General Principles
- The most commonly used arteries are the radial, brachial artery, and femoral arteries. Of these, the radial is the most frequently used because it is easier to access, easy to palpate and it has a collateral blood flow. If damage to the radial artery occurs or if it becomes obstructed, the ulnar artery will supply blood to the tissues normally supplied by the radial artery. The Allen test is routinely performed first, to be sure the patient can tolerate temporary blockage of the radial artery.
- If the Allen test is negative for both hands and the radial artery is not accessible, then the brachial artery may be used. The potential for obtaining a venous sample is greater when using the brachial artery for arterial puncture because there are large veins lying in close proximity to the brachial artery. Additionally, the medial nerve lies parallel to the brachial artery and will cause the patient pain if inadvertently nicked.
The femoral artery is the least preferred arterial sampling site because it is a relatively deep artery; it lies adjacent to the femoral nerve and vein; and it does not have collateral blood flow. Puncture of the femoral artery is usually reserved for emergent situations or for the severely hypotensive patient who has poor peripheral perfusion.

Selection of Appropriate Equipment
- Prepackaged ABG kit
- Sterile gloves

Allen’s Test – Used to determine that collateral circulation is present from the ulnar artery in the event that thrombosis of the radial artery should occur.

- Position the patient’s arm on a flat surface with the wrist supported on a rolled towel. Severe extension should be avoided as it will obliterate a palpable pulse.
- Instruct the patient to clench his/her fist, or if the patient is unable, you may close the hand tightly.
- Using your fingers, apply occlusive pressure to both the radial and ulnar arteries for several seconds. Allow a few seconds for the blood to drain from the hand while the patient opens and closes his/her hands several times. This maneuver obstructs blood flow to the hand. While applying occlusive pressure to both the arteries, have the patient relax his/her hand. Blanching of the palm and fingers should occur. If it does not, you have not completely occluded the arteries with your fingers.
- Release the pressure on the ulnar artery while keeping the radial artery occluded.
- Return of color within 5 to 15 seconds signifies a positive Allen’s test denoting that the ulnar artery is patent and has good blood flow. A negative Allen’s test is one in which ulnar filling is poor or no flushing occurs. In this case, do not proceed but try the other arm for a suitable site as the radial artery supplying arterial blood to that hand should not be punctured. Documentation of the results of the Allen’s test is important. Document either, “rapid and adequate return of circulation noted” or “inadequate return of circulation noted in the (affected extremity) versus a + or – Allen’s test as people frequently forget which is which!”

If the Modified Allen’s test is positive, or circulation is adequate, you may proceed with the arterial puncture.

Specimen Collection
- Wash your hands and put on gloves. Cleanse the site with a 2% chlorhexidine-based prep is preferred but if that is not available, next cleanse with povidone iodine or alcohol prep. Prep the fingers that will be used for palpation. Allow to dry, being careful not to touch the site.
- The patient’s hand should be bent back slightly, or place a small rolled towel under the wrist. This brings the radial artery closer to the surface. Overextending the wrist should be avoided as this might oclude the pulse. Have the patient make a fist.
- Palpate for the pulse by slowly rolling your index finger from side to side with your index and middle fingers. Never use the thumb, because it has its own pulse and can be confused with the patient’s. After locating the strongest pulse sensation, slightly anchor the artery with your index and middle fingers. This will prevent the artery from rolling when you puncture it.

- The syringe should be held at a 30-45° angle, much like you hold a pencil or a dart. This near parallel insertion of the needle will minimize trauma to the artery and allow the smooth muscle fibers to seal the puncture hole after you withdraw the needle.
While anchoring the artery and with the bevel of the needle turned upward, insert the needle just under the skin surface. As you insert the needle slowly and deeper into the wrist, you may feel a "pop" and a flash of blood will appear in the hub of the needle. At this point, stop advancing the needle. Once the artery is punctured, arterial pressure will easily fill the syringe so it is not necessary to pull back on the plunger. At least 1 mL of blood will be required for a core lab evaluation, less may be required for certain point of care testing devices. If you should advance the needle too far, or if you missed the artery, slowly withdrawal the needle to just below the skin and re-insert again.

- This can be done with butterfly wings if you prefer.

- Do not probe with the needle, as this can be very painful and can lead to a hematoma, thrombus formation and damage to the artery itself.
- Hold the syringe very still until the amount of blood needed has been collected (1.5 ccs). Note: Suspect venous puncture if pulsation is minimal and blood is dark in color.
- After obtaining the desired amount of blood, withdraw the needle and apply pressure to the puncture site with the gauze pad for 5 minutes, check the site for bleeding, oozing, or seepage of blood. If present, apply pressure until all bleeding has stopped. A long compression time will be necessary for patients on anticoagulant therapy or who have bleeding disorders. Do not ask that the patient to apply pressure to the site as this may result in inadequate pressure and possibly a hematoma or bleeding.
- In the meantime, remove the needle from the syringe. Needles should never be recapped, bent, or purposely broken because of the danger of self puncture. Use the point lock device located in the kit or the needleless cap or dispose of the needle in a sharps container.
- Carefully cap the syringe with the cap provided in the kit and tip it upside down a few times to mix it well then label the specimen.
- Expel all bubbles from the sample by holding the syringe upright and gently tapping the syringe so that the air bubbles are forced to the top. Evacuate them by pushing on the plunger.
- It is very important to return about 20 minutes later to check for adequate perfusion of the hand and for possible hematoma formation.

Complications
- **Discomfort**: Generally, arterial punctures are painful and the patient will feel some discomfort or pain for a period of time after the procedure. This is true even if a local anesthetic was used.
- **Infection**: Failure to use antiseptic can cause infection.
- **Hematoma**: Because the blood is under considerable pressure in the arteries, blood is initially more apt to leak from an arterial puncture than from a venipuncture site. However, arterial puncture sites tend to close more rapidly due to the elastic nature of the arterial wall. This elasticity tends to decrease with age, therefore, the probability of a hematoma formation is greater in older patient or in patients receiving anticoagulants.
- **Arteriospasm**: The artery muscle can be irritated by needle penetration which can cause a reflex constriction of the artery or arteriospasm. The condition is transitory but may make it difficult to obtain a specimen.
- **Thrombus formation**: Injury to the intima of the artery can lead to clot (thrombus) formation. A large thrombus can obstruct the flow of blood and impair circulation.
- **Air or clotted blood emboli**
- **Anaphylaxis from local anesthetic**
Problems With the Integrity of the ABG and Possible Erroneous Results

- **Air bubbles:** If not removed immediately, oxygen from the bubbles can diffuse into the sample and CO2 can escape, changing the results.

- **Delay in cooling:** Blood cells continue to consume oxygen and nutrients and produce acids and carbon dioxide at room temperature. If the specimen remains at room temperature for more than 5 to 10 minutes, the pH, blood gases, and glucose values will change. Cooling to between 1°C to 5°C slows the metabolism and helps stabilize the specimen. Processing the specimen as soon as possible after collection will ensure the most accurate results.

- **Venous blood mixed in ABG sample:** Normal arterial blood is bright red, whereas venous blood is slightly darker in color. Sometimes it is difficult to distinguish between arterial and venous blood in patients with poor oxygen content. Arterial blood may appear as dark as venous blood. The best way to be certain that a specimen is arterial is if the blood pulses into the syringe or by noting the PaO₂ value from the lab. If it comes back low, it is venous blood.
Cervical Collar Placement

Objectives
At the end of the session students will:
1. Discuss the indications for placement of a cervical collar.
2. Describe the NEXUS low-risk criteria for C-spine clearance.
3. Demonstrate the ability to select the appropriate sized C-collar.
4. Demonstrate the ability to appropriately place a C-collar.

Indications
Full spinal precautions involve immobilizing the cervical, thoracic, lumbar and sacral spine (CTLS). A portion of initial spinal immobilization is application of a cervical collar. In most instances, this is initiated at the scene of the accident. All injured patients require spinal evaluation. For most patients, clearance will be determined by history and physical examination. Any patients at risk of spinal injury that have life-threatening issues needing to be addressed prior to spinal evaluation require full spinal precautions until they can be evaluated.

Contraindications
None

General Principles
- Full spinal immobilization maintains alignment of the spine until clinical and/or radiological evaluation is performed. The most important rule to remember is that all trauma patients assessed by a physician must have their spine evaluated.
- Clinical clearance of the c-spine utilizing the NEXUS low-risk criteria requires the following:
  - Normal level of consciousness, (no drugs/alcohol)
  - Absence of a painful distracting injury
  - Absence of midline cervical tenderness
  - Absence of any focal neurological deficit
  If the preceding criteria are not met, the patient will require a radiological evaluation.
- All patients in spinal precautions must be moved with the spine in complete alignment. This is done using a technique termed log-rolling. The patient is rolled as a complete unit with the neck, shoulders and torso stabilized.
- If a patient is in full CTLS precautions, the head of the bed may be elevated using reverse Trendelenburg.
- All patients remain in spinal precautions until a physician clears their spine and writes the order in the patient record. If radiological studies have been done, a final read must be done by the radiologist.
- Even with a properly secured and sized C-spine collar, this is not 100% protection against movement. This can be problematic in the uncooperative or agitated patient. This population may need sandbagging with head and torso secured for pre-hospital transport or in the in-hospital setting, sedation or chemical paralysis.

