



# Invasive Lines

Lungs, Lines and Larynx

Lecture 2

# Learning Outcomes

1. You will be able to list the different invasive lines used in the treatment of critically ill patients
2. You will be able to describe the indications of different invasive lines and how these can benefit patient care
3. You will be able to list the pros and cons of various invasive lines
4. You will be able to describe safe insertion methods of various invasive lines

# Case 1

- 71 year old female
- Productive cough for 1 week
- Temp 39
- Resp rate 32
- Hr 120
- Sats 83% RA, 92% NRM
- BP 80/40
- Confused

# Case 2

- 50 year old male
- History of diverticular disease
- PR bleeding 48 hours
- HR 130
- BP 85 systolic
- Resp 24
- Sats poor trace
- Pale and clammy

# Case 3

- 2 year old
- Lethargic 24 hours
- Resp rate 60
- Sats poor trace
- Temp 39
- ?beginning of purpuric rash on leg
- Several attempts at iv cannulation have failed

You will use a different approach for each of these cases.....

# Central line / Central Venous Access



# Indications

- Lack of peripheral access
- Infusion of irritant / potent drugs
- TPN
- CVP monitoring
- Transvenous cardiac pacing



# Contraindications

- No absolute contraindications
- Avoid sites of sepsis
- Apical emphysema / bullae contraindicate infraclavicular / supraclavicular approaches to the subclavian vein
- Carotid artery aneurysm precludes using IJ vein of the same side
- Reconsider central venous cannulation in hypocoagulation / hypercoagulation states or if septicaemia is present

# Equipment

- Skin prep
- Local anaesthetic
- Sterile gloves and gown
- Towel drapes and sterile dressings
- Needle
- Guidewire
- Scalpel
- Dilator
- Catheter
- Suture
- Cardiac monitor

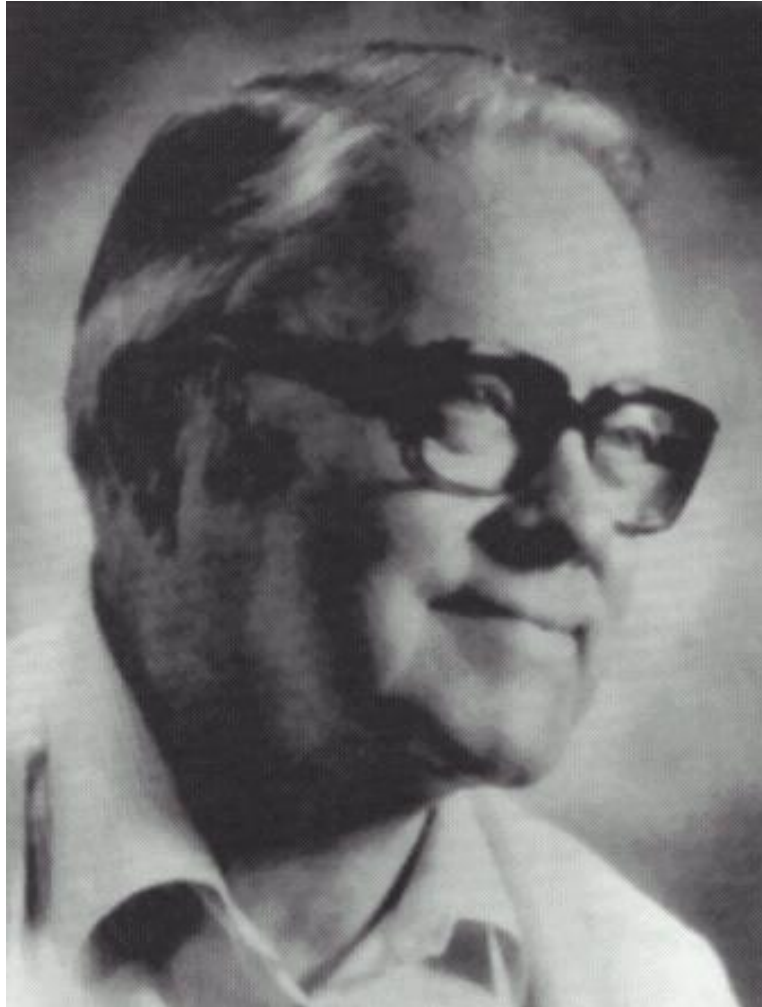


# Preparation

- Consent if appropriate
- ***Position patient head down (IJ or Subclavian)***
- Choose site of approach based on skills, back-up and patient
- Sterile Preparation
- Antiseptic
- Sterile draping
- Prime catheter - leave brown port open
- Operator should wear sterile gloves, gown and eye protection

