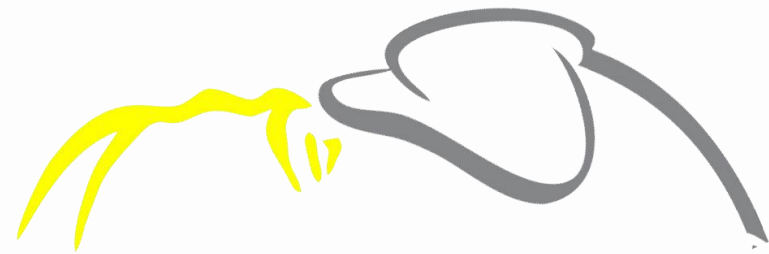


# Vascular Access



433

ANAESTHESIA





# Objectives:

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

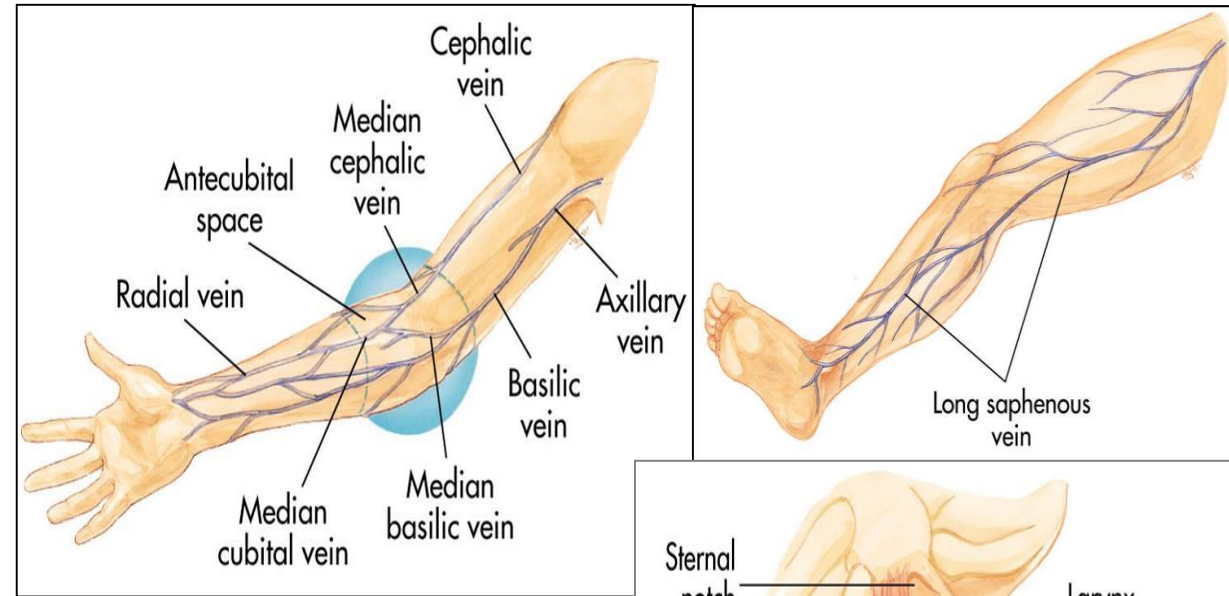
Vary in length and gauge

**Larger gauge means a smaller needle**

# 1. Peripheral IV Insertion

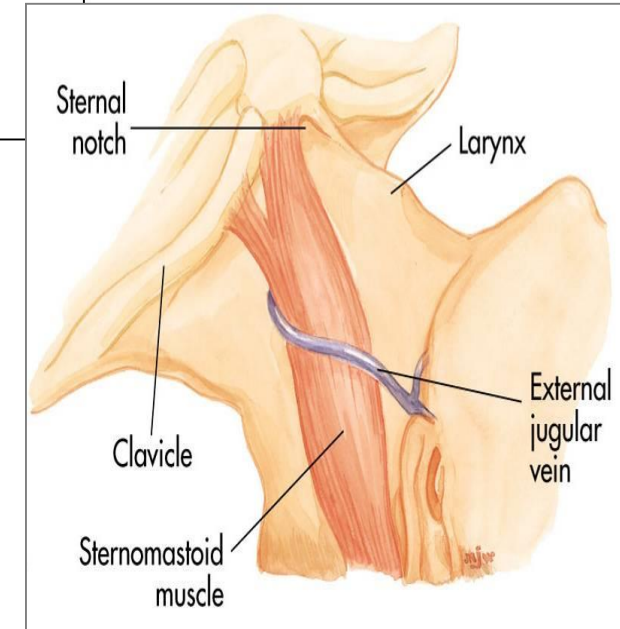
- **Common sites:**
  - Hands and arms
  - Antecubital fossa (AC space)
- **Alternate sites:**
  - Long saphenous veins
  - External jugular veins