Selection of Appropriate Size Collar
See Aspen fit guide.

Equipment
Cervical collar and at least two people.

Procedure for Placing Cervical Collar
1. When able to do so, e.g., patient awake and alert and able to follow commands, obtain a neurological assessment before and after placement.
2. With the patient supine, one person maintains immobilization by placing their hands on each side of the patient's neck. The thumb of each hand is placed on the patient's anterior shoulders with the other fingers behind the shoulders. The neck is immobilized by the hands and the arms are beside the neck and head.
3. The second person slids the posterior cervical collar behind the patient's neck without moving the neck. This is properly placed when the neck rests in the middle of the collar and the top edge of the collar is at the occiput. The lower edge of the collar is at the trapezius.
4. Once this is accomplished, the anterior portion is placed by the second person. This is properly placed when the chin sits securely in the chin rest. The neck is in neutral position, i.e, not extended or flexed. The bottom of the anterior collar rests on the sternum.
5. The anterior and posterior sections are fastened together with the Velcro so the neck is snug in the collar but not so tight that vessels or the trachea are strangulated.

**Post Placement Care**

1. Maintain full alignment until the spine is cleared.
2. Sometimes the TLS is cleared but the C-spine is not. C-spine immobilization continues with the cervical collar in place until further evaluation is done. The neck must remain in neutral position, i.e., no bending, flexing, extending or turning side to side. At this point, the head of the bed may be elevated.
3. BE CAREFUL. Ensure that you always know if the patient is in full spinal precautions (CTLS) or cervical spinal precautions (C-Spine only).
4. Perform a neurological examination daily noting, movement of all extremities (to verbal / pain / none). Assess and document sensation to all four extremities.
5. The skin underneath the collar is assessed at least every shift, especially in obtunded patients, to look for decubiti, especially around the occiput.
3-Lead System Electrocardiogram (ECG) Monitoring

Objectives
At the end of the session the student will:
1. State the clinical conditions/situations which require continuous ECG monitoring.
2. Demonstrate the ability to set-up a 3-Lead ECG system.
3. Understand the differences between Lead I, Lead II and Lead III.
4. Discuss potential errors that may occur when using a continuous 3-lead ECG.

Indications
Many patient conditions/situations require continuous ECG monitoring. Unstable vital signs (hypotension, tachycardia, bradycardia,) heart arrhythmias, e.g., heart blocks, heart disease, electrolyte abnormalities (hyperkalemia, hypomagnesemia, etc.) are all problems that require continuous monitoring.

Contraindications
None

General Principles
An electrocardiogram graphically displays the electrical forces of the heart. The number of leads used to display a continuous heart rhythm and rate are usually three or five leads. These systems are used at the bedside with portable transport monitors. They graphically display the patient’s ECG waveform and provide a digital (numeric) reading of the heart rate.

Equipment
An ECG monitor, cable, and three electrodes.

Procedure for Placing Electrodes on the Patient Chest
Ensure patient’s chest is clean and dry. Hair and diaphoresis may make it difficult for the leads to adhere to the chest. If necessary, the chest hair may be shaved and if someone is very diaphoretic, you may use an adhesive agent, e.g., tincture of benzoin to help the leads stick to the chest wall.

- Right Arm (RA) Placement – place directly below the clavicle and near the right shoulder
- Left Arm (LA) Placement – place directly below the clavicle and near the left shoulder
- Left Leg Placement – place on the left lower abdomen.

With three leads positioned on the chest in the preceding locations, you may obtain three different graphic displays of heart activity. These leads are termed, lead I, lead II and lead III.

Lead I – the (+) is on the left shoulder and the (−) lead is on the right shoulder
Lead II – the (+) lead is on the left leg/lower left chest and the (−) negative lead is on the right shoulder
Lead III – the (+) lead is on the left leg/lower left chest and the (−) negative lead is on left shoulder

Lead II is commonly used because the wave of depolarization moves towards the positive lead on the left leg. All of the ECG waveforms (p-wave, QRS complex, t-wave) should be upright when cardiac conduction is normal.

If you are unable to get an adequate display of activity in Lead II, you may switch to Lead I or III.

Monitoring
The patient’s ECG is continuously displayed. How often the numeric value or rhythm is recorded is dependent upon the patient and the situation. Different protocols guide documentation of patient’s vital signs. The heart rate and rhythm is only a portion of the vital signs. Always check the unit or service guideline/protocol for monitoring and recording vital signs. It is important to document significant changes in the rhythm or the rate.
Urinary Catheter Placement

Objectives
At the end of the session the students will:
1. Describe the indications and contraindications for urinary catheter placement.
2. Describe the process of selecting the appropriate size catheter.
3. Demonstrate the appropriate technique for urinary catheter placement.
4. Demonstrate the appropriate technique for urinary catheter removal.
5. Describe post-insertion care.

Indications
- Treat urinary retention and bladder outlet obstruction (anatomic or physiologic).
- For accurate urine output measurement of critically ill or postoperative patients.
- To obtain a urine specimen, e.g., urinalysis, urine toxicology, urine culture (only if patient is unable to provide voided specimen).
- To measure intra abdominal pressures (for abdominal compartment syndrome).

Contraindications
Evidence of urethral trauma. May occur in patients with pelvic fractures, straddle injuries or penetrating trauma. Signs and symptoms: blood at the meatus of the urethra, scrotal or perineal hematoma, high riding prostate – these all require a retrograde urethrogram to document urethral integrity prior to attempted insertion of a urinary catheter. **A rectal and genital exam must be done prior to inserting a foley catheter**

General Principles
- **Practice Alert** - Infections associated with indwelling urinary catheters are one of the most common hospital acquired infections.
- Must be done under strict aseptic technique.
- The cornerstone of preventing catheter associated urinary tract infection is strict adherence to maintaining the closed sterile urinary drainage.
- Once the catheter is in place, the catheter and collecting tubing must remain below the bladder and the urinary drainage bag must remain lower than the collecting tubing and catheter.

Selection of Appropriate Sized Catheters
- Adults: #16 or #18
- Children – use Broselow system

Equipment
- Sterile gloves
- Sterile drapes
- Cleansing solution
- Cotton swabs
- Forceps
- Syringe with sterile water (usually 10cc for adults, less for smaller catheters - check hub for amount)
- Foley catheter (usually #16 or #18 French)
- Lubricant (water based jelly)
- Collection bag and tubing
- Laboratory specimen tubes (urinalysis, toxicology, culture)

Procedure for Inserting Urinary Catheters
- Maintain standard precautions at all times.
- Gather equipment.
- Assist patient into supine position. Head of bed may be at position of comfort.
- Legs spread and feet together (female).
- Open catheterization kit and catheter.
- Prepare sterile field, apply sterile gloves.
- Connect catheter to drainage bag and tubing if not done.
- Apply sterile drape.
- Generously lubricate the distal portion (2-5 cm) of the catheter with lubricant.
- **Females**: separate labia using non-dominant hand.
- **Males**: hold the penis with the non-dominant hand.
- Maintain these positions until preparing to inflate the balloon.
- Cleansing – cleanse peri-urethral mucosa with cleansing solution.
- **Females**: use your non-dominant hand to spread the labia.
- Wipe one side of the labia majora in an anterior posterior direction.
- Use a new wipe/cotton ball for the opposite side.
- Repeat for the labia minora.
- Use the last wipe/cotton ball to cleanse directly over the meatus. Cleanse anterior to posterior, outer to inner, one wipe per swab/cotton.
- **Males**: retract foreskin if necessary, hold penis just below the glans. Cleanse in a circular motion from the meatus around the glans, one wipe/cotton ball per each circular motion. Discard away from sterile field.
- Pick up and hold end of catheter tip in dominant hand. Lubricate tip liberally.
- **Males**: hold the penis at the base in a perpendicular position to the patient’s body and apply upward traction (with non-dominant hand). This straightens the urethra.
- **Females**: Identify the urinary meatus and gently insert until 1 to 2 inches beyond where urinary flow was first noted.
- **Males**: Identify urinary meatus and gently insert until the catheter hub is at the urinary meatus (the entire length) of the catheter. Look for urine.
- Inflate the balloon.
- Tape catheter.
- **Females**: to the inside of the thigh.
- **Males**: to the thigh or abdomen.
- Document catheter size, amount and color of urine returned and any complications.

**Post Insertion Care**
Maintain the closed drainage system.
Incision and Drainage (I&D)

Objectives
At the end of the session the students will:
1. Recognize clinical features of abscesses.
2. Describe the indications and contraindications for I&D.
3. Describe the principles of management of various types of abscesses.
4. Demonstrate the technique of local anesthesia.
5. Demonstrate the general technique of I&D outside of the operating room.

Indications/Definitions/Principles
- Abscesses are localized infections of tissue marked by a collection of pus surrounded by inflamed tissue. Abscesses begin when normal tissue planes are breached, and microorganisms invade these underlying tissues. Causative organisms commonly include *Streptococcus*, *Staphylococcus*, enteric bacteria (perianal abscesses), or a combination of anaerobic and gram-negative organisms.
- Pressure develops within the abscess cavity resulting in a fluctuant mass which is hot, tender, and red when it involves the skin. Untreated, the abscess may burrow to the surface and rupture or spread, dissect, and destroy adjacent tissues. Bacteria may then gain entry into the blood stream, resulting in bacteremia.
- Cutaneous abscesses have been described in all areas of the body, but are most commonly found in the axillae, buttocks, and extremities.
- Abscesses resolve by drainage. Small abscesses may resolve without incision and drainage however, in general the primary therapy for abscess management is Incision and Drainage (I&D).