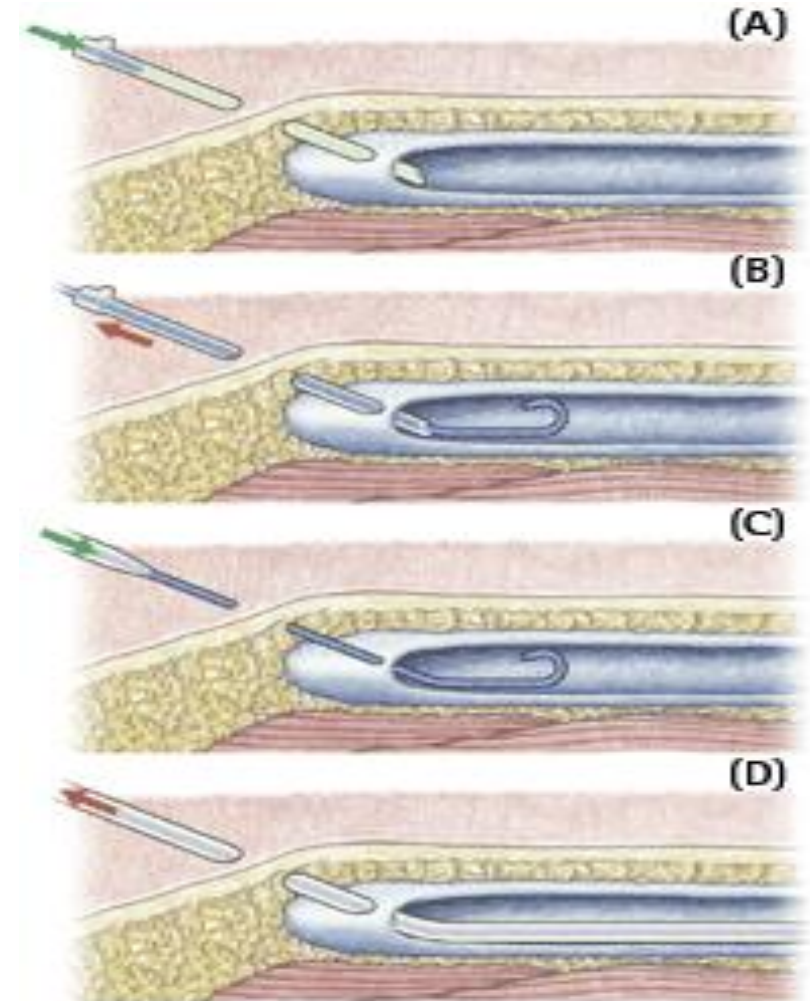


# Technique



*Sven Ivar Seldinger*

**“NEVER** *let go  
or lose sight of the  
guide wire!!!!!!”*

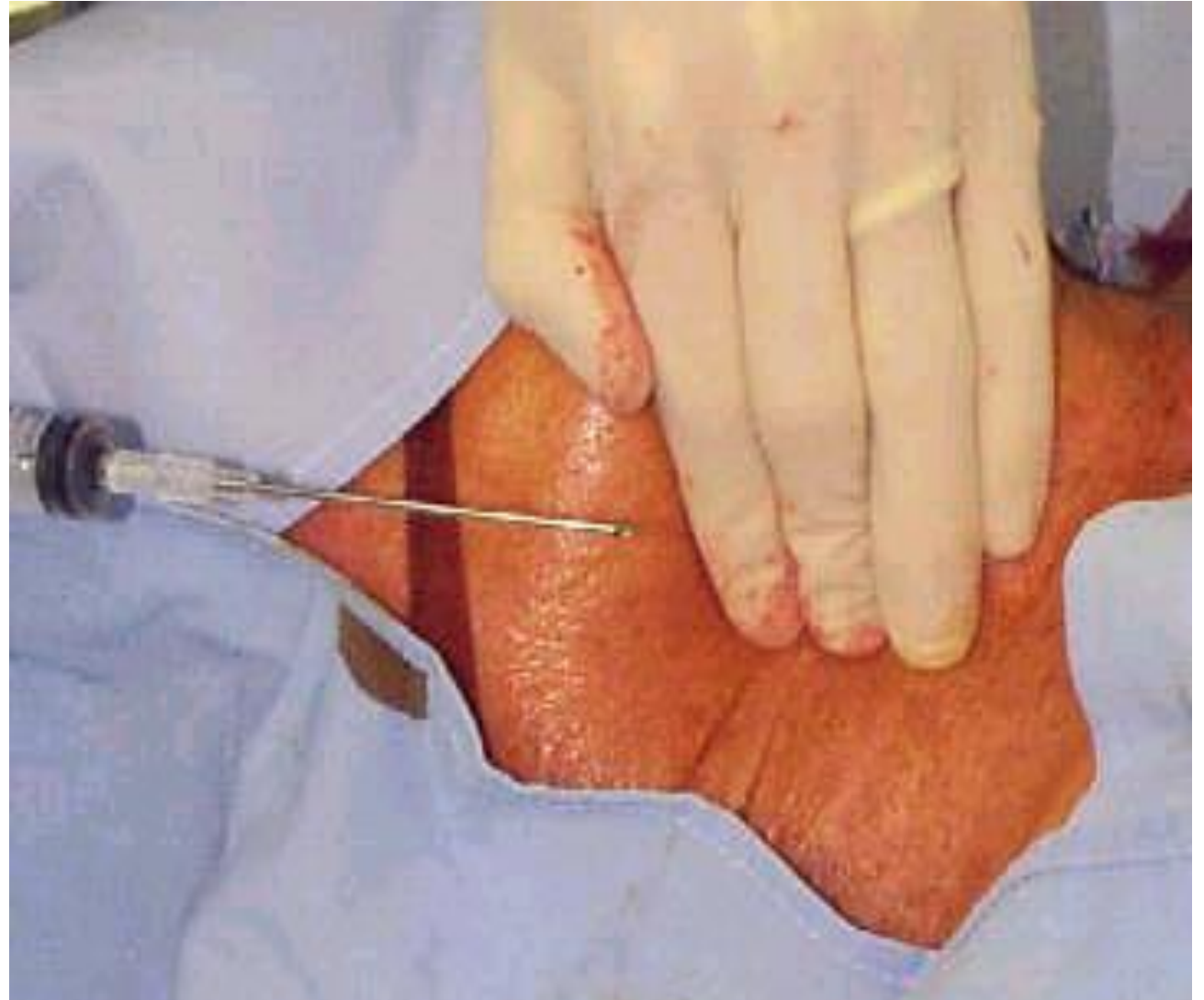


- Using a tracer needle aspirate venous blood
- Using central line needle with negative pressure aspirate venous blood
- (confirm venous access with blood gas)
- Pass guide wire (curved end first) and use marking to place to 20-25cm whilst watching cardiac monitor
- **Never let go of the wire**

