Vascular Access

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Learning Objectives….

At the end of the lecture you will be able to:

1. Examine the construction of the commonly used venous catheters.
2. Anatomical considerations regarding peripheral and central **venous access**.
3. Choice of catheter size.
4. Prepare and set-up an IV infusion set.
5. The choice of sites for placement of IV catheters.
6. What are the different sites suitable for central venous catheter and arterial catheter placement?
7. Universal precautions.
8. Indications and complications of central venous access
9. **Indications and complications of arterial access**

Medical Asepsis

- Removal or destruction of disease-causing organisms or infected material
- Sterile technique (surgical asepsis)
- Clean technique

Antiseptics and Disinfectants

- Chemical agents used to kill specific microorganisms
- **Disinfectants**
  - Used on nonliving objects
  - Toxic to living tissue
- **Antiseptics**
  - Applied to living tissue
  - More dilute to prevent cell damage
- Some chemical agents have antiseptic and disinfectant properties

Universal Precautions

Universal standard precautions on every patient

- Observe hand washing and gloving procedures
- Face shields indicated during clean procedures
- Sterile gowns plus above all for sterile procedures.

Types of IV Catheters

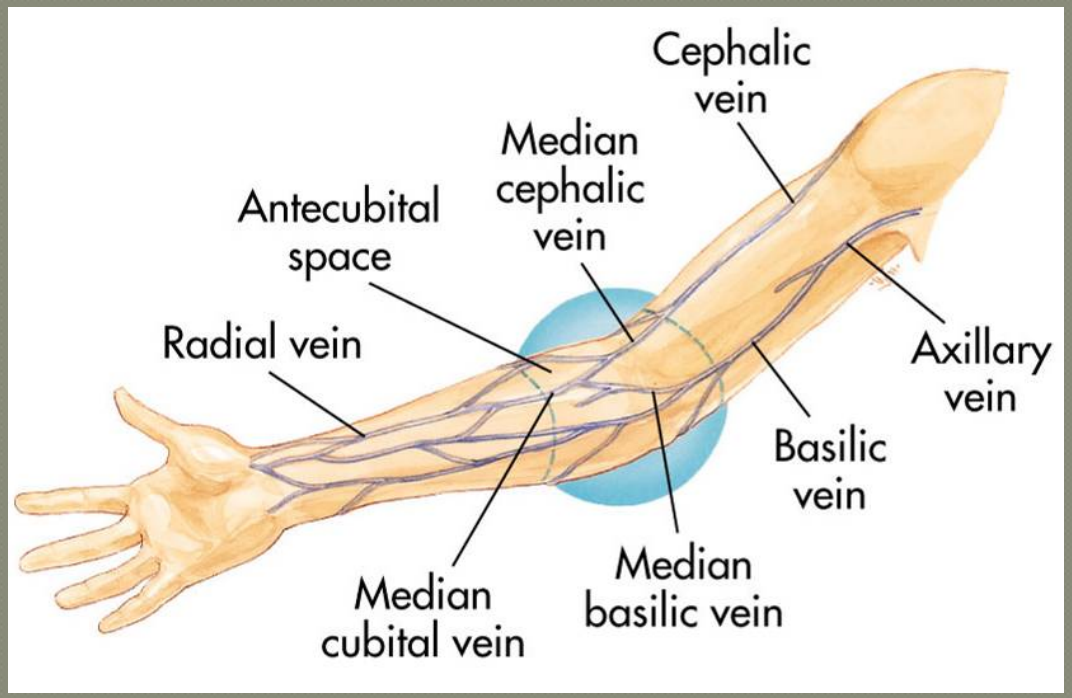
- **Hollow needles**
  - Butterfly type
- **Indwelling plastic catheter over hollow needle**
- Indwelling plastic catheter inserted through a hollow needle
  - Intracath

Needles

- Vary in length and gauge
  - **Larger gauge means a smaller needle**

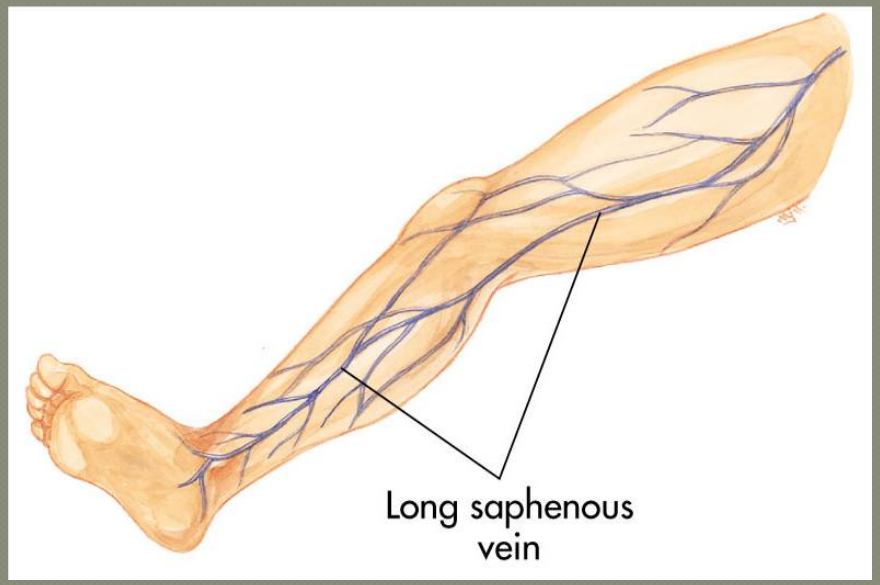
Peripheral IV Insertion

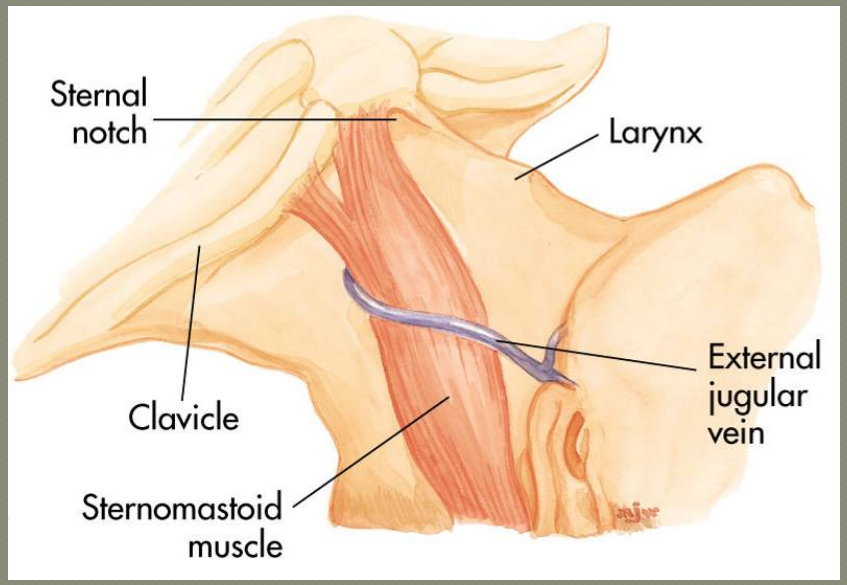
- Common sites:
  - Hands and arms
  - Antecubital fossa (AC space)



Peripheral IV Insertion

- **Alternate sites:**
  - Long saphenous veins
  - External jugular veins
- Embolism and infection rates higher





Peripheral IV Insertion

- Avoid sites that have injury or disease:
  - Trauma
  - Dialysis fistula
  - History of mastectomy

Peripheral IV Procedure

- Explain procedure
- Assemble equipment
- Inspect fluid for contamination, appearance, and expiration date
- Prepare infusion set
  - Attach infusion set to bag of solution

Peripheral IV Procedure

- Clamp tubing and squeeze reservoir on infusion set until it fills half way
- Open clamp and **flush air from tubing**
- Close clamp
- Maintain aseptic technique