Contraindications to I & D Outside of the Operating Room
- Extremely large abscesses may require extensive incision, debridement, or irrigation.
- Deep abscesses in very sensitive areas (supralevator, ischiorectal, perirectal) require general anesthetic.
- Palmar space abscesses, or abscesses in the deep plantar spaces are more likely to develop complications.
- Abscesses in the nasolabial folds (may drain to sphenoid sinus, causing septic phlebitis).
- Patients at increased risk for endocarditis, such as those with abnormal or artificial heart valves, may require pre-operative antibiotic therapy prior to I&D.

Equipment
- Universal precautions materials – gown, gloves, face mask with a shield (many abscesses are under pressure)
- A preassembled laceration kit should include many of the necessary items:
  - Skin prep solution (chlorhexidine or povidone iodine)
  - #11 or #15 scalpel blade with handle
  - Curved hemostat
  - Forceps
  - Scissors
  - Culture swabs
  - Normal Saline with a sterile bowl
  - Bulb syringe, a larger syringe with a splash guard or a needleless 18-gauge angiocatheter for irrigation
  - Wound packing material (plain or iodoform, 1/2”)
  - Draping
  - Sterile gauze
  - Tape
  - 1% or 2% lidocaine with epinephrine or bupivacaine
  - 25 gauge needle
  - 5-10 cc syringe

Preparation and Anesthesia
- Wash hands, put on gown, gloves and face shield
- Drape to create a sterile field
- Cleanse the skin starting at the peak of the abscess and circling out. Cover a wide area outside of the wound.
- Anesthetize the top of the wound by inserting a 25-gauge needle just under and parallel to the surface of the skin. Once the bore of the needle is under the skin, draw back to ensure that you are not in a vessel and then use gentle pressure to infiltrate the skin with the anesthetic agent. Inject anesthetic into the intradermal tissues. You will note blanching of the tissue as the anesthetic
spreads out. Continue with infiltration until you have covered an area over the top of the abscess large enough to anesthetize the area of incision.

**Incision and Drainage Procedure**

- Hold the scalpel between the thumb and forefinger to make initial entry directly into the abscess. Cosmetic results can be optimized if the incision is made parallel to existing skin-tension lines.

- Make an incision directly over the center of the cutaneous abscess.

- The tissue overlying the abscess cavity is incised so that the full width of the cavity is opened. The incision should be oriented along the long axis of the fluid collection. You may feel resistance as the incision is initiated. Steady, firm pressure will allow a controlled entry into the subcutaneous tissues. Control the scalpel carefully during the stab incision to prevent puncturing through the back wall, which can lead to bleeding that is difficult to control. Purulent discharge will begin draining when the abscess cavity has been entered successfully. Extend the incision to create an opening large enough to ensure adequate drainage and to prevent recurrent abscess formation; the incision may need to extend the length of the abscess borders. The goal is to allow enough access for introduction of hemostats to break up loculations and for placement of internal packing material.

- After allowing the wound to drain spontaneously, gently express any further contents. Most abscesses are located so that incision into the cavity alone will not provide adequate drainage. Once the cavity is entered a finger or a curved hemostat is used to gently breakdown the loculations to convert the space into a single cavity. Work in a circular fashion. Identify any deep tracts that extend into surrounding tissues.
• If aerobic and possibly anaerobic bacterial cultures are necessary, use a swab or syringe to obtain a sample from the interior aspect of the abscess cavity. Although most patients will not require antibiotics after successful incision and drainage, a culture can be very useful during a follow-up appointment, especially if the abscess has clinically worsened and treatment with antibiotics becomes necessary.

• Gently irrigate the wound with normal saline, using a bulb syringe or a needleless 18-gauge angiocatheter, to reach the interior of the abscess cavity. Continue irrigation until the effluent is clear.

• Drainage to the exterior should be maintained by keeping the wound open, initially with firm gauze packing for 24 hours to achieve hemostasis. It is critical that the skin margins remain open until the wound granulates from within out. If the skin margins close before the cavity is obliterated, recurrence of the abscess may occur. Using wound-packing material, such as 1/4 or 1/2 inch packing strips with or without iodoform, gently pack the abscess by starting in one quadrant and gradually working around the entire cavity.

Place sufficient packing material to keep the walls of the abscess separated and to allow further drainage of infected debris. Avoid over packing the wound as this may cause ischemia of the surrounding tissues and can impede the desired drainage of purulent material.

**Aftercare**

• Generally, antibiotics are not necessary unless there is associated soft tissue infection present or the patient is at high risk of systemic infection.
• Cover the wound with a sterile, non-adherent dressing.
• Remove the packing in two to three days.
• The frequency of further dressing changes will depend on the wound characteristics.
Intravenous Catheter Insertion

Objectives
At the end of the session the students will:
1. Describe the indication and contraindications for IV insertion.
2. Describe common sites for IV insertion.
3. Describe the different sizes and indications for IV cannulas/catheters.
4. Demonstrate the proper technique of IV insertion.
5. Demonstrate the proper technique for IV removal.
6. Describe the benefits of saline vs. heparin locks.

Indications
Administration of IV fluids, and/or medications.

Contraindications
Do not use an extremity if there is a fistula, shunt, amputation, or past surgical procedure (mastectomy).

General Principles
- Peripheral sites and tubing in the adult patient may be replaced according to local hospital policies.
- In children, leave the catheter in place until IV therapy is completed, unless there are complications (phlebitis, infiltration).
- All IV access should be removed as soon as they are no longer required.
- Saline locks are preferred over heparin locks because of possible side effects such as heparin-induced thrombocytopenia, thrombosis, hemorrhage, and potential incompatible drug interactions. Saline is also less expensive.

<table>
<thead>
<tr>
<th>Color</th>
<th>Size</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow</td>
<td>24G</td>
<td>Used in infants and children</td>
</tr>
<tr>
<td>Blue</td>
<td>22G</td>
<td>In children and patients with small veins (elderly)</td>
</tr>
<tr>
<td>Pink</td>
<td>20G</td>
<td>Standard size for routine use. Useful for most infusions and blood. 18G better for blood</td>
</tr>
<tr>
<td>Green</td>
<td>18G</td>
<td></td>
</tr>
<tr>
<td>Grey</td>
<td>16G</td>
<td>Used for patients in shock (GI bleeds, trauma)</td>
</tr>
</tbody>
</table>

Sites
- Antecubital - easy, fast but if the patient bends their arm solution may not infuse or it may infiltrate and go unnoticed.
- Hand - insertion more painful.
- Wrist - insertion more painful, mobile area may need to be splinted.
- Wrist to elbow - multiple choices, easy access.

Equipment
- Tourniquet
- Gloves
- Cannula/catheter
- IV solution
- IV tubing
- Saline Lock (Heparin Lock in infants and children – 100 units per mL)
- 2% chlorhexidine gluconate swabs preferred. If not available, may use alcohol or betadine swabs
- Clear dressing (op site, tegaderm, tape)
Procedure

- Wash hands.
- Prepare IV infusion and prime tubing.
- Explain procedure to patient.
- Place patient’s arm on a pillow.
- Select appropriate venipuncture site.
- Attach tourniquet to the upper arm or proximal to the proposed site.
- Put on gloves.
- Cleanse area with either a chlorhexidine swab or an alcohol or betadine prep with sufficient friction to reach into the cracks and fissures of the skin. Allow solution to dry.
- Hold catheter hub and rotate barrel 360 degrees.
- Anchor vein and insert cannula, bevel up, at a 10° angle to the skin and advance slowly until you feel the vein wall "give."
- Upon flashback visualization, lower catheter almost parallel to the skin.
- Advance entire unit slightly.
- Pull back the needle part of the cannula (the stylet) 1–2 mm and watch blood flow into plastic tubing.
- Thread catheter into vein while maintaining skin traction.
- Release tourniquet.
- Apply digital pressure beyond catheter tip.
- Gently stabilize the catheter hub.
- Press button to retract needle.
- Connect primed IV tubing to catheter hub.
- Initiate flow of IV fluid and assess for signs of infiltration.
- Cover catheter with transparent dressing.
- Regulate infusion as prescribed.
- Label dressing with date, time, catheter gauge and initials.
- Document (time, site, size, saline or heparin lock).
Knot Tying

Objectives
At the end of the session students will:
1. Understand the basic principles of knot tying.
2. Appropriately perform a two-handed square knot.
3. Appropriately perform an instrument tie.

Indications
Knots are tied in order to approximate tissues or vessels.

General Principals
Knots must be tied firmly in order to avoid slipping. Knots should be as small as possible. Suture can be damaged by crushing or crimping it with forceps or needle holders. Tissue strangulation with sutures tied too tightly should be avoided. Tension on each throw should be as horizontal and equal as possible.