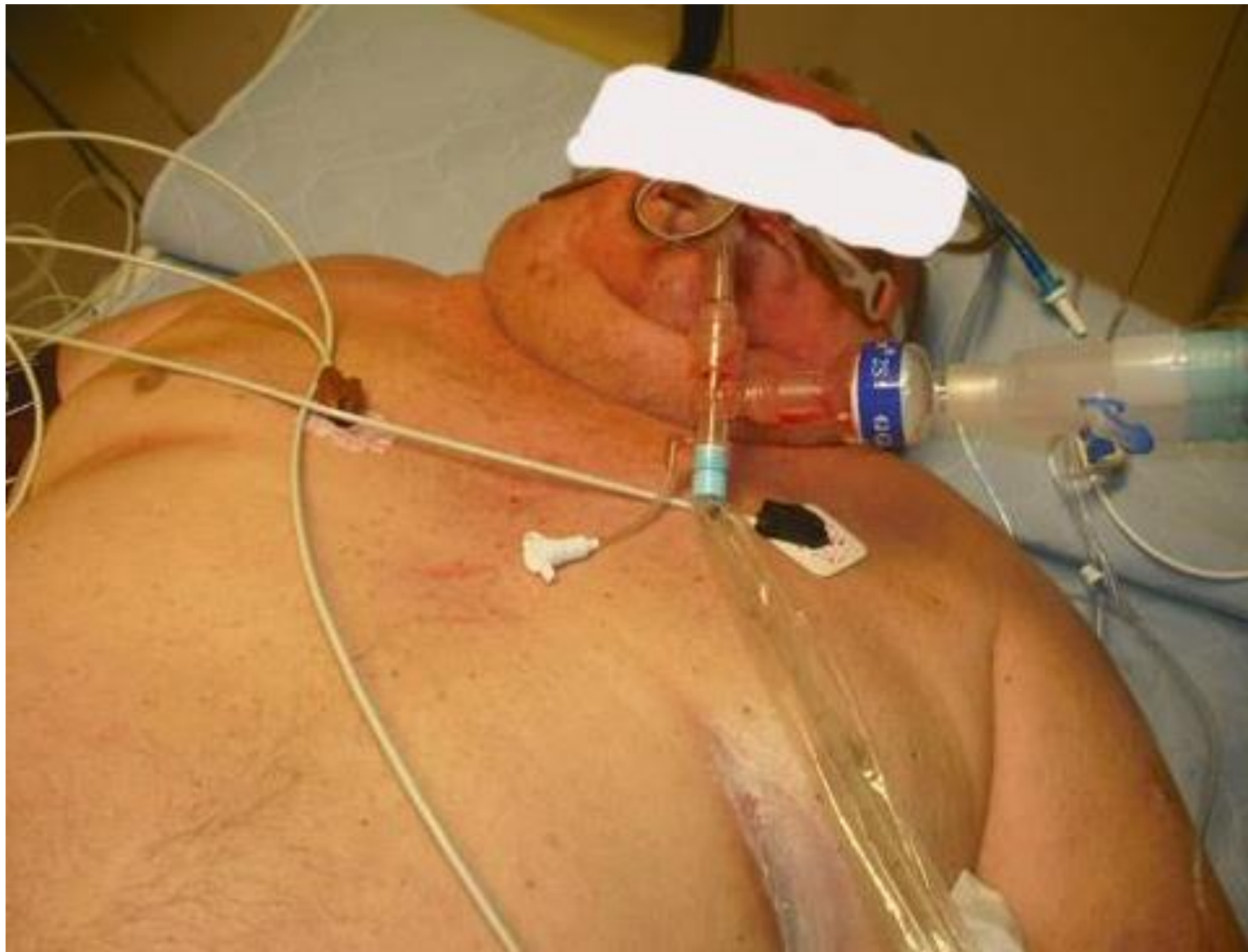
- Use dilator (+/- scalpel)
- Pass catheter to appropriate length -wire will pass through brown port
- Remove guide wire
- Aspirate blood from each port before flushing each port - avoid air embolus
- Suture
- Dressing
- CXR

- ***Internal Jugular***

- gently palpate the carotid artery.  
approximate level of the hyoid bone,  
at the medial border of sternomastoid  
aiming point is the ipsilateral nipple.
- **Advantages:** less risk of pneumothorax
- **Disadvantages:** increased difficulty in  
obesity, short flaccid neck
- **Complications:** carotid artery  
puncture, PTX