**Embolism and infection rates higher**
- **Avoid sites that have injury or disease:**
  - Trauma
  - Dialysis fistula
  - History of mastectomy



## 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



# 1. Peripheral IV Insertion

## Peripheral IV Procedure:

1. Explain procedure
2. Assemble equipment
3. Inspect fluid for contamination, appearance, and expiration date
4. Prepare infusion set
  - Attach infusion set to bag of solution
5. Clamp tubing and squeeze reservoir on infusion set until it fills half way
6. Open clamp **and flush air from tubing**
7. Close clamp
8. Maintain aseptic technique
9. 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**



For simplicity sake we numbered it ,in our slides its not numbered, so don't be confused.

# 1. Peripheral IV Insertion

## Peripheral IV Procedure:

10. Prepare other equipment
11. Put on gloves
12. Select site
13. Apply tourniquet above antecubital space
14. Prepare site
15. Cleanse area with alcohol or iodine wipes (per protocol)  
*Check for iodine allergy*
16. Stabilize vein
17. Apply pressure and tension to point of entry
18. Bevel of the needle up in adults  
*May be down in infants and children*
19. Pass needle through skin into vein from side or directly on top
20. Advance needle and catheter **about 2 mm** past point where blood return is seen in hub of needle
21. Slide catheter over needle and into vein
22. Withdraw needle while stabilizing catheter
23. Lock in protective sheath if present
24. Apply pressure on proximal end of catheter to stop escaping blood
25. Obtain blood samples if needed
26. Release tourniquet
27. Attach IV tubing
28. Open in at prescribed flow rate
29. Cover puncture site dressing  
*20. Antibiotic ointment if indicated by protocol*
30. Anchor tubing
31. Secure catheter
32. Document procedure
- 33. Monitor flow**



# 1. Peripheral IV Insertion

## 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

### Signs & Symptoms

- Cool skin around IV site
- Swelling at IV site
  - With or without pain
- Sluggish or absent flow
- Infusion flows when pressure is applied to vein above tip of cannula
- No backflow of blood into IV tubing when clamp is fully opened and solution container is lowered below IV site



### 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

# 2. 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
- **Common Sites include:**
  - **Femoral vein**
  - **Internal jugular vein**
  - **Subclavian vein**
- Prepare as for peripheral veins
- **Sterile procedure**
- **Success depends on:**
  - Patient's body position
  - Knowledge of anatomy
  - Familiarity with the procedure

## Indications :

- Available when peripheral vessels collapse
- Access to central pressure measurements
  - In-hospital procedure
- Safer vasopressor administration