Tying a Square Knot with Instruments
- With the needle holder in the right hand, place the needle through the tissue. Pull the suture through the tissue leaving a 2-3 cm end.
- Release the needle from the needle holder and grasp the long end of the suture (the side with the needle attached to it) with the left hand. The needle holder should be held in a position parallel and above the incision or wound and against the near side of the suture.
- With the left hand, wrap the suture toward the wound, around the needle holder once for a square knot, forming a clockwise loop around the needle holder, and twice for the first throw of a surgeon’s knot.
- Pick up the 2-3 cm end of the suture with the tip of the needle holder and pull it through the loop.
- To tighten the throw, pull the 2-3 cm end toward you and the long end away from you making sure the suture lies flat. This completes the first half of the knot.
- For the second half of the knot, release the 2-3 cm end from the needle holder. Again, position the needle holder parallel and above the incision or wound and against the near side of the suture. Wrap the long end once around the needle holder with the left hand. This mirror image half hitch is formed the same way as the first half hitch, except this time it forms a counter-clockwise loop around the needle holder.
- Pick up the 2-3 cm end with the tip of the needle holder and pull it through the loop. Lay the knot flat by pulling on the strands in opposite directions – the 2-3 cm end away from you and the long end toward you.

Two Handed Knot Tying
Basic concepts: One hand is a “working” or “throwing” hand, the other hand is an “assisting” or “pulling” hand. One should learn to tie knots using both hands in the different positions.

Following are the steps performed using the left hand as the “working” or “throwing” hand with bi-colored rope:
- Holding Position: Hold the white strand in the left hand on top of the purple strand which is held in the right hand. Rope ends are held by the ring and little fingers. Extended index fingers are placed under the rope. Thumbs are directed upwards. Keep thumbs and index fingers apart.
- Cross purple strand in between the left index finger and left thumb which places it under the white strand.
- Pinch index finger and thumb of left hand together.
- Pull purple strand up and over white strand and push it down through the loop. The right hand or “assisting/pulling” hand then grasps the purple end and pulls it away from the knot tier. The knot should be laid down perpendicular to the incision or wound.
- Assume the same Holding Position.
- Swing left thumb right to left under the white strand and put thumb on top of the white strand.
- Cross purple strand in between the left index finger and left thumb which places it over the white strand.
- Pinch index finger and thumb of left hand together and reach down through the loop.
- Pull purple strand up through the loop.
- The right hand then grasps the purple strand and pulls it towards the knot tier. Again, the knot should be laid down perpendicular to the incision or wound.
After perfecting the above, reverse hands and perform the steps using the right hand as the “working” or “throwing” hand with bi-colored rope.
Naso/Orogastric Tube Placement

Objectives
At the end of the session the students will:
1. Describe the indications and contraindications for naso/orogastric tube placement.
2. Describe the process of selecting the appropriate size tube.
3. Describe the process for verification of placement of a naso/orogastric tube.
4. Demonstrate the appropriate technique for naso/orogastric tube placement.
5. Demonstrate the appropriate technique for naso/orogastric tube removal.
6. Describe post-insertion care.

Indications
- Decompress the stomach, e.g., obstruction, adynamic ileus
- Administer feedings and medications
- Lavage post toxic ingestion
- Diagnostic for gastrointestinal bleeding, diaphragmatic hernias

Contraindications
- Blunt or penetrating head injury with suspected basilar skull fracture.
- Facial fractures.
- Suspected esophageal perforation (Boerhaave’s).
- Gastrointestinal surgery with orders stating that the nasogastric tube may not be manipulated by anyone or replaced if dislodgment occurs.

General Principles
- Insertion of a nasogastric tube is a painful procedure. Frequently, the tube is placed quickly and easily into the stomach. Some cases may take multiple attempts and can be very difficult.
- Orogastric tubes are generally inserted when nasogastric tubes are contraindicated or the nasogastric route is inaccessible (operator or patient).
- The most dreaded complication of naso/orogastric insertion is vomiting with subsequent aspiration. Other complications include nasal trauma, i.e., bleeding, sinus infections.
- Keep the head of bed (HOB) elevated 30 to 45 degrees when a feeding is infusing.
- Turn off feedings prior to placing HOB flat, e.g., for patient turning, transport, etc.

Selection of Appropriate Sized Catheters
- Adults - #16 or #18
- Children – use Broselow tape

Equipment
- Personal protective equipment, (face shield, non-sterile gloves)
- Naso/orogastric tube
- Tape – non-allergenic
- Water soluble lubricant
- Towel
- Cup with water and a straw
- Emesis basin or bag
- 60 ml catheter tip syringe

Verification of Placement
Always obtain radiographic confirmation of correct tube placement before instilling fluids (lavage) / medications (charcoal, potassium, etc.) There are multiple case reports where an auscultatory method of confirmation was used and was found inaccurate lending a false positive result.
*Examples – charcoal lavaged into the lung, tube feeding into the peritoneal cavity, etc.

Procedure
- Maintain universal precautions at all times.
- Determine if there are any contraindications to placing a nasogastric tube.
- Obtain appropriately sized tube.
- Explain the procedure to the patient and/or patient’s family.
- Wash hands and don gloves.
- Place the patient in a sitting position with the head of the bed elevated.
• If sitting is contraindicated, e.g., patient in full spinal precautions, place bed in reverse Trendelenburg. If neither position is possible, patient may be supine.
• Measure the distance the tube is to be inserted.
  Nasogastric – Beginning with the proximal tip, measure the distance from the bridge of the patient’s nose to the ear lobe and to the tip of the xiphoid process. Mark the distance on the tube with tape.
  Orogastric – Beginning with the proximal tip, measure the distance from the corner of the mouth to the ear lobe to the xiphoid process.
• When inserting a nasogastric vs. an orogastric tube, check nostril patency by asking the patient to sniff with one nostril closed and then repeat with the other nostril.
• Lubricate the tip of the tube (around the fenestrations) with water-soluble lubricant.
• Insert the tube into the nostril. Slide the tube backwards along the floor of the nostril. Do not force the tube. If an obstruction is felt, withdraw the tube and attempt reinsertion in a slightly different direction or use the other nostril.
• As the tube passes into the nasopharynx, have the patient take sips of water or instruct the patient to swallow. This closes the glottis and facilitates passage into the esophagus.
• Continue passing through the pharynx and down the esophagus until the tape-marked section of the tube reaches the external nares.
• Observe the patient for signs/symptoms of respiratory distress (coughing, gasping, cyanosis). Remove the tube immediately if any change in respiratory status occurs.
• Assess the tube for coiling in the oropharynx. If coiling is detected, remove the tube and reinsert.
• Secure the tube with tape to the nostril.
• Assess the tube for placement in the stomach.
• **GOLD STANDARD = Chest x-ray**
• May pull back and check contents and note color and amount.
• Document tube insertion in the appropriate patient care record.
  o Indicate size, color and amount of drainage
  o Note any complication, epistaxis, vomiting, nausea
• Daily documentation for patients receiving tube feedings is important.
  o Note type of feeding, amount, residual volumes (these are obtained every 4 hours by a nurse)
  o Recheck chest x-ray with any suspicion of tube dislodgement/movement
Papanicolaou (PAP) Smear

Objectives
At the end of the session students will:
1. Understand the indications and contraindications of a papanicolaou smear.
2. Appropriately demonstrate the procedure for performing a papanicolaou smear.
3. Describe appropriate analysis and follow up after performing a papanicolaou smear.

Indications
- **First Screen**: Women starting at 21 years of age, using standard pap or liquid-based technology.
- **Women age 21 up to age 65**: Screen every three years
- **Women age 30 or older**: Screen every 3 years, with either Pap or liquid-based technology. Screen more frequently in patients with positive PAP or positive high-risk HPV test; HIV infection; immunosuppression; DES exposure in utero; prior history of cervical intraepithelial neoplasia (CIN) 2, CIN 3, or cervical cancer.
- **Women age 30-65**: May screen every five years if an HPV co-test is completed and results of both are negative.
- **Women with Hysterectomy**: Discontinue screening if the cervix was removed for benign reasons and there is no history of abnormal or cancerous growth. If the woman has a history of abnormal cell growth, screen annually; may discontinue screening if three consecutive vaginal cytology tests are negative.
- **Older women**: Discontinue screening after 65 years of age.

Contraindications
- Menses.
- Avoid intercourse or use of douches, tampons, contraceptive foams, creams, or vaginal suppositories for 48 hours before examination.

General Principles
The best time for screening is between 10 and 20 days after the first day of the last menstrual period.

Procedure
- Correctly label the slide or liquid container with the patient’s name.
- Before bimanual examination, insert speculum to allow complete visualization of the cervix. You may lubricate the speculum sparingly.
- Perform Pap smear after testing for sexually transmitted diseases.

**Cervical Spatula and Endocervical Brush**:
- **Cervical Spatula**:
  - The concave end (curving inward) fits against the cervix, while the convex end (curving outward) is used for scraping vaginal lesions.
  - The concave end of the spatula is placed against the cervix and rotated in circular fashion so that the entire area around the cervical opening (os) is sampled, making sure to include the transformation zone and the squamocolumnar junction.
  - Place the spatula on the slide.
- **Endocervical Brush**:
  - Push the cytobrush into the endocervical canal, no deeper than the length of the brush (1.5 cm – 2.0 cm).
  - Rotate the brush 180 degrees.
  - Remove the brush and smear the slide with the brush, using a gentle rolling motion to avoid destroying any cells. Next smear the specimen from the cervical spatula on the slide.
  - Spray the slide promptly with a special fixative.
  - For women who have had a hysterectomy, Pap smears are obtained by using the convex end of the spatula, scraping it horizontally across the top of the vagina. Then the cytobrush is used to reach into the right and left top corners of the vagina.
  - Allow the slide to dry before placing in packaging.
• **Cervical Broom:**
  - Insert the broom’s long, central fibers into the endocervical canal.
  - Then rotate the broom in a complete circle, five times. Don’t rotate backwards in the opposite direction to avoid the loss of cells.
  - Remove the head of the broom and place in the solution without touching the broom.