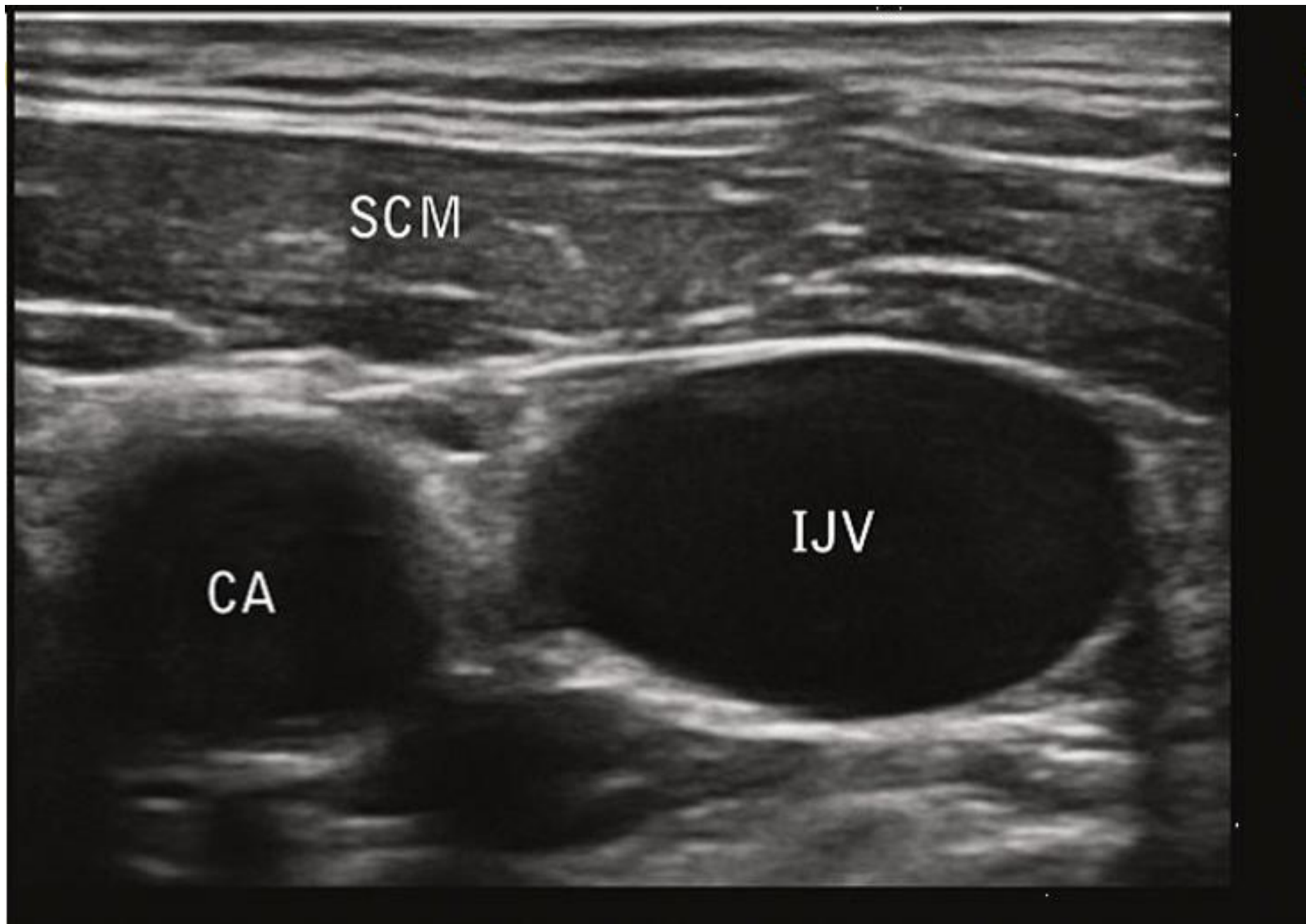




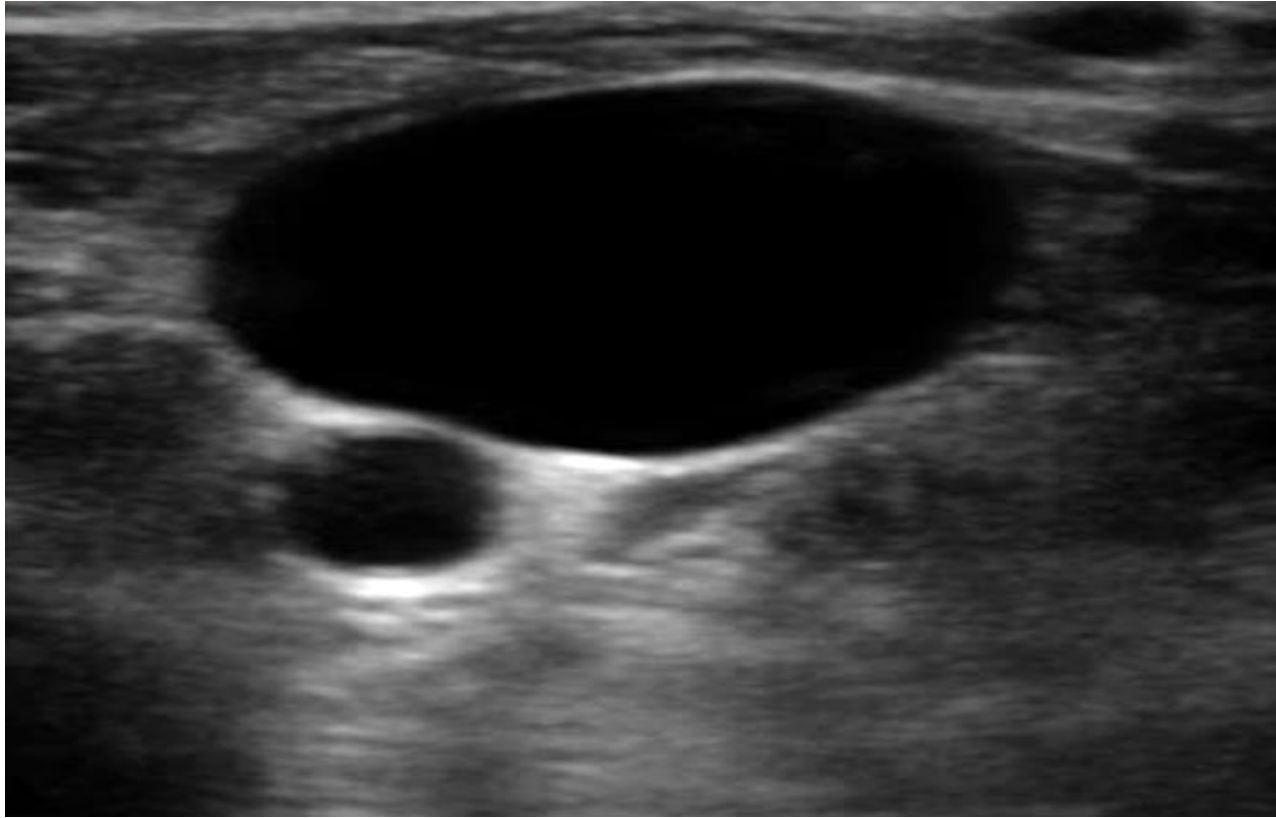


# Ultrasound



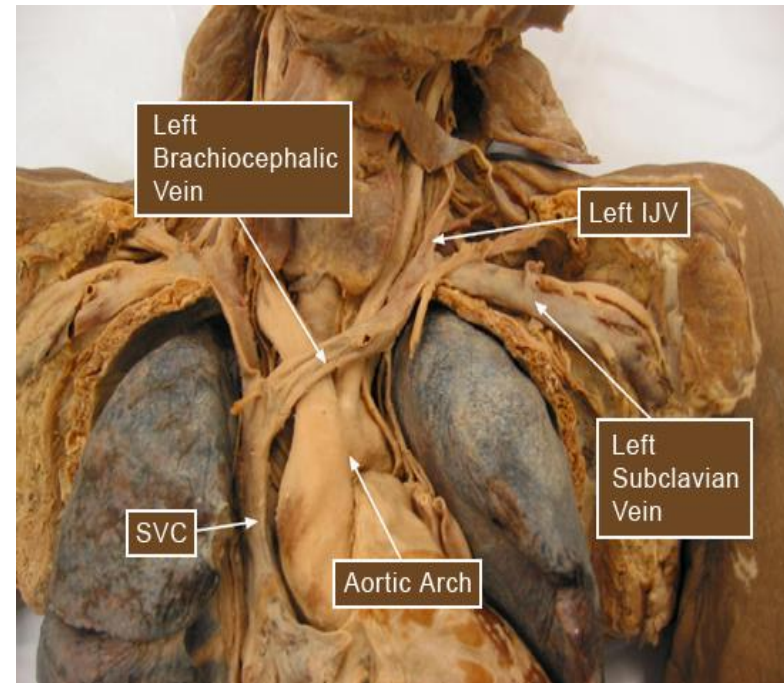
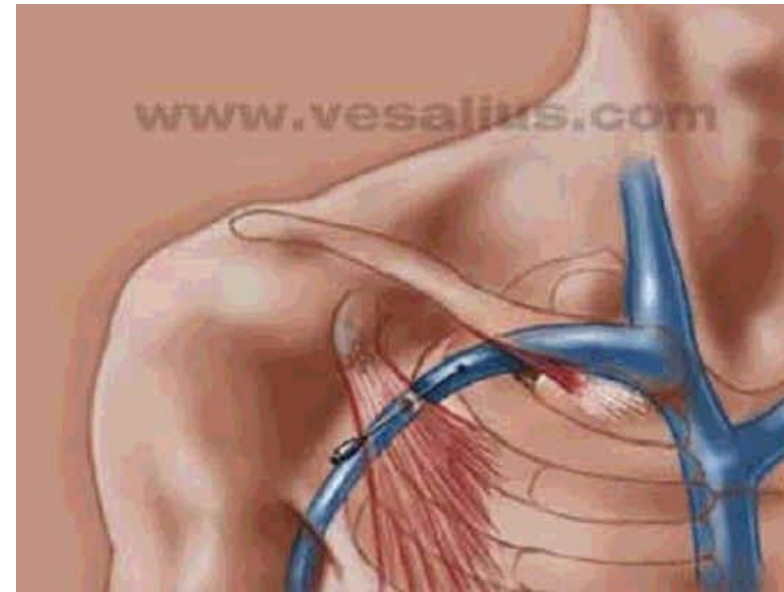


Remember to put patient head down!



- ***Subclavian***

- 1cm below and lateral to the midclavicular point. Keeping the needle horizontal, advance posterior to the clavicle aiming for the sternal notch