## Disadvantages:

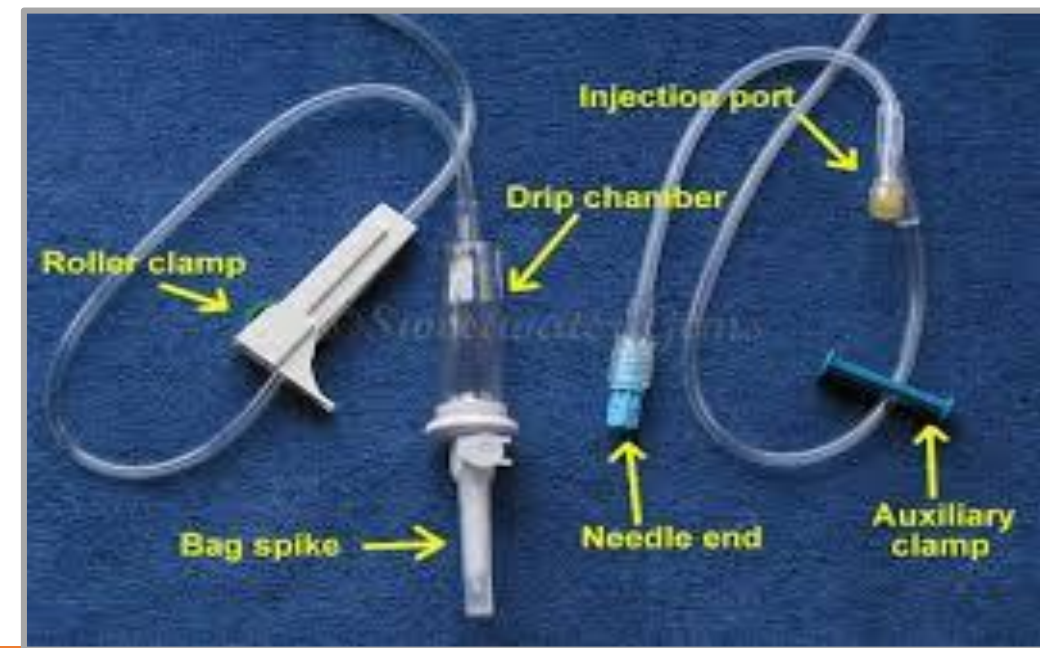
- Excessive time for placement
- Sterile technique
- Special equipment
- Skill deterioration
- High complication rate
  - **Pneumothorax, arterial injury, abnormal placement**
- Chest x-ray should be obtained immediately
- Can't initiate during other patient care activities
- Not generally considered to be a useful prehospital technique
- Lower flow rates than peripheral IV



# 2. Central Venous Access

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

### Signs and symptoms

- Hypotension
- Cyanosis
- Weak and rapid pulse
- Loss of consciousness

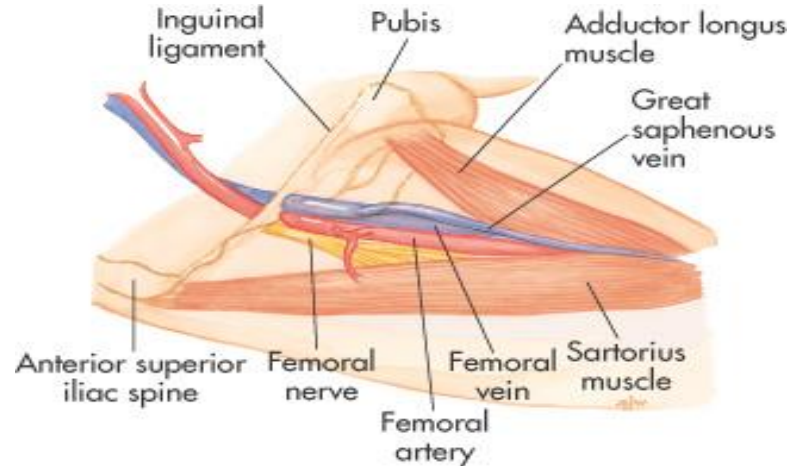
### Management

- Close the tubing
- Turn patient on left side with head down
- Check tubing for leaks
- Administer 100% Oxygen
- Notify medical direction