• **Thin-Prep:**
  - If using the cervical spatula and endocervical brush, agitate both in the thin-prep solution 10 times, remove, and replace the cap on the container.
  - If using the cervical broom, remove the head of the broom, place in the thin-prep solution and replace the cap on the container.

• Remove speculum and continue with bimanual exam.
Skin Stapling

Objectives
At the end of the session the students will:
1. Describe the indications and contraindications for skin stapling.
2. Demonstrate the appropriate technique for placing skin staples.
3. Demonstrate the appropriate technique for removing skin staples.

Indications
The main advantage of staples over sutures is that they can be placed quickly. They produce minimal tissue reaction, low risk of infection, and strong wound closure. Staple closure is mainly used for large wounds that are not on the face. Stapling is especially useful for closing scalp wounds and also routinely used for linear lacerations of the torso and extremities, especially if they are relatively long.

Contraindications
Staples tend to leave more noticeable marks in the skin compared with sutures. They should NEVER be used on the face. They should not be used on any surface that must bear weight or is subject to pressure.

General Principles
The skin stapler is a medical device that places metal staples across the skin edges to bring the skin together. Stainless steel staples are frequently used in wounds under high tension, including wounds on the scalp and trunk. Surgical staples can hold wound edges very well. As they are placed, the wound margins should be brought together tightly with an exacting match and eversion of the skin edges. The area must be anesthetized before placing the staples if the patient is awake.

Procedure
- Create a sterile field.
- Administer local anesthetic.
- Thoroughly cleanse wound.
- The edges of the wound must be everted. Usually an assistant must help by using forceps to hold the skin edges so that the dermis on each side touches.
- Place the center of the stapler (usually an arrow on the center of the stapler marks the center) at the point where the skin edges come together.
- Gently touch the stapler to the skin; you do not have to push into the skin. Then grasp the handle to compress it; the compression releases the staple.
- Release the handle, and move the stapler a few millimeters back to separate the staple from the stapling device.
- The staples should be placed about 1 cm apart.

Staple Removal
- A staple remover device can be used to remove the staples easily. Put the jaws under the staple, and close the device. This bends the staple and allows it to be removed.
- If you do not have a staple remover, a clamp can be placed under the staple. After placing the clamp under the staple, open the clamp to bend the staple so that it can be removed. Removing a staple in this fashion can be painful.
- Skin staples should be removed at the same time that sutures would be removed based on wound location and tension.

<table>
<thead>
<tr>
<th>Location</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scalp</td>
<td>10 days</td>
</tr>
<tr>
<td>Neck</td>
<td>7 days</td>
</tr>
<tr>
<td>Trunk and upper extremities</td>
<td>10-14 days</td>
</tr>
<tr>
<td>Lower extremities</td>
<td>14-21 days</td>
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</tbody>
</table>
Suturing
(Adapted from Suturing: The Basics - Practical Plastic Surgery)

Objectives
At the end of the session the students will:
1. Understand the difference between a simple interrupted, simple continuous and a subcuticular suture.
2. Demonstrate the appropriate use of suture instruments (needle holder, scissors, forceps).
3. Describe the different types of suture needles.
4. Describe the indications for local anesthetics.
5. Demonstrate the proper technique for a simple interrupted, simple continuous and a subcuticular suture.
6. Demonstrate the proper technique for suture removal.

Indications
Suturing is the joining of tissues with a needle and suture so that the tissues bind together and heal. Suturing is required for most transcutaneous injuries. The functions of sutures are to close dead space, stop bleeding, support and strengthen wounds until healing increases their tensile strength, and approximate skin edges for an aesthetically pleasing and functional result.

Contraindications
Wounds should NOT be sutured if they are infected or have not been thoroughly debrided of necrotic tissue.

General Principles
The choice of suture technique depends on the type and anatomic location of the wound, the thickness of the skin, the degree of tension, and the desired cosmetic result. The proper placement of sutures enhances the precise approximation of the wound edges, which helps minimize and redistribute skin tension. Wound eversion is essential to maximize the likelihood of good epidermal approximation. Eversion is desirable to minimize the risk of scar depression secondary to tissue contraction during healing. Usually, inversion is not desirable. Poorly sutured wounds heal more slowly and have an increased risk of bad result in an individual with a propensity for hypertrophic scars. The elimination of dead space, the restoration of natural anatomic contours, and the minimization of suture marks are also important factors to optimize the aesthetic and functional results.

Equipment/Instruments
- Suture kit
- Needle Holder: used to grab onto the suture needle
- Forceps: used to hold the tissue gently and grab the needle
- Suture scissors: used to catch the stitch from the rest of the suture material
- Lidocaine
- Sterile saline
- Syringe
- Needle
- Sterile gauze
- Suture
- Adhesive tape

Types of Needles
- There are two broad classifications of needles: curved and straight.
  1. Curved: More preferred needle for suturing. There are two types of curved needles: cutting and tapered.
     a. Cutting Needle: Used primarily for suturing the skin. It has a very sharp tip with sharp edges which are needed to pass through the skin.
     b. Tapered Needle: “Round bodied” needles. Tapered needles have a sharp tip with smooth edges and are less traumatic to the surrounding tissues. Used primarily on the deeper, subcutaneous tissues, blood vessels, and intestinal anastomoses. A tapered needle is not good for skin suturing because it is difficult to pass the tapered needle through the skin.
  2. Straight: A straight needle can be used without instruments. Cumbersome and entails a much higher risk of accidentally sticking yourself. Uncommon and not recommended if curved needles are available.

Suture Sizes
- Sutures come in various sizes. The bigger the number, the smaller the size of the suture. Suture sizes range from 00 (very...
large, used to close the abdominal wall) to 10-0 (very tiny, used for microvascular anastomoses). You will generally use sizes in the middle range: 3-0 to 5-0.

- It is best to use small sutures on the face, such as a 5-0 or 6-0. Smaller sutures are associated with decreased scarring. On most areas of the body a 3-0 or 4-0 is appropriate. It is best to use smaller sutures on children due to their delicate skin.

Types of Suture Material
There are many types of suture material available. The two main classifications are absorbable or non-absorbable. Sutures can be further broken down into braided or non-braided.

- **Non-absorbable Sutures**
  Remain in place until they are removed. They are less tissue-reactive and leave less scarring as long as they are removed in a timely manner. They are best used on skin.

- **Absorbable Sutures**
  Dissolved by the body’s tissues. Do not need to be removed. Primarily used under the skin where they are well hidden. Tend to leave a more pronounced scar when used on the skin.

- **Braided Sutures**
  Made up of several thin strands of suture material twisted together. Easier to tie than non-braided sutures, however they have little interstices in the suture material where bacteria can hide and grow. This may result in skin infections.

- **Non-braided Sutures**
  A monofilament single strand. Recommended for most skin closures, especially wounds at risk for infection.

Handling of Instruments

- **Scissors**: Place your thumb and ring finger in the holes. Cut with the tips of the scissors to avoid accidentally injuring any surrounding structures or tissue.

- **Needle Holder**: If the driver is ratcheted, grab the needle until the clasp engages, ensuring that the needle is securely held. The needle holder is tightened by squeezing it until the first ratchet catches. The needle holder should not be tightened excessively because damage to both the needle and the needle holder may result. The needle is held in place by the needle holder in the middle third, with the tip pointing upward. Incorrect placement of the needle in the needle holder may result in a bent needle, difficult penetration of the skin, and/or an undesirable angle of entry into the tissue. Grab the suture needle with the needle holder: *never handle the suture needle with your fingers.*

- **Forceps**: Hold the forceps like a pencil. Be careful not to grab the skin too hard. It is best to grab the dermis or subcutaneous tissue—not the skin—with the forceps. The tissue must be stabilized to allow suture placement. Depending on the one’s preference, toothed or untoothed forceps or skin hooks may be used to gently grasp the tissue. Excessive trauma to the tissue being sutured should be avoided to reduce the possibility of tissue strangulation and necrosis.

Local Anesthesia
The evaluation, cleansing, and suturing of a wound can be painful. Often it is necessary to use a local anesthetic for pain control. Local anesthetics work by reversibly blocking nerve conduction. The duration of effect depends on how long the agent stays in the immediate working area before being absorbed into the circulation or broken down by the surrounding tissues.

There are two commonly used anesthetic agents: Lidocaine and Marcaine (Bupivacaine)

- **Lidocaine**: Most commonly used and the least expensive agent. The usual dose is 3-5 mg/kg/body weight. Do not give more than this amount at one time. The anesthesia becomes effective after 5-10 minutes and lasts from 45 minutes to 1 hour.