Indwelling Vascular Devices

- Heparin or saline lock

Peripheral IV Procedure

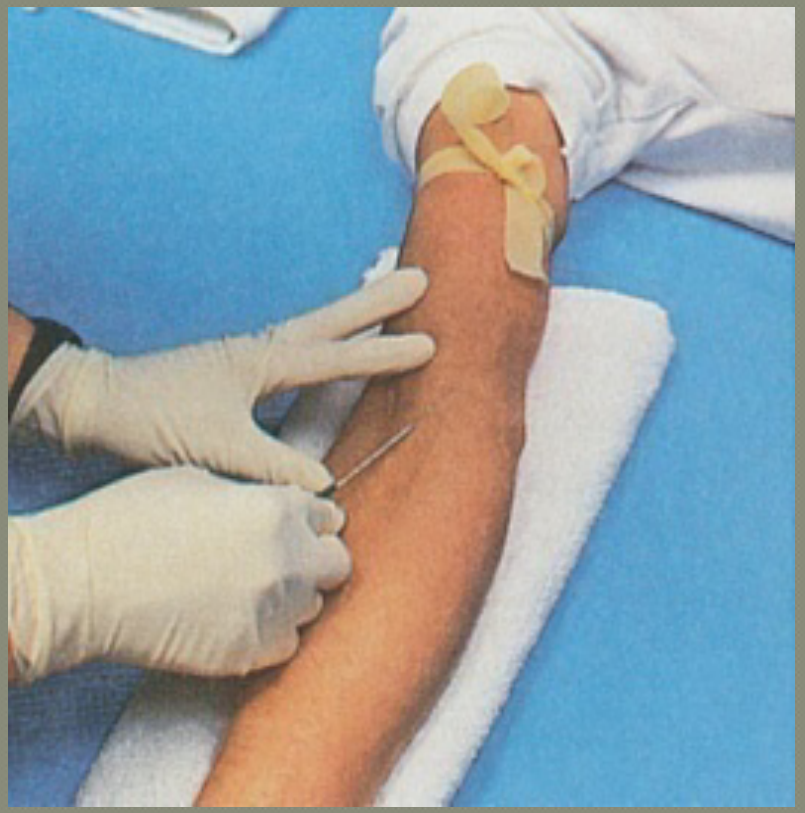
- Select catheter:
  - **Large-bore** catheter used for fluid replacement
    - **14 to 16 gauge**
  - **Smaller bore** catheter used for "keep open" lines
    - **18 to 20 gauge**
- Prepare other equipment

Peripheral IV Procedure

- Put on gloves
- Select site
- Apply tourniquet above antecubital space
- Prepare site
- Cleanse area with alcohol or iodine wipes (per protocol)
  - Check for iodine allergy

Peripheral IV Procedure

- Stabilize vein
- Apply pressure and tension to point of entry



Peripheral IV Insertion

- Bevel of the needle up in adults
  - May be down in infants and children
- Pass needle through skin into vein from side or directly on top

Peripheral IV Procedure

- Advance needle and catheter about 2 mm past point where blood return is seen in hub of needle
- Slide catheter over needle and into vein

Peripheral IV Procedure

- Withdraw needle while stabilizing catheter
- Lock in protective sheath if present
- Apply pressure on proximal end of catheter to stop escaping blood
- Obtain blood samples if needed

Peripheral IV Procedure

- Release tourniquet
- Attach IV tubing

Peripheral IV Procedure

- Open tubing clamp and allow fluid infusion to begin at prescribed flow rate

Peripheral IV Procedure

- Cover puncture site dressing
  - Antibiotic ointment if indicated by protocol
- Anchor tubing
- Secure catheter
- Document procedure
- **Monitor flow**

Local Complications

- Pain and irritation
- Infiltration and extravasation
- Phlebitis
- Thrombosis and thrombophlebitis
- Hematoma formation
- Venous spasm
- Vessel collapse
- Cellulitis
- Nerve, tendon, ligament, and limb damage

Infiltration—Causes

- **Dislodgement of catheter or needle cannula during venipuncture**
- **Puncture of vein wall during venipuncture**
- **Leakage of solution into surrounding tissue from insertion site**
- **Poorly secured IV**
- Poor vein or site selection
- Irritating solution inflames vein's intima
- Improper cannula size
- High delivery rate or pressure

Infiltration—Signs & Symptoms

- Cool skin around IV site
- Swelling at IV site
  - With or without pain
- Sluggish or absent flow
- **Infusion flows when fluid is pushed focefully**
- **No backflow of blood into IV tubing when clamp is fully opened and solution container is lowered below IV site**

Infiltration—Management

- Lower fluid reservoir to check for presence of backflow of blood into the tubing
  - **Absence of backflow suggests infiltration**
- Discontinue IV infusion
- Remove needle or catheter
- Apply a pressure dressing to the site
- Choose new site
- Initiate IV therapy with new equipment
- Document

Central Venous Access

- Requires special training
- Authorization from medical direction
- **Not for rapid fluid replacement in pre-hospital setting**
- Within scope of paramedic practice in some EMS systems

Venous access

- https://youtu.be/cmK3hjJYCKA

Central Venous Access

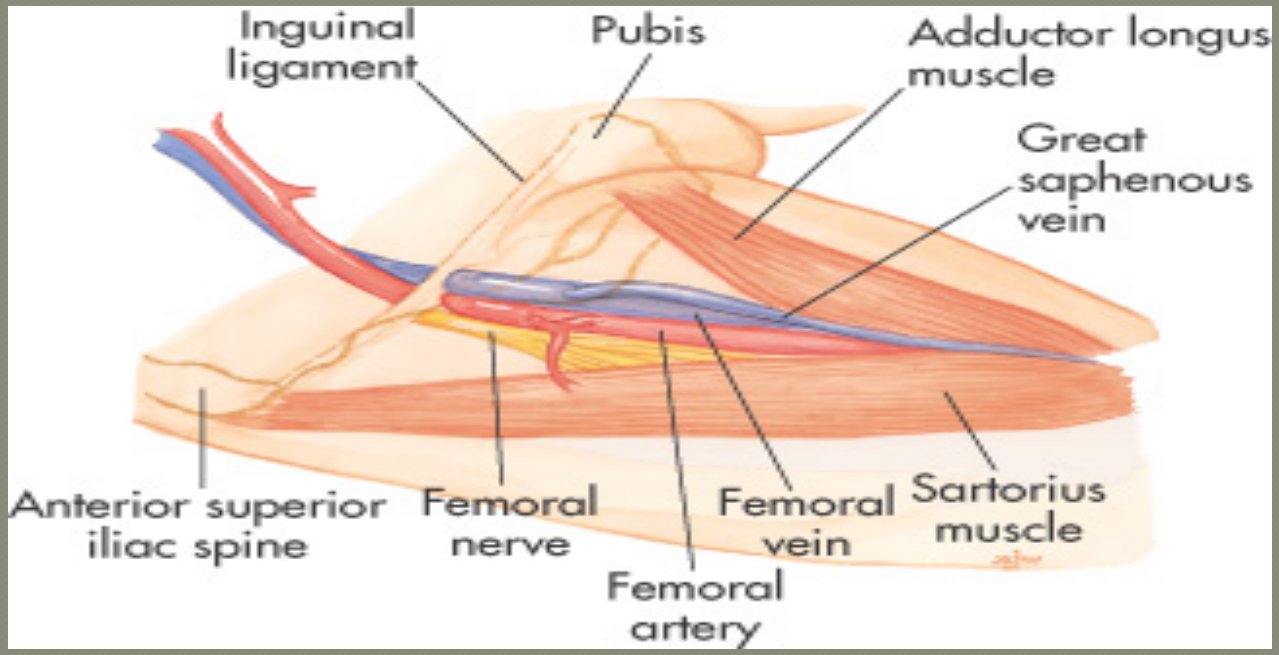
- Common Sites include:
  - Femoral vein
  - Internal jugular vein
  - Subclavian vein