# 2. Central Venous Access

## A. Femoral Vein

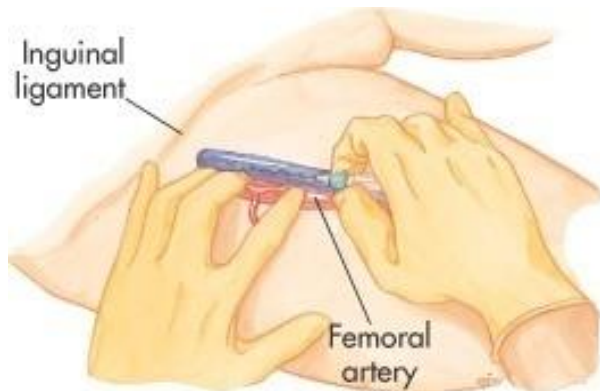
- **Anatomy:**



VEIN  
ARTERY  
NERVE

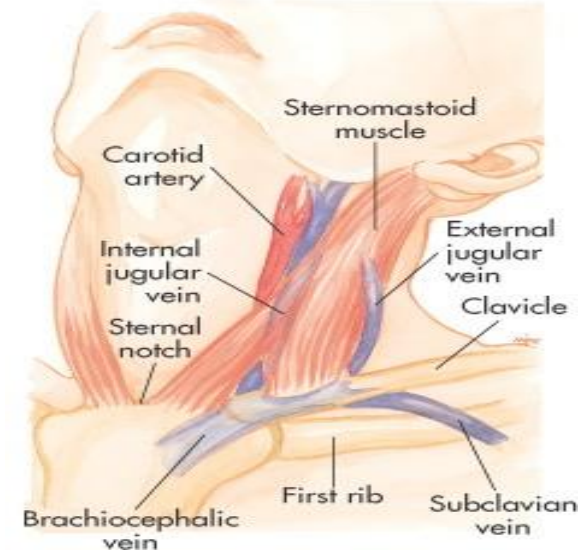
the **femoral vein** is a blood vessel that accompanies the **femoral artery** in the **femoral sheath**. It begins at the adductor canal (also known as Hunter's canal) and is a continuation of the **popliteal vein**

- **Cannulation**



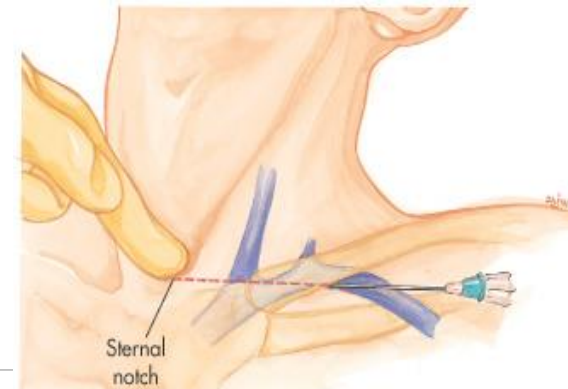
## B. Subclavian Vein:

- **Anatomy:**



Each **subclavian vein** is a continuation of the axillary **vein** and runs from the outer border of the first rib to the medial border of anterior scalene muscle. From here it joins with the internal jugular **vein** to form the brachiocephalic **vein**

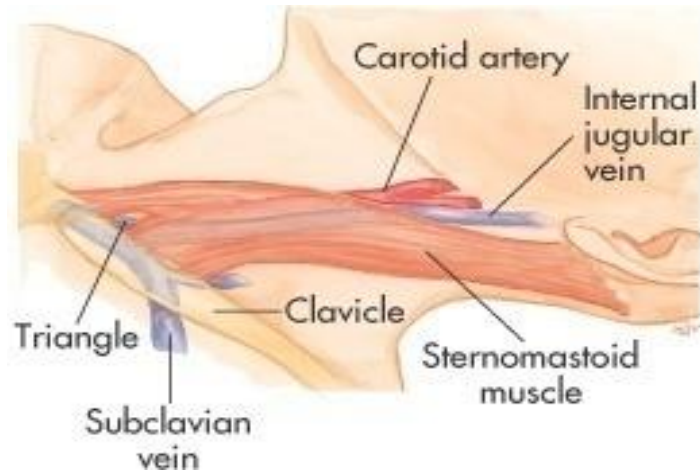
- **Cannulation**



## 2. Central Venous Access

### C. Internal Jugular Vein:

- **Anatomy:**



It descends in the carotid sheath with the internal carotid artery.