- **Marcaine**: Longer acting than lidocaine. More expensive. The usual dose is 2-4 mg/kg/body weight. The anesthesia becomes effective after 10-15 minutes and lasts from 2-4 hours. Marcaine should be given when the wound will take more than one hour to clean and suture. In addition, marcaine also gives residual pain control after the procedure is complete.

- **Additives**: It is sometimes useful to add additional drugs to the local anesthetic solutions to optimize their effect. The two most common additives are bicarbonate and epinephrine.

  - **Epinephrine**: Epinephrine is a vasoconstrictor that shrinks blood vessels and thus reduces bleeding from the wound and surrounding skin edges. Lidocaine and marcaine are available in solutions premixed with epinephrine. The proper doses are as follows:
**Lidocaine with epinephrine:** 7 mg/kg body weight. Effects last 1.5-2 hours.

**Bupivacaine (Marcaine™) with Epinephrine:**
Dosing stays the same at 2-3 mg/kg/body weight. Effects last 2-4 hours.

**Contraindications** to adding epinephrine: In certain circumstances, the vasoconstricting effects of epinephrine can be detrimental and lead to tissue loss. Examples include:
- Digital blocks
- Tip of the nose
- Penis
- Ragged and irregular lacerations

**Local Anesthesia Procedure**
- Use the smallest needle possible and inject slowly.
- Draw back on the syringe before injecting the solution to ensure that you are not in an artery. Injecting the solution into an artery can be dangerous.
- Inject directly into the wound if the wound is reasonably clean.
- If the wound is dirty, inject into the non-injured skin along the outside of the wound.
- Inject until you see the skin start to swell.
- Be sure to allow enough time for the agent to take effect prior to suturing.

**Placement of Sutures**
For most areas of the body, the sutures should be placed in the skin 3-4 mm from the wound edge and 5-10 mm apart. Sutures on the face should be approximately 2-3 mm from the skin edge and 3-5 mm apart.

Approximation of the wound should be very exact and performed with a gentle eversion of the wound edges. Wound edges that are inverted will almost always produce a sunken scar. When sutures are removed from a wound, there will be some relaxation and tissue that had been raised with gentle eversion will likely flatten in a relatively short time.

**Suturing Techniques**

**Simple Interrupted**

**Indications**
- Used for most skin suturing. Easy to place, have greater tensile strength than running sutures, and have less potential for causing wound edema and impaired cutaneous circulation. Interrupted sutures also allow the physician to make adjustments as needed to properly align wound edges as the wound is sutured. Technique of choice if you are worried about the cleanliness of the wound. Allows the ability to remove a few sutures if the wound looks like it is becoming infected.

**Disadvantages**
- Length of time required for placement and the greater risk of crosshatched marks (i.e., train tracks) across the suture line. The risk of crosshatching can be minimized by removing sutures early to prevent the development of suture tracks.

**Procedure**
- Create a sterile field.
- Administer local anesthetic.
- Thoroughly cleanse wound.
- Insert needle through the epidermis into the subcutaneous tissue from one side, then come through the subcutaneous tissue on the opposite side, and come out the epidermis above.
- To evert the edges, the needle tip should enter at a 90° angle. Once the needle tip has penetrated through the top layers of the skin, twist your wrist so that the needle passes through the subcutaneous tissue and then comes out into the wound.
- Pull the suture through the skin leaving a few centimeter “tail”.
- Take the needle out of the needle holder.
- Place your needle in the center between the skin edges parallel to the wound. One end of the suture should be on each side of the wound without crossing in the middle.
- Perform an instrument tie (see knot tying module) to secure suture.
- The length of the tails will depend on the type of suture in question.
Simple Continuous

Indications
Running sutures are useful for long wounds in which wound tension has been minimized with properly placed deep sutures and in which approximation of the wound edges is good. This type of suture may also be used to secure a split- or full-thickness skin graft. Theoretically, less scarring occurs with running sutures compared with interrupted sutures because fewer knots are made with simple running sutures; however, the number of needle insertions remains the same. The major advantage of running sutures is that they can be placed quickly with more rapid reapproximation of wound edges.

Disadvantages
Risk of dehiscence if the suture material ruptures, difficulty in making fine adjustments along the suture line, and puckering of the suture line when the stitches are placed in thin skin.

Procedure
- Create a sterile field.
- Administer local anesthetic.
- Thoroughly cleanse wound.
- Start by placing a simple interrupted stitch. Tie the stitch by performing an instrument tie. DO NOT cut the suture.
- Place a series of simple sutures in succession without tying or cutting the suture material after each pass. Sutures should be evenly spaced, and tension should be evenly distributed along the suture line.
- When you reach the end of the wound, do not pull the next-to-last stitch all the way through; leave it as a loop.
- Perform an instrument tie to secure the suture using the loop of the suture as one end.

Running Subcutaneous/Subcuticular

Indications
The running subcutaneous suture is used to close the deep portion of surgical defects under moderate tension. It is used in place of buried dermal sutures in large wounds when a quick closure is desired. Absorbable suture is often used however, non-absorbable suture may also be used for subcuticular suturing.

Disadvantages
Risk of suture breakage and the formation of dead space beneath the skin surface.
Procedure
- Create a sterile field.
- Administer local anesthetic.
- Thoroughly cleanse wound.
- Begin with a simple interrupted subcutaneous suture, which is tied but not cut.
- Loop the suture through the opposite side of the wound staying within the subcutaneous tissue.
- When you reach the end of the wound, do not pull the next-to-last stitch all the way through; leave it as a loop.
- Perform an instrument tie to secure the suture using the loop of the suture as one end.

Disadvantages
The suture does not provide significant wound strength, although it does precisely approximate the wound edges. Therefore, the running subcuticular suture is best reserved for wounds in which the tension has been eliminated with deep sutures, and the wound edges are of approximately equal thicknesses.

Procedure
- Create a sterile field.
- Administer local anesthetic.
- Thoroughly cleanse wound.
- Begin with a simple interrupted subcutaneous suture, which is tied but not cut.
- Loop the suture through the apex of the wound and continue on taking horizontal bites through the papillary dermis on alternating sides of the wound. No suture marks should be visible.
- On the last throw, leave a loop and either tie and instrument knot or a hitch knot. Cut the tail just above the knot, reenter the wound just below the knot, exit a centimeter away and cut the suture on the surface of the skin.

Running Subcuticular Sutures

Indications
The running subcuticular suture is valuable in areas in which the tension is minimal, the dead space has been eliminated, and the best possible cosmetic result is desired. Because the epidermis is penetrated only at the beginning and end of the suture line, the subcuticular suture effectively eliminates the risk of crosshatching.

Suture Removal
- Sutures should be removed within 1-2 weeks of their placement, depending on the anatomic location. Prompt removal reduces the risk of suture marks, infection, and tissue reaction. The average wound usually achieves approximately 8% of its expected tensile strength 1-2 weeks after surgery. To prevent dehiscence and spread of the scar, sutures should not be removed too soon.
- As a general rule, the greater the tension across a wound, the longer the sutures should remain in place. As a guide, on the face, sutures should be removed in 5-7 days; on the neck, 7 days; on the scalp, 10 days; on the trunk and upper extremities, 10-14 days; and on the lower extremities, 14-21 days. Sutures in wounds under greater tension may need to be left in place slightly longer. Buried sutures, which are placed with absorbable suture material, are left in place because they dissolve.
- Proper suture removal technique is important to maintain good results after sutures are properly selected and executed.
Procedure

- Cleanse the area with an antiseptic. Saline can be used to remove serum encrusted around the sutures.
- Pick up one end of the suture with forceps and cut as close to the skin as possible where the suture enters the skin.
- Gently pull the suture strand out through the side opposite the knot with the forceps. To prevent risk of infection, the suture should be removed without pulling any portion that has been outside the skin back through the skin.
- Steri-Strips may be applied with a tissue adhesive to provide continued supplemental wound support after the sutures are removed.
- Pitfalls to avoid:
  - Do not cut the suture at two points. Doing this may leave the rest of the material embedded in the skin.
  - Do not pull the suture away from the incision. This could separate the wound edges and disrupt the epithelization.
Objectives
At the end of the session students will:
1. Understand the indications and contraindications of a vaginal wet mount.
2. Appropriately demonstrate the procedure for performing a vaginal wet mount.
3. Describe appropriate analysis and follow up after performing a vaginal wet mount.

Indications
- Complaint of abnormal vaginal discharge, itching or odor.
- Observable non-physiologic discharge on exam.

Contraindications
- Menses.
- Recent intercourse.
- Recent douching or use of any intravaginal medications.

Procedure
- Collecting Specimen
  o Insert speculum and visualize cervix: collect other necessary specimens first (Pap).
  o Swab multiple areas of vaginal walls and fornices with a new cotton-tipped applicator, noting the color, consistency and odor of any discharge present (often the odor of bacterial vaginosis and trichomoniasis is grossly appreciable).
  o Touch the applicator to a small piece of litmus paper, noting the pH.
  o Rest applicator on a glass slide while you complete the rest of your exam (DO NOT SMEAR…it will dry out and become unreadable).
  o Remove speculum and complete the bimanual exam.
  o Remove gloves, wash hands, and ask patient to re-dress while you perform microscopy.
  o Don clean gloves and transport applicator with specimen and glass slide to microscope.