Central Venous Access

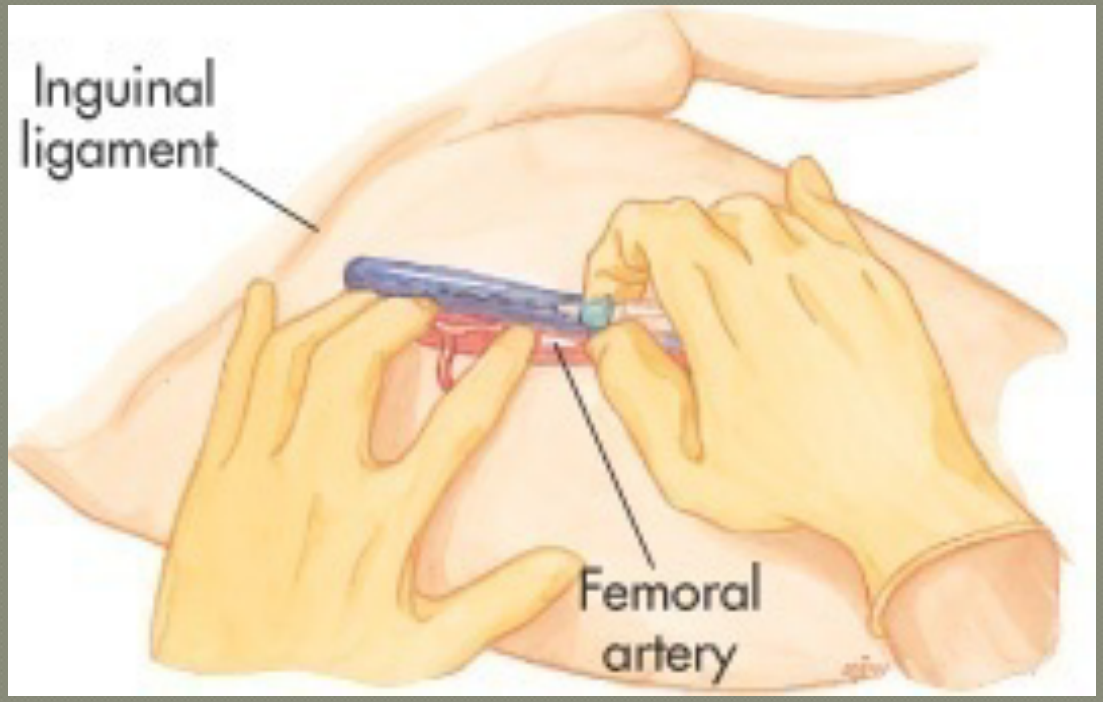
- Prepare as for peripheral veins
- **Sterile procedure**

- **Success depends on**:
  - Patient's body position
  - Knowledge of anatomy
  - Familiarity with the procedure and equipment