usually between the heads of the sternocleidomastoid muscle

- **Cannulation**

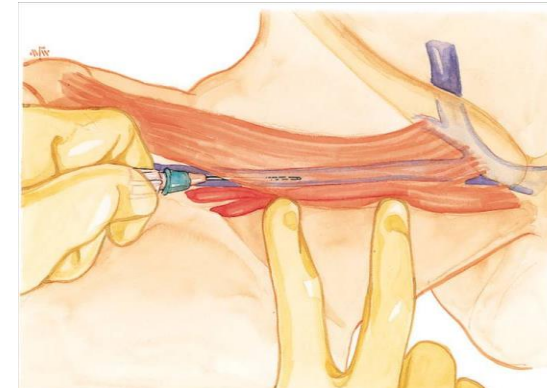
Posterior approach



Central approach



Anterior approach



# 2. Central Venous Access

## IV Medications :

### IV injection may be given in:

- An established IV line
- Heparin or saline lock
- Implantable port : Port-A-Cath, Hickman catheter
- Directly into the vein

**IV injections generally less than 5 mL, IV push or IV bolus medications**

## Volume-Control IV Devices:

- Permit accurate delivery of IV medications
- Electronic flow-rate regulators :
  - Regulate precise doses of drugs that can cause toxicity
  - Vasopressors
  - Antidysrhythmics
- Follow manufacturer's instructions

## Intravenous Therapy:

IV solution

Infusion set

**Macro drip or microdrip**

Tubing clamp

Injection port

## Drug Pump:

- Slow injection of medication
- Syringe with battery attachment that regulates injection of medication
- To administer medication SC
- Can attach to indwelling vascular devices:
  - Port-A-Cath
  - Hickman catheter

## Intermittent Infusion:

- IV piggybacks
- Setup is secondary to primary IV infusion
- Piggyback medication hung in tandem and connected to primary setup
- Calculate rate of secondary infusion : Drops per minute
- Lower primary infusion reservoir: Center of gravity lower than secondary infusion reservoir
- Open piggyback line flow clamp
- Adjust flow rate

## Indwelling Vascular Devices :

Heparin or saline lock

Single-, dual-, and triple-lumen catheters



# 3. Arterial Line Placement

- Provide continuous blood pressure (BP) monitoring
- Arterial blood sampling

## Indications:

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

### 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.

## Contraindications for arterial line placement

Absolute	Relative
<ul style="list-style-type: none"> <li>• Absent pulse</li> <li>• Thromboangiitis obliterans (Buerger disease)</li> <li>• Full-thickness burns over the cannulation site</li> <li>• Inadequate circulation to the extremity</li> <li>• Raynaud syndrome</li> </ul>	<ul style="list-style-type: none"> <li>• Anticoagulation</li> <li>• Atherosclerosis</li> <li>• Coagulopathy</li> <li>• Inadequate collateral flow</li> <li>• Infection at the cannulation site</li> <li>• Partial-thickness burn at the cannulation site</li> <li>• Previous surgery in the area</li> <li>• Synthetic vascular graft</li> </ul>

## Complications

### 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%)

# 3. 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-connector

## Patient Preparation

- **Uncoscious patient:** anesthesia/ sedation is not required.
- **Conscious patient:** provided 1% lidocaine
- **Uncooperative patient:** sedation or general anesthesia may be required.

## 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





# 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 catheterisation.
- The test is used to reduce the risk of ischemia to the hand.

## Method:

1. Instruct the patient to clench his or her fist OR hand tightly.
2. **Using your fingers, apply occlusive pressure to both the ulnar and radial arteries, to obstruct blood flow to the hand.**
3. 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.



## Result

Allen test- Release the occlusive pressure on the ulnar artery

### POSITIVE test

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 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**.