Preparing and Interpreting Slides
- Apply 2 drops of normal saline to the slide.
- Gently touch applicator to drop, creating a homogeneous suspension of cellular material: thick specimens will preclude diagnosis.
- Apply cover slip slowly at an angle to prevent air bubbles from forming.
- Drain excess fluid and dry back of slide with paper towel if necessary.
- Prepare KOH sample in same manner (drop of KOH onto slide, touch with applicator).
- NOTE: you may place both of the drops of saline and the drops of KOH on the same slide at opposite ends if you’re careful. Always standardize which end is which and be sure to touch the applicator to the saline drop BEFORE touching the KOH drop.
- Not any amine or “fishy” odor before applying cover slip (the “whiff” test).
- Examine both suspensions under 10X then 40X:
  o Saline: note present/absence of lactobacilli, PMNs, RBCs, clue cells, trichomonads, other.
  o KOH: note presence/absence of yeast/pseudohyphae or other fungal organisms.

Analysis and Follow-up
- Correlate microscopic and clinical findings with patient complaint to arrive at a diagnosis.
- Chart all findings appropriately, provide patient education, and treat any infection present.
Venipuncture - Blood Withdrawal/Blood Culture Withdrawal

Objectives
At the end of the session students will:
1. Understand the appropriate order of tube collection.
2. Understand universal precautions while collecting blood specimens.
3. Demonstrate the ability to appropriately draw blood.
4. Demonstrate the ability to appropriately draw blood cultures.

Indications
For the purpose of obtaining a sample of venous blood for laboratory testing.

General Information
- Three methods for withdrawing blood are possible.
  1. Vacutainer – vacutainer needle and holder.
  2. Cannula/Angiocath with a luer tip syringe, vacutainer adaptor and holder.
  3. Wing-Tip/Butterfly - 23 gauge needle.
- Certain tests require containers with additives and/or anticoagulants.

<table>
<thead>
<tr>
<th>Tubes</th>
<th>Additives/Anticoagulants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold Top</td>
<td>Serum Separation Gel separates blood from serum when centrifuged</td>
</tr>
<tr>
<td>Lavender Top</td>
<td>EDTA (K3E)</td>
</tr>
<tr>
<td>Light Blue Top</td>
<td>Buffered Sodium Citrate</td>
</tr>
<tr>
<td>Pink Top</td>
<td>EDTA (K2)</td>
</tr>
</tbody>
</table>

- Use gel tubes for chemistry and immunology tests. The gel increases the stability of the analytes and enhances laboratory efficiency by improving turn around time.
- Use pink top tubes for the Blood Bank.
- Label all tubes correctly. If tubes are not labeled or if they are mislabeled, the request will be cancelled and the specimen discarded.

Order of Collection
The first two draws must be obtained in a specific order to avoid contaminating the culture tubes or contaminating the electrolyte tube with additives.
1. Blood culture bottle or tube
   a. aerobic
   b. anaerobic
   c. fungal (only used if indicated)
2. Electrolytes, liver function tests
Then, any order for the following:
3. Type and Cross – (it is really “Type and Hold” as the Type and Cross is not completed until the patient actually needs blood).
4. CBC – magenta colored top (tube must be filled completely)
5. Coagulation Studies – blue top (tube must be filled completely).
6. Troponin, Ammonia – green top (ammonia must be sent on ice).

Tubes With Additives Must Be Thoroughly Mixed to Avoid Erroneous Results.

Safety
- Positive patient identification - check ID band (must be on the patient's wrist or ankle).
- Always ensure that tubes are labeled with the patient's name (check ID band, ask the patient their name, etc. Check and double check!).
- Wash your hands.
- Wear non-sterile gloves.
- Use Universal (Standard) Precautions.

Equipment
- Non sterile gloves.
- Angiocath, Butterfly, Vacutainer.
- Chlorhexidine (if chlorhexidine is not available, alcohol may be used).
- 2 x 2” gauze.
- Specimen tubes.
- Tourniquet
Procedure Using a Vacutainer
- Select the venipuncture site. Blood is most commonly obtained from the median cubital vein, on the anterior forearm. The cephalic veins of the arm are also used frequently. The basilic vein on the dorsum of the arm or dorsal hand veins are also acceptable for venipuncture. Avoid withdrawing blood in extremities with IV infusions or with signs of tissue injuries, vascular compromise, arterial-venous shunt, and extremities adjacent to a mastectomy site.
- Wash your hands and put on gloves.
- Apply the tourniquet 3-4 inches above the selected puncture site.
- The patient should make a fist without pumping the hand.
- Cleanse the site by starting in the center of the target area with a 2% chlorhexidine prep pad using sufficient friction back and forth to assure that the solution reaches into the cracks and fissures of the skin. Allow the skin to dry for 30 seconds (especially important if drawing cultures). If chlorhexidine is not available, use an alcohol prep pad and cleanse in a circular fashion from the inside to the outside.
- Twist Vacutainer needle to expose the rubber sleeve and screw into Vacutainer holder.
- Grasp the patient’s arm firmly using your thumb to draw the skin taut and anchor the vein. The needle should form a 15 to 30 degree angle with the surface of the arm.
- Swiftly insert the needle through the skin and into the lumen of the vein. Avoid trauma and excessive probing.
- Stabilize the Vacutainer holder and gently push a specimen tube onto the rubber sleeve.
- Aspirate the minimal amount of blood required for the specimen.
- Repeat the process as many times as necessary.
- When the last tube to be drawn is filling, remove the tourniquet.
- Remove the needle from the patient’s arm using a swift backward motion.
- Press down on the gauze once the needle is out of the arm, applying adequate pressure to avoid formation of a hematoma.
- Dispose of contaminated materials/supplies in designated containers.
- Mix and label all appropriate tubes at the patient bedside.
- Attach syringe to plastic adapter of butterfly tubing.
- Insert the needle quickly and firmly with the bevel up.
- Aspirate the minimal amount of blood required for the specimen.

Procedure Using a Cannula
- Prepare as above
- Hold catheter hub and rotate barrel 360 degrees.
- Anchor vein and insert cannula quickly and firmly with the bevel up, at a 10° angle to the skin and advance slowly until you feel the vein wall "give."
- Upon flashback visualization, lower catheter almost parallel to the skin.
- Advance entire unit slightly.
- Thread catheter into vein while maintaining skin traction.
- Apply digital pressure beyond catheter tip.
- Gently stabilize the catheter hub.
- Press button to retract needle.
- Screw in a Vacutainer luer adapter with a holder into the plastic hub of the Angiocath.
- Aspirate the minimal amount of blood required into the specimen tubes.
- Unscrew the Vacutainer luer adapter.
- Insert the primed IV tubing or reflux valve into the plastic hub.
- Stabilize the angiocath with tape.

Blood Culture Withdrawal

Equipment
As above, plus blood culture bottles.

Procedure
- Remove caps from bottles. Wipe the stopper with alcohol.
- As above, select site, wash hands, put on gloves and apply tourniquet.
- Perform venipuncture and obtain 8-10 mls in each bottle (adult) or 1-5 ml (peds).
- Remove the tourniquet.

Procedure Using Wing Tipped access “butterfly”
- Prepare as above.
Wound Care

**Dressing Change/Wound Irrigation/Packing a Wound**

**Objectives**
At the end of the session the student will:
1. Understand the difference between the various types of dressings.
2. Demonstrate the ability to appropriately apply a dressing.
3. Demonstrate the ability to appropriately clean a wound.
4. Identify when wound irrigation is indicated.
5. Demonstrate the ability to irrigate a wound.
6. Identify the indications for wound packing.
7. Demonstrate the ability to appropriately pack a wound.

**General Principles**
The cardinal rule is to keep wound tissue moist and surrounding tissue dry. Ideally, a dressing should keep the wound moist, absorb drainage or debris, conform to the wound, be adhesive to the surrounding skin and be easily removable. The basic purpose of a dressing is to provide the best environment for the body to heal itself. Functions of a wound dressing include:
- Protecting the wound from contamination and trauma.
- Providing compression if bleeding or swelling is anticipated.
- Applying medications.
- Absorbing drainage or debrided necrotic tissue.
- Filling or packing a wound.
- Protecting the skin surrounding the wound.