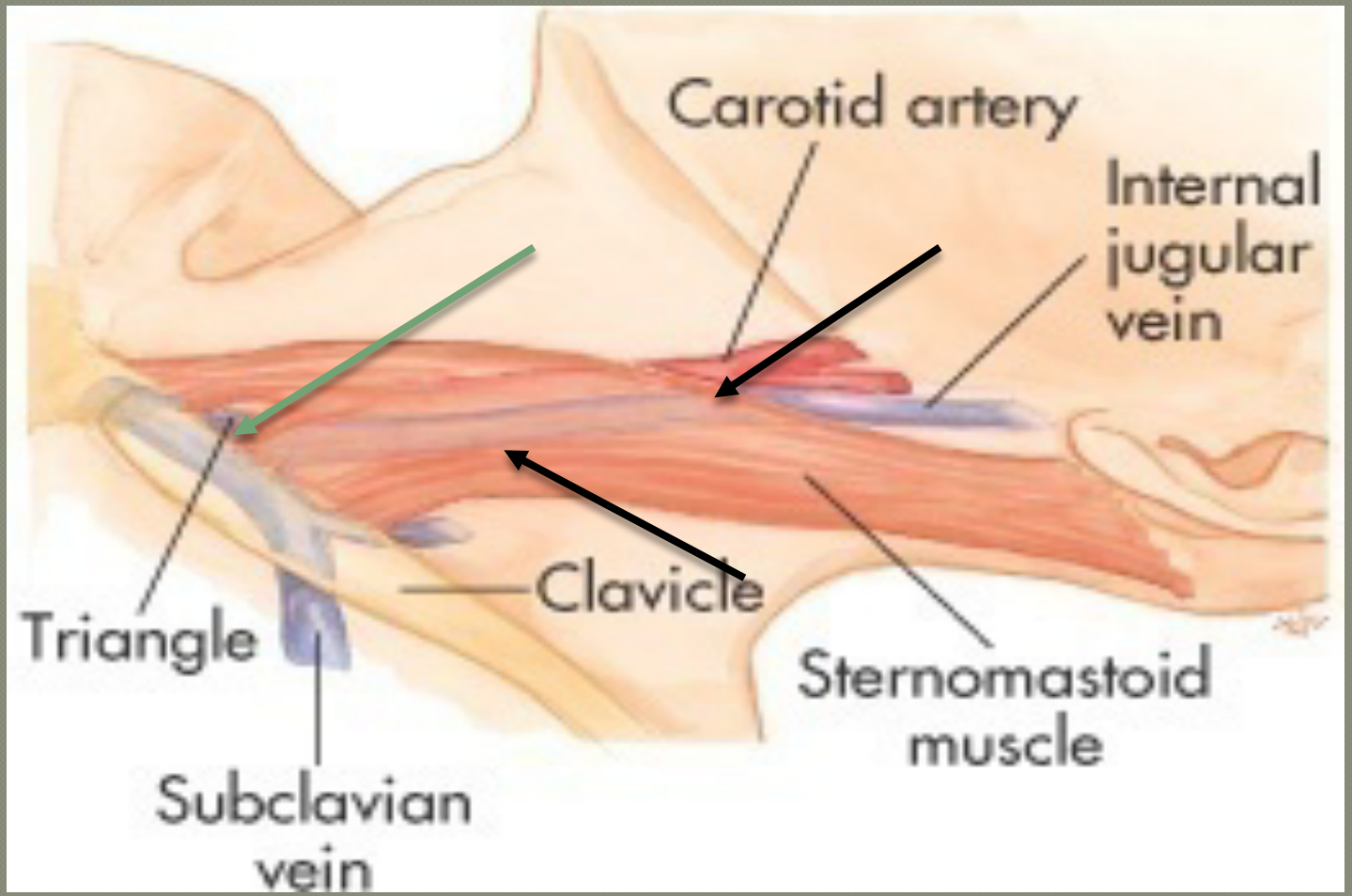
Femoral Vein Anatomy



Femoral Vein Cannulation

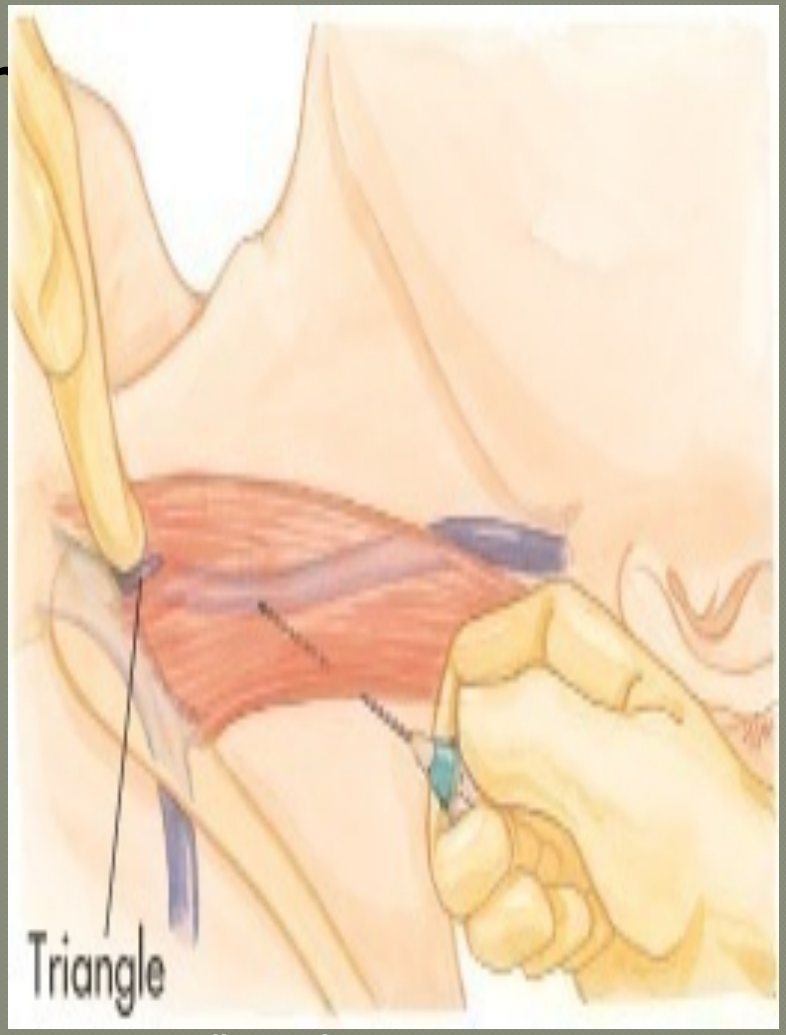


Internal Jugular Vein Anatomy



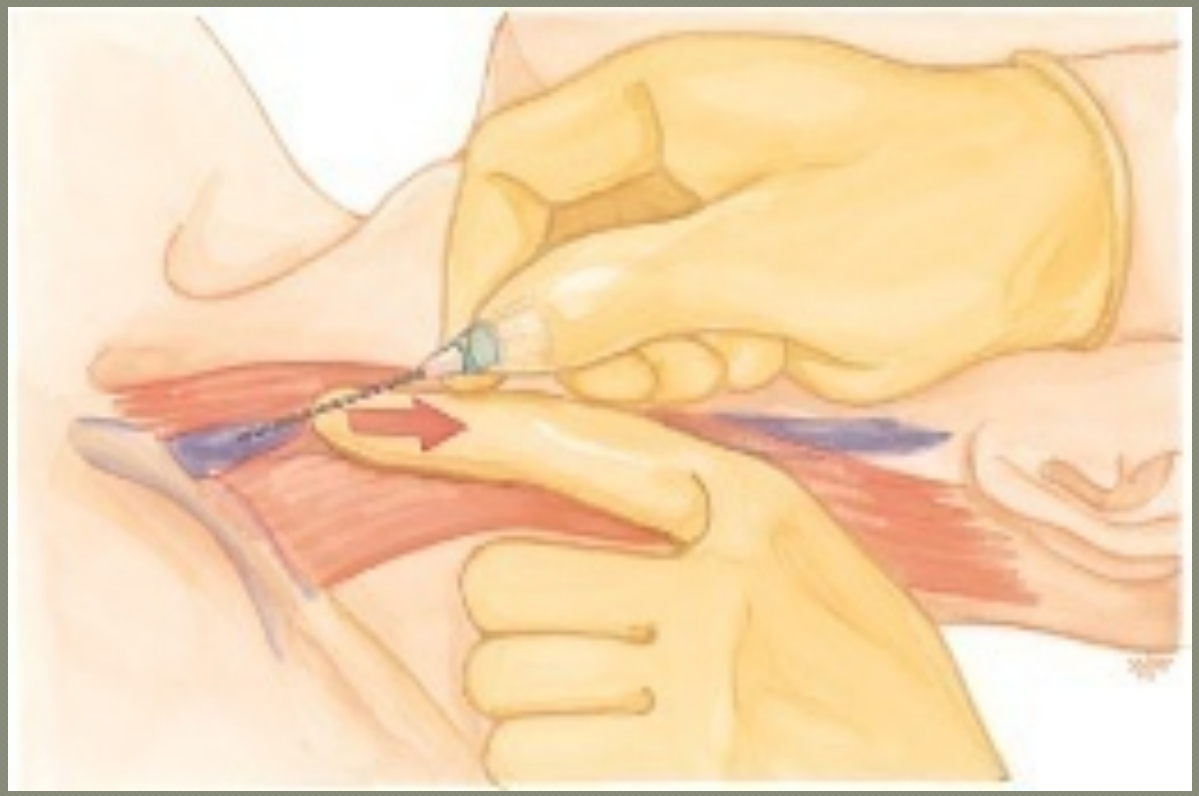
Internal Jugular Vein Cannulation

- Posterior approach



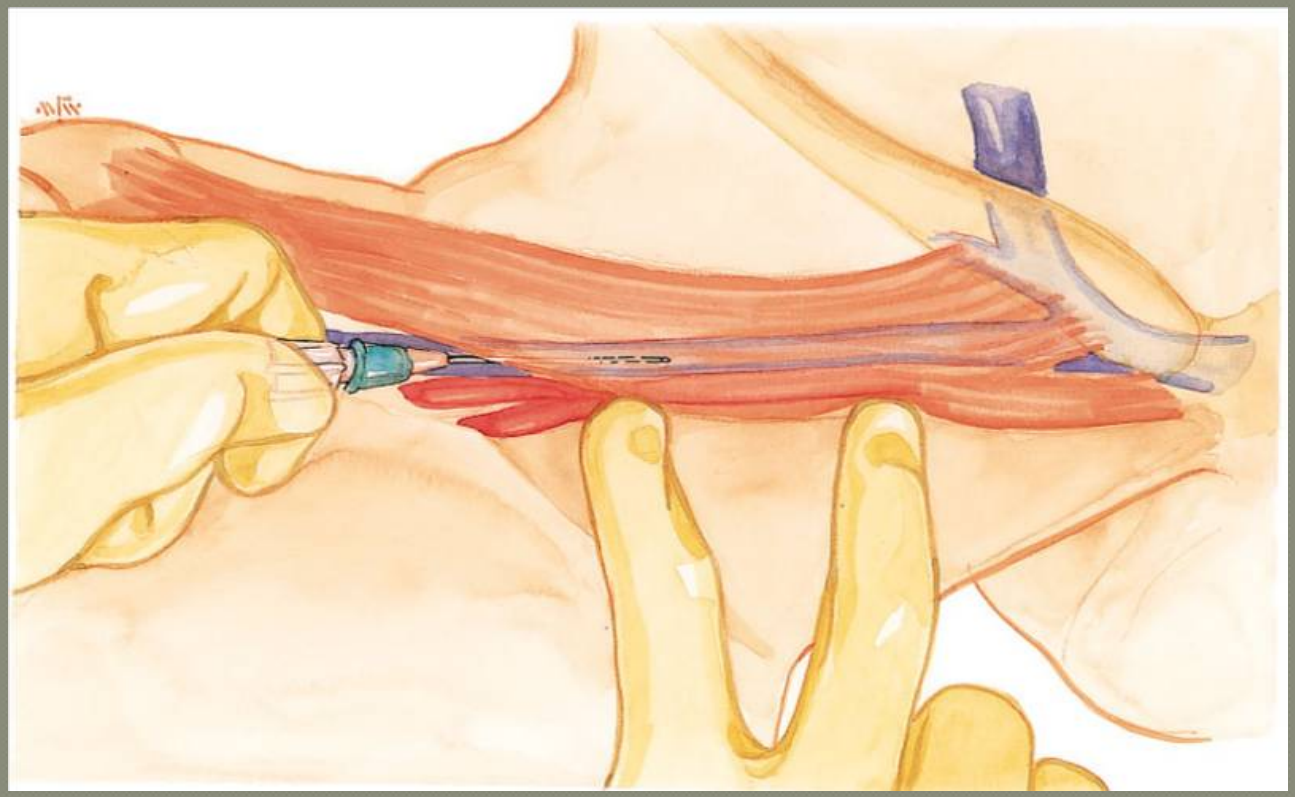
Internal Jugular Vein Cannulation

- Central approach

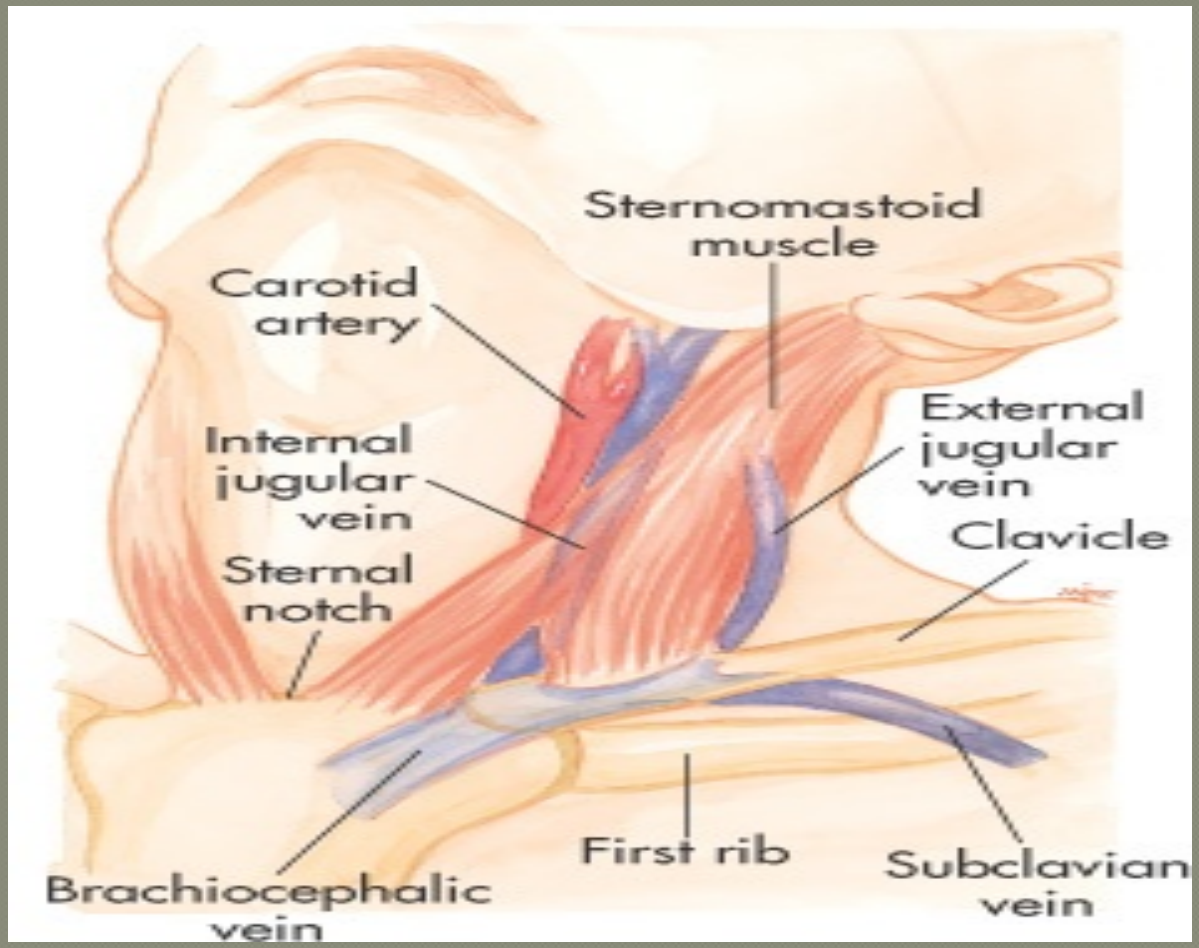


Internal Jugular Vein Cannulation

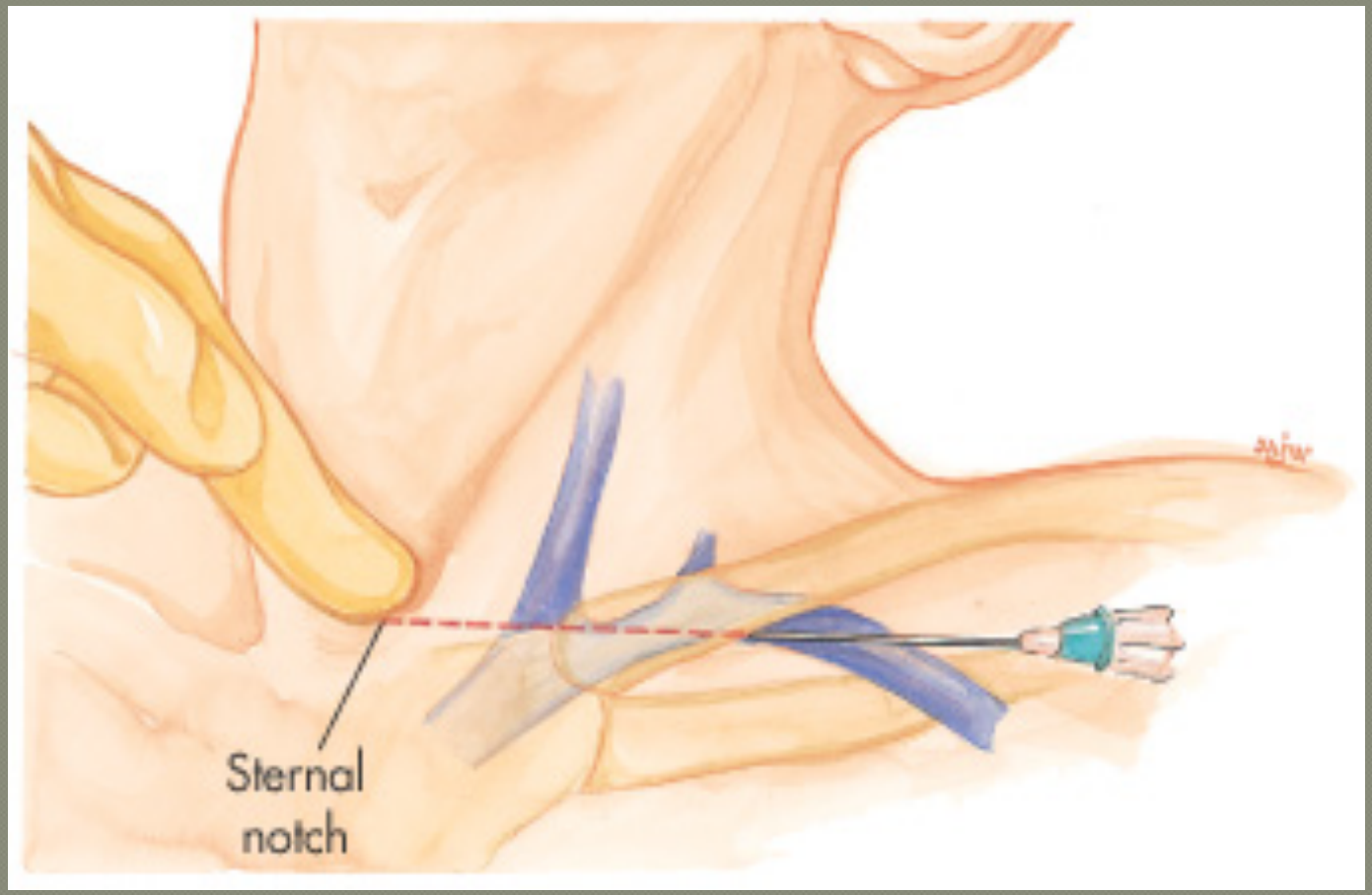
- Anterior approach



Subclavian Vein Anatomy



Subclavian Vein Cannulation



Central Venous Access

Central Venous Access

- **Indications**
  - Available when peripheral vessels collapse
  - Access to central pressure measurements
    - In-hospital procedure
  - Safer vasopressor administration
  - Administration of irritant fluids

Central Venous Access

- **Disadvantages**
  - Excessive time for placement
  - Sterile technique
  - Special equipment
  - Skill deterioration
  - High complication rate
    - **Pneumothorax, arterial injury, abnormal placement**
  - Chest x-ray should be obtained immediately