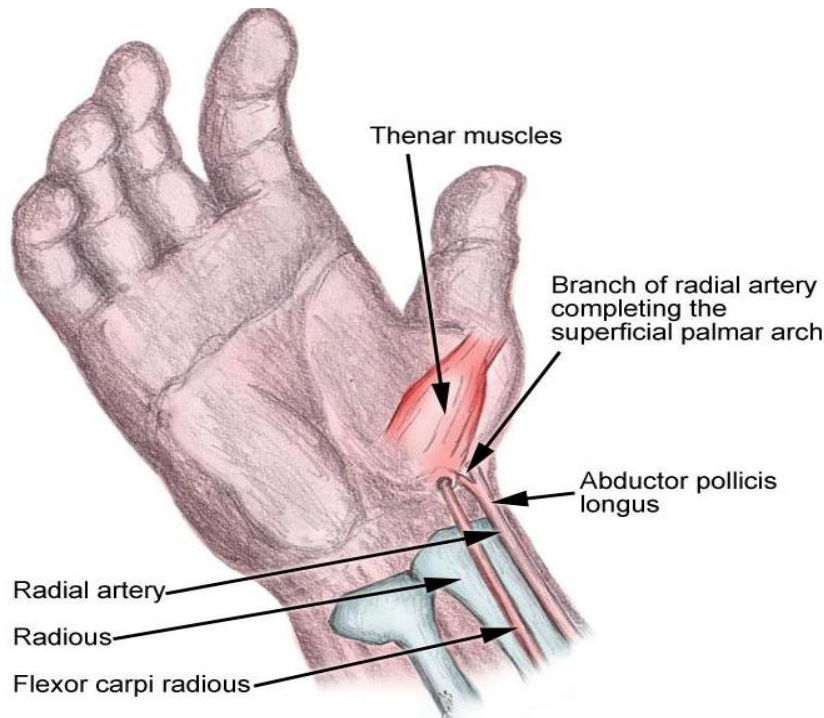


# 3. Arterial Line Placement

## Radial artery

### Anatomic consideration

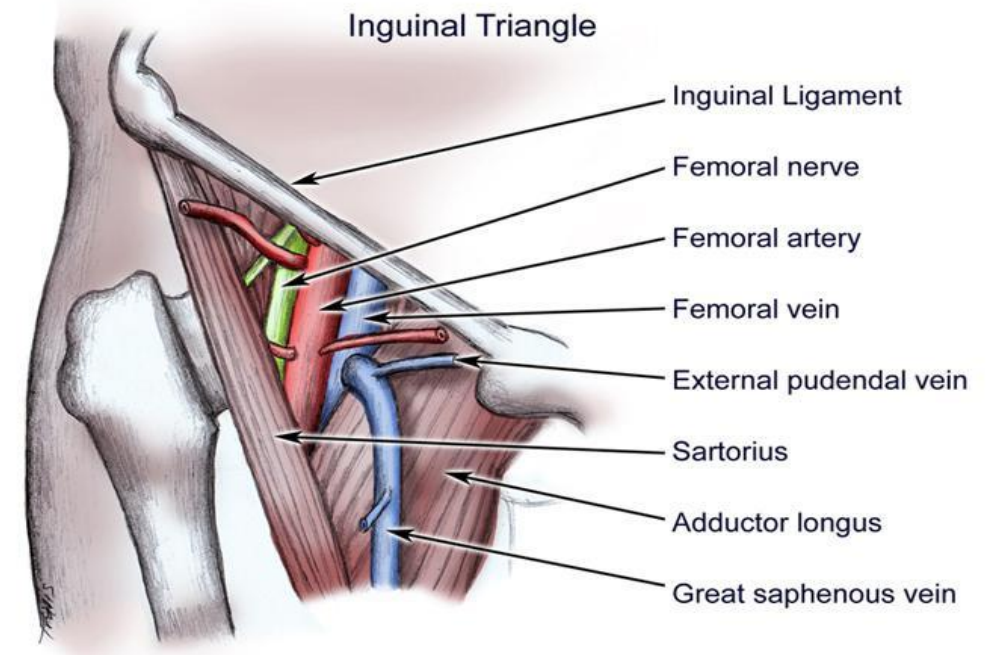
- **Originates in the cubital fossa from the brachial artery**
- At the wrist, the radial artery sits proximal and medial to the radial styloid process and just lateral to the flexor carpi radialis tendon.



## 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.**



# 3. Arterial Line Placement

## Catheter over needle



The most commonly used methods

## Catheter over wire

- including direct Seldinger and modified Seldinger techniques



Radial artery cannulation

**Seldinger: Advancement of catheter over guide wire.**



**Done by:** Yara Alanazi

**Reviewed by** Noha Almndeel

**Leader** Yasmine Alshehri

**Color reference:**

Black-slids

Green-Notes

Blue-Book

Red-important

**Contact us:**

**Anesthesia433**

**@gmail.com**