**Choosing a dressing**
The patient’s needs and wound characteristics determine the type of dressing to use on a wound.

**Types of dressings include:**

<table>
<thead>
<tr>
<th>Gauze Dressings</th>
<th>Made of absorptive cotton or synthetic fabric. They are permeable to water, water vapor, and oxygen and may be impregnated with hydrogel or another agent. When uncertain about which dressing to use, you may apply a gauze dressing moistened with normal saline.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrocolloid Dressings</td>
<td>Hydrocolloid dressings are adhesive, moldable wafers made of a carbohydrate-based material and usually have water-proof backings. They are impermeable to oxygen, water, and water vapor and most have some absorptive properties.</td>
</tr>
<tr>
<td>Transparent Film Dressings</td>
<td>Clear, adherent, and non-absorptive. These polymer-based dressings are permeable to oxygen and water vapor but not to water. Their transparency allows visual inspection. Because they can’t absorb drainage, they are used on partial thickness wounds with minimal exudate.</td>
</tr>
<tr>
<td>Alginate Dressings</td>
<td>Made from seaweed, alginate dressings are nonwoven, absorptive dressings available as soft white sterile pads or ropes. They absorb excessive exudate and may be used on infected wounds. As these dressings absorb exudate, they turn into a gel that keeps the wound bed moist and promotes healing. It is best to switch to another type of dressing when exudate is no longer excessive.</td>
</tr>
<tr>
<td>Foam Dressings</td>
<td>Sponge-like polymer dressings that may be impregnated or coated with other materials. Somewhat absorptive, they must be adherent. These dressings promote moist wound healing and are useful when a non-adherent surface is desired.</td>
</tr>
<tr>
<td>Hydrogel Dressings</td>
<td>Water-based and non-adherent, hydrogel dressings are polymer-based that have some absorptive properties. They are available as a gel in a tube, as flexible sheets, and as saturated gauze packing strips. They may have a cooling effect, which eases pain, and are used when the wound needs moisture.</td>
</tr>
<tr>
<td>Negative Pressure Wound Dressing</td>
<td>Vacuum based wound dressing applied to any soft tissue defect, including those areas with active enterocutaneous fistulas. Promotes wound healing and may impact the systemic inflammatory response.</td>
</tr>
</tbody>
</table>
Choosing a Cleaning Solution

<table>
<thead>
<tr>
<th>Solution</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Saline</td>
<td>Most commonly used cleaning solution. Provides a moist environment promotes granulation tissue formation, causes minimal fluid shifts in healthy adults.</td>
</tr>
<tr>
<td>Hydrogen Peroxide</td>
<td>Commonly used ½ strength. Irrigates the wound and aids in mechanical debridement (its foaming action warms the wound which can cause vasodilation and reduce inflammation.</td>
</tr>
<tr>
<td>Acetic Acid</td>
<td>Treats <em>Pseudomonas</em> infection. Commonly used as a ¼ strength solution.</td>
</tr>
<tr>
<td>Sodium Hypochlorite</td>
<td>Antiseptic that also slightly dissolves necrotic tissue. This is an unstable solution that must be freshly prepared every 24 hours. Commonly used as a ¼ strength solution.</td>
</tr>
<tr>
<td>Povidone-iodine</td>
<td>Broad spectrum, fast acting antimicrobial. Watch for patient sensitivity to this solution. May stain surrounding skin.</td>
</tr>
</tbody>
</table>

Cleaning a Wound

The goal of wound cleaning is to remove debris and contaminants from the wound without damaging healthy tissue. The wound should be cleaned initially; repeat cleaning as needed and before a new dressing is applied.

Procedure for Cleaning the Wound

- Gather equipment.
  - Hypoallergenic tape or elastic netting
  - Piston type irrigating system
  - Two pairs of gloves
  - Cleaning solution
  - Sterile 4x4” gauze pads
  - Selected topical dressing
- Wash your hands and put on gloves.
- Inspect the wound. Note the color, amount and odor of drainage and necrotic tissue.
- Inspect the skin around the wound. Note redness, heat, moisture and irritation.
- Fold a sterile 4x4” gauze pad into quarters and dip into the cleaning solution. Alternatively, use a wound cleaning solution in a spray bottle or piston-type syringe.

- When cleaning, be sure to move from the least contaminated area to the most contaminated area. For a linear-shaped wound, such as an incision, gently wipe from top to bottom in one motion, starting directly over the wound and moving outward. For an open wound, gently wipe in concentric circles.
- Discard the gauze pad.
- Using a clean gauze pad for each wiping motion, repeat the procedure until you have cleaned the entire wound.
- Dry the wound with 4x4” gauze pads, using the same procedure as for cleaning.
- Measure the perimeter of the wound with a disposable wound-measuring device. Measure the longest length and widest width.
- Measure the depth of a full-thickness wound. Insert a sterile cotton-tipped applicator gently into the deepest part of the wound bed and make a mark on the applicator where it meets the skin level. Measure the marked applicator to determine the wound depth.
- *Test for tunneling:* Gently probe the wound bed and edges with your gloved finger or sterile cotton-tipped applicator to assess for wound tunneling or undermining. Tunneling usually signals wound extension along fascial planes. Gauge tunnel depth by determining how far you can insert your gloved finger or the cotton-tipped applicator.

Wound Irrigation

It is sometimes necessary to irrigate the wound to ensure that all debris and drainage is removed. It also helps prevent premature surface healing over an abscess pocket or infected tract.

Procedure for Wound Irrigation

- Gather equipment.
  - Emesis basin
  - Clean gloves
  - Sterile gloves if indicated
  - Goggles
  - Gown, if indicated
  - Prescribed irrigant such as sterile normal saline or water
  - Sterile container
  - 35-ml piston syringe with 19G needle or catheter
- Wash your hands and put on a gown and gloves.
Establish a clean or sterile field with all the equipment and supplies you’ll need for wound irrigation and dressing.

Pour irrigating solution into a clean or sterile container. Put on a new pair of gloves if indicated.

Attach a 19G catheter to a 35-ml piston syringe. This setup delivers an irrigation pressure which is effective in cleaning the wound and reducing the risk of trauma and wound infection. To prevent tissue damage, avoid forcing the catheter into the wound.

Gently instill a slow, steady stream of solution into the wound until the syringe empties.

Refill the syringe, reconnect the catheter, and repeat the irrigation. Continue to irrigate the wound until you’ve administered the prescribed amount of solution or until the solution returns clear.

Note the amount of solution administered.

Keep the patient positioned to allow further wound drainage.

Procedure for Applying a Dressing

- Applying a moist saline gauze dressing
  - Clean and dry the wound.
  - Moisten the gauze dressing with normal saline solution. Squeeze out excess fluid.
  - Gently place the dressing into the wound surface. Don’t pack gauze too tightly.
  - To protect the surrounding skin from moisture, apply a sealant or barrier.
  - Change the dressing often enough to keep the wound moist.

- Applying a hydrocolloid dressing
  - Clean and dry the wound
  - Choose a clean, dry, pre-sized dressing or cut one to overlap the wound by about 1”. Remove the dressing from its package, pull the release paper from the adherent side of the dressing, and apply the dressing to the wound. Hold the dressing in place with your hand. The heat from your hand will help with adherence and also helps with the molding of the dressing the shape of the wound.
  - As you apply the dressing, carefully smooth out wrinkles and avoid stretching the dressing.

- Applying a transparent dressing
  - Clean and dry the wound.
  - Select a dressing to overlap the wound by 1 to 2 inches.
  - Gently lay the dressing over the wound: avoid wrinkling the dressing. To prevent shearing force, don’t stretch the dressing over the wound. Press firmly on the edges to promote adherence. You may have to tape the edges to prevent them from curling.
  - Change the dressing every 3-5 days, depending on the amount of drainage. If the seal is no longer secure, or if accumulated tissue fluid extends beyond the edges of the wound and onto surrounding tissue, change the dressing.

- Applying an alginate dressing
  - Clean and dry the wound
  - Apply the alginate dressing to the wound surface. Cover the area with a secondary dressing (such as gauze pads or transparent film) as necessary. Secure the dressing with tape.
  - If the wound is draining heavily, change the dressing once or twice daily. As drainage decreases, change the dressing less frequently, every 2-4 days. When the drainage stops or the wound looks dry, stop using an alginate dressing.

- Applying a foam dressing
  - Clean and dry the wound
  - Gently lay the foam dressing over the wound.
  - Use tape, elastic netting, or gauze to hold the dressing in place.
  - Change the dressing when the foam no longer absorbs exudate.

- Applying a hydrogel dressing
  - Clean and dry the wound
  - Apply a moderate amount of gel to the wound bed.
  - Cover the area with a secondary dressing (gauze, transparent film, or foam).
- Change the dressing daily or as needed to keep the wound bed moist.
- If the hydrogel dressing you select comes in sheet form, cut the dressing to overlap the wound by 1”. Then apply the as you would a hydrocolloid dressing.

**Procedure for Removing a Dressing**
- Put on gloves.
- Gently roll or lift an edge of the soiled dressing to obtain a starting point. Support adjacent skin while gently releasing the soiled dressing from the skin. When possible remove the dressing in the direction of hair growth.
- Use saline solution to moisten portions of the dressings that don’t easily pull away.
- Discard old dressing and gloves in a waterproof trash bag.

**Packing a Wound**
Open wounds that are deeper than 1” often require packing. This is often done to avoid “bridging”, which is when the sides of the wound mend together before the bottom has filled in leaving dead space at the bottom of the wound where an abscess may form. Packing a wound serves three purposes: 1) to debride the wound bed of dead tissue during healing, 2) to absorb the exudate and 3) to keep the sides of the wound from touching and mending together.

**Procedure for Packing a Wound**
- Gather materials
  - 2x2” gauze pads
  - Sterile water or saline
  - Sterile gloves
  - Adhesive tape
- Clean the inside of the wound as described above.
- Moisten the gauze that you are using to pack the wound with sterile water or saline. The amount of gauze you need depends on the size of the wound.
- Push the corner of the gauze into the wound, and then pack the rest of the gauze on top of it. Continue in the same manner with more pieces of gauze as needed. The object is to keep the sides of the wound from touching and the gauze reaches the bottom of the wound. You may need to use a cotton-tipped applicator to reach the bottom of the wound.
- Place a gauze pad over the top of the wound and tape it down.