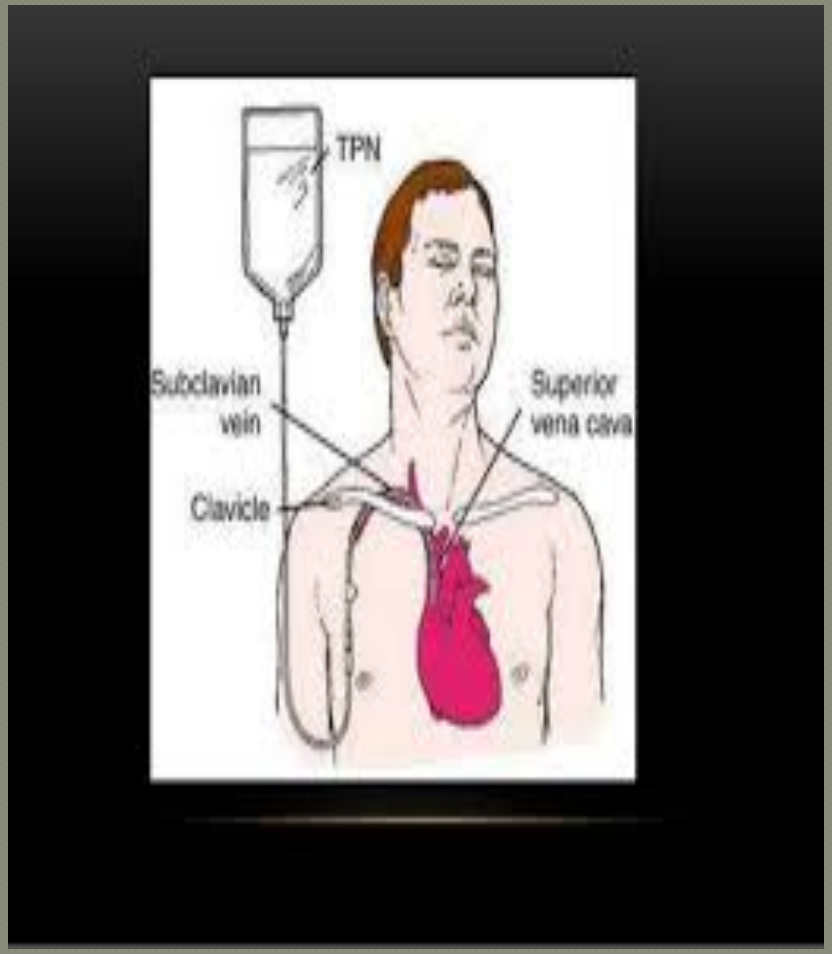
Fig. 5—*Frontal chest radiograph demonstrating the right lateral wall of the superior vena cava (open arrow) and the junction of the lower SVC with the superior convexity of the right cardiac border (SVC-RAA junction) (closed arrow). The cavoatrial junction (*) lies approximately 1–2 cm below SVC-RAA junction in adults.*

Central Venous Access

- **Disadvantages**
  - Can't initiate during other patient care activities
  - **Not generally considered to be a useful prehospital technique**
  - Lower flow rates than peripheral IV

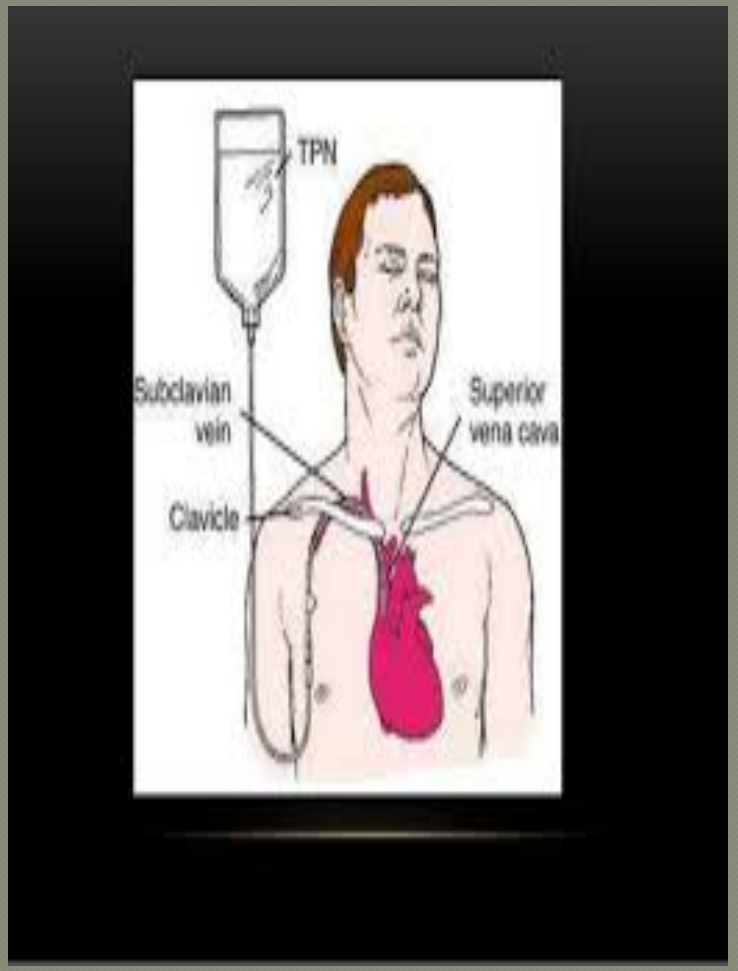
Systemic Complications

- Contamination and infection
- Hypersensitivity reactions
- Sepsis
- Speed shock
- Emboli (blood clot, air, and catheter)



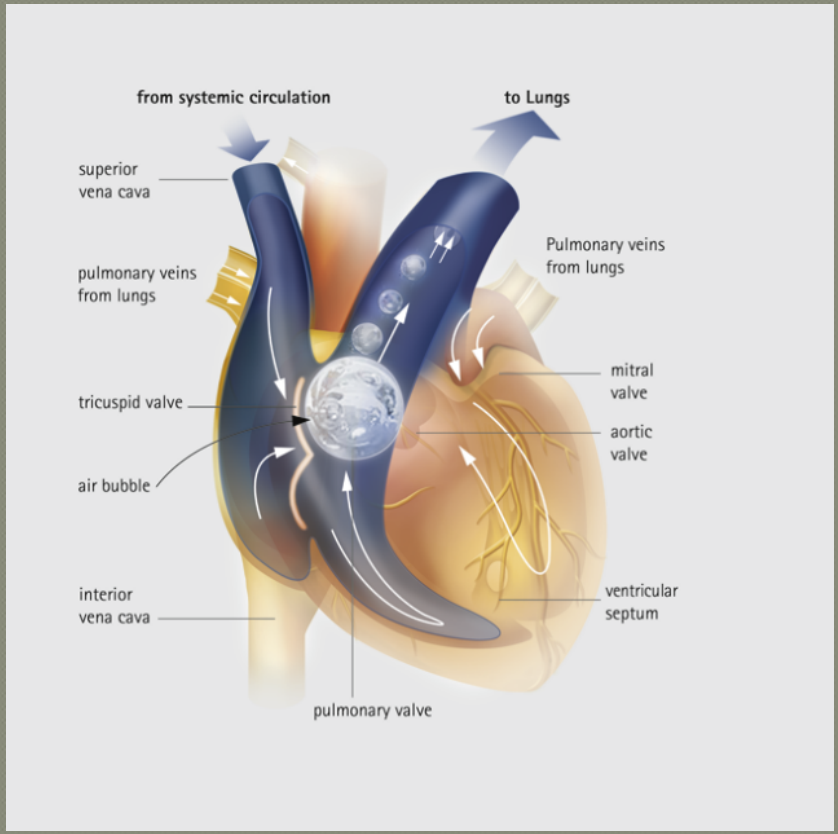
Air Embolism

- Uncommon but can be fatal
- **Air enters bloodstream through catheter tubing**
- Risk greatest with catheter in central circulation
  - **Negative pressure may pull air in**



Air Embolism

- Air can enter circulation
  - During catheter insertion
  - If tubing is disconnected
- If enough air enters the heart chamber:
  - **Blood flow is impeded**
  - **Shock develops**



Air Embolism

- **Signs and symptoms**
  - Hypotension
  - Cyanosis
  - Weak and rapid pulse
  - Loss of consciousness

Air Embolism

MANAGEMENT

- Close the tubing
- **Turn patient on left side with head down**
- Check tubing for leaks
- Administer100% Oxygen
- Notify medical direction

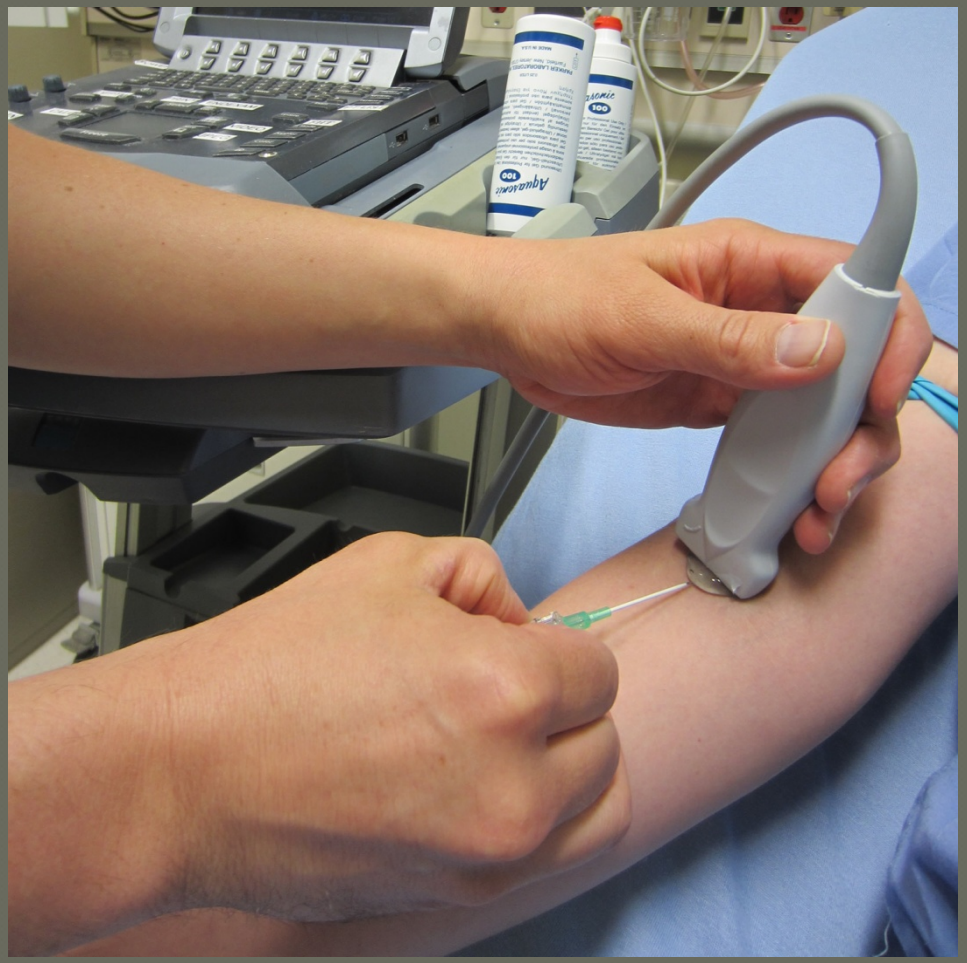
Complications—Central Veins

- **Femoral vein**
  - Local complications
  - Systemic complications
- **Internal jugular and subclavian veins**
  - Local complications
  - Systemic complications

Indwelling Vascular Devices

- Single-, dual-, and triple-lumen catheters

Ultrasound guided IV insertion



Ultrasound guided CVC insertion

2) The probe marker should point to the patient's left shoulder corresponding to the marker on the left side of the ultrasound screen.

Central catheter insertion

- https://youtu.be/cmK3hjJYCKA

Arterial Line Placement

- Provide continuous blood pressure (BP) monitoring

- Arterial blood sampling

Arterial line placement Indications

- Continuous arterial BP monitoring - more accurate than NIBP
- Inability to use indirect BP monitoring (eg, in patients with severe burns or morbid obesity)
- Frequent blood sampling
- Frequent arterial blood gas sampling

Contraindications for arterial line placement

ABSOLUTE

- **Absent pulse**
- **Thromboangiitis obliterans (Buerger disease)**
- **Full-thickness burns over the cannulation site**
- **Inadequate circulation to the extremity**
- **Raynaud syndrome**

RELATIVE

- Anticoagulation
- Atherosclerosis
- Coagulopathy
- Inadequate collateral flow
- Infection at the cannulation site
- Partial-thickness burn at the cannulation site
- Previous surgery in the area
- Synthetic vascular graft

Technical Considerations

- Not entirely without risks,
- Requires appropriate knowledge of the anatomy and procedural skills.
- Arterial line placement is considered a safe.
- Major complications that is below 1%.

- **Common site of cannulation**
- radial, ulnar, brachial, axillary, posterior tibial, femoral, and dorsalis pedis arteries.

Allen test

- The Allen test is a worldwide used test to determine whether the patency of the radial or ulnar artery is normal.
- It is performed prior to radial cannulation or catheterization.
- The test is used to reduce the risk of ischemia to the hand.

Allen test

- Instruct the patient to clench his or her fist OR hand tightly.
- Using your fingers, apply occlusive pressure to both the ulnar and radial arteries, to obstruct blood flow to the hand.
- While applying occlusive pressure to both arteries, have the patient relax his or her hand, and check whether the palm and fingers have blanched. If this is not the case, you have not completely occluded the arteries with your fingers.

Performance of the Allen test.

Allen test

POSITIVE

NEGATIVE

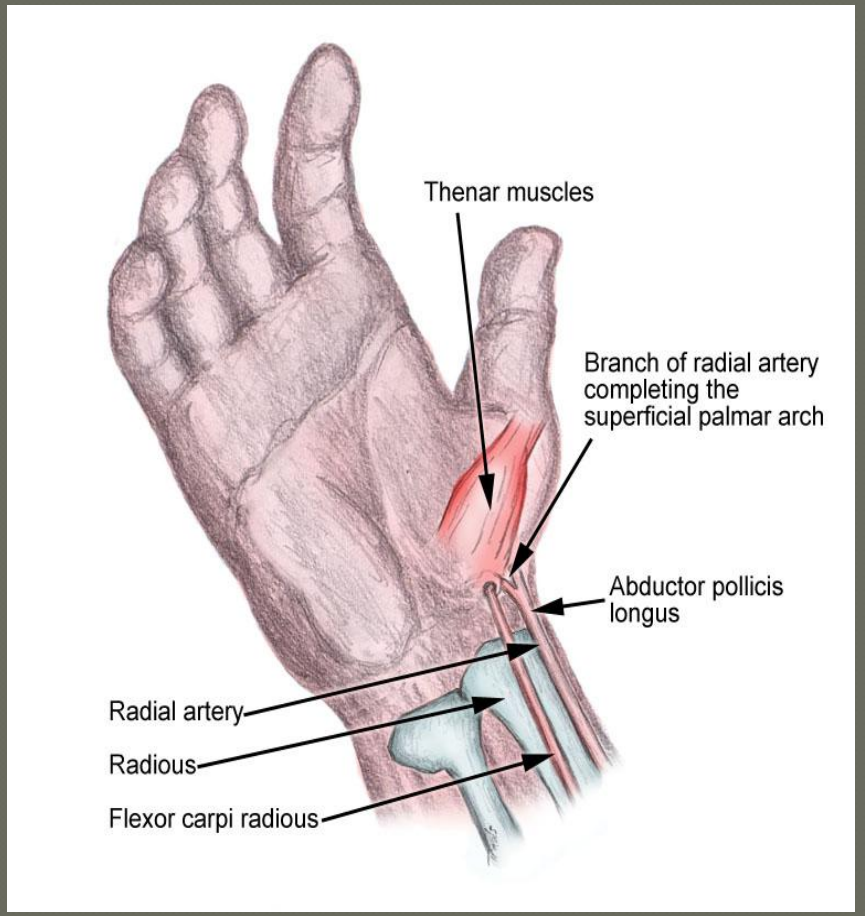
Allen test- Release the occlusive pressure on the ulnar artery

- **Positive modified Allen test** – hand flushes within 5-15 seconds it indicates that the ulnar artery has good blood flow; this normal flushing of the hand is considered to be a positive test.
- **Negative modified Allen test** – If the hand does not flush within 5-15 seconds, it indicates that ulnar circulation is inadequate or nonexistent; in this situation, the radial artery supplying arterial blood to that hand should not be punctured.

Radial artery

Aatomic consideration

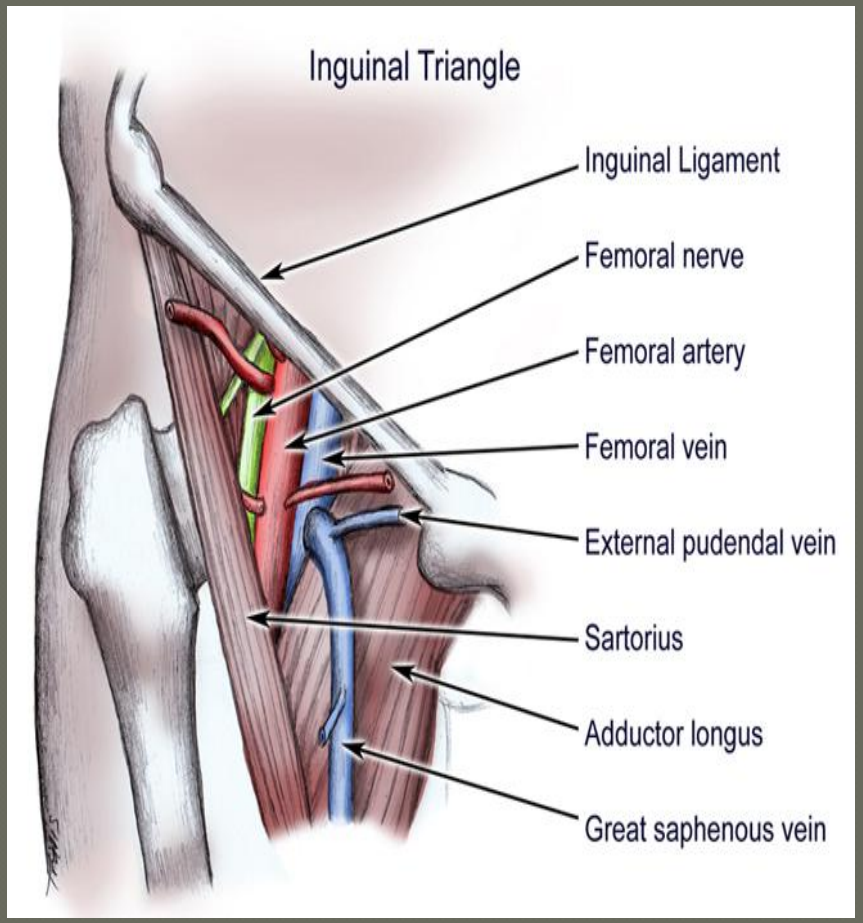
- Originates in the cubital fossa from the brachial artery
- At the wrist, the radial artery sits proximal and **medial** to the radial styloid process and just **lateral** to the flexor carpi radialis tendon.



Femoral artery

Anatomic consideration

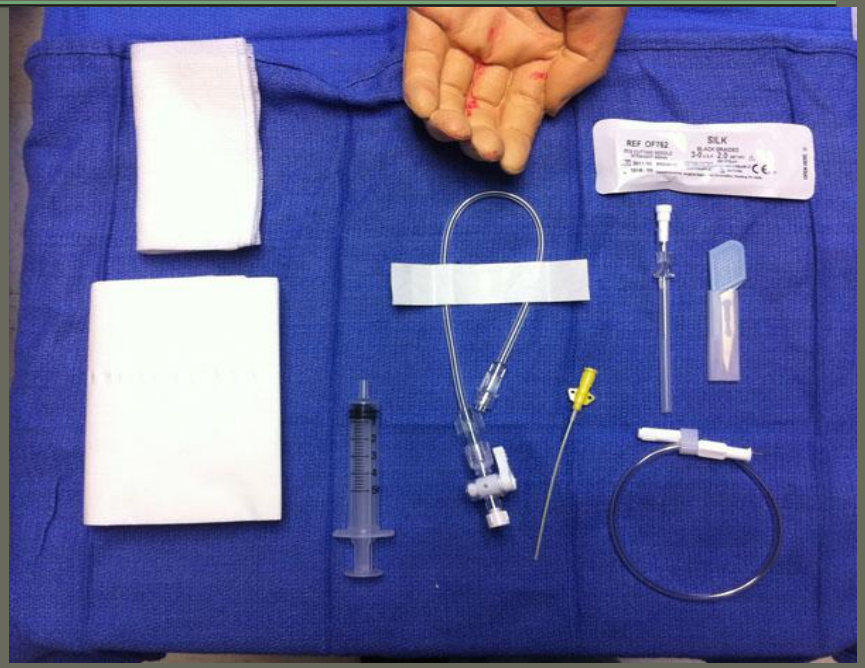
- Originates at the inguinal ligament from the external iliac artery
- Medial to the femoral nerve and lateral to the femoral vein and lymphatics.

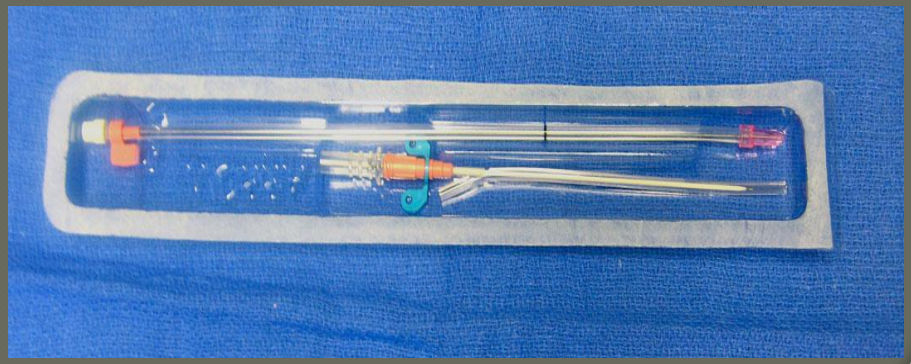


Arterial Line Placement

Equipment

- Sterile gloves
- Sterile gauze
- Sterile towels
- Chlorhexidine or povidone-iodine skin preparation solution
- 1% Lidocaine needle
- 5-mL syringe
- Appropriate-sized cannula for artery
- Scalpel (No. 11 blade)
- Nonabsorbable suture (3-0 to 4-0)
- Adhesive tape or strips
- Sterile nonabsorbable dressing
- Three-way stopcock
- Pressure transducer kit
- Pressure tubing
- Arm board of appropriate size for the patient (eg, neonate, pediatric, adult)
- Needle holder
- Intravenous (IV) tubing T-





Arterial Line Placement Patient Preparation

- UNCOSCIOS PATIENT

  Anesthesia/ Sedation is not required.

- CONSCIOUS PATIENT

  provided LA -lidocaine 1%

- UNCOPERATIVE PATIENT

  sedation or general anesthesia may be required.

Arterial Line Placement Positioning

- The patient is placed in the supine position.
- The arm is placed up on a flat surface in neutral position, with the palm up and the wrist adequately exposed.
- The wrist is dorsiflexed to 30-45° and supported in this position with a towel or gauze under its dorsal aspect

Arterial Line Placement

The most commonly used methods

- **Catheter over needle**
- Catheter over wire (including direct Seldinger and modified Seldinger techniques)

technique

Catheter over needle technique

Radial artery cannulation **(Seldinger).** Advancement of catheter over guide wire.

Complications of arterial line placement

COMMON

- Temporary radial artery occlusion (19.7%)
- Hematoma/bleeding (14.4%)

LESS COMMON

- Localized catheter site infection (0.72%) - The risk increases with the length of time the catheter is in place
- Hemorrhage (0.53%)
- Sepsis (0.13%)
- Permanent ischemic damage (0.09%)
- Pseudoaneurysm formation (0.09%)

Arterial line insertion

- https://youtu.be/8hK04ai17-k


Thank
You