- advantage: consistent anatomy, best line placement for nursing staff to manage and for sterility
- disadvantage: increased risk of PTX/bleeding
- Complications: PTX, subclavian artery puncture

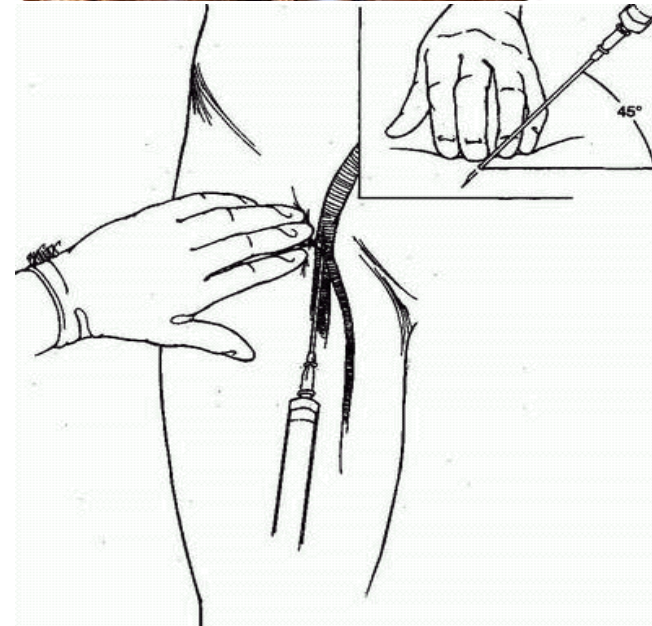




- ***Femoral***

- Remember **N.A.V.Y** Palpate the artery and aim medially at a 45 degree angle
- Advantages: does not interrupt CPR, patient does not need to be completely flat
- Disadvantage: sterility difficulty
- Complications: femoral artery puncture/haematoma

femoral nerve  
femoral artery  
femoral vein



# Prevention of Infection

- Strict aseptic technique
- Change infusion set daily
- Avoid injection and blood sampling via line if possible

# Prevention of Clotting

- Continuous slow infusion
- Heparinised saline

# Procedure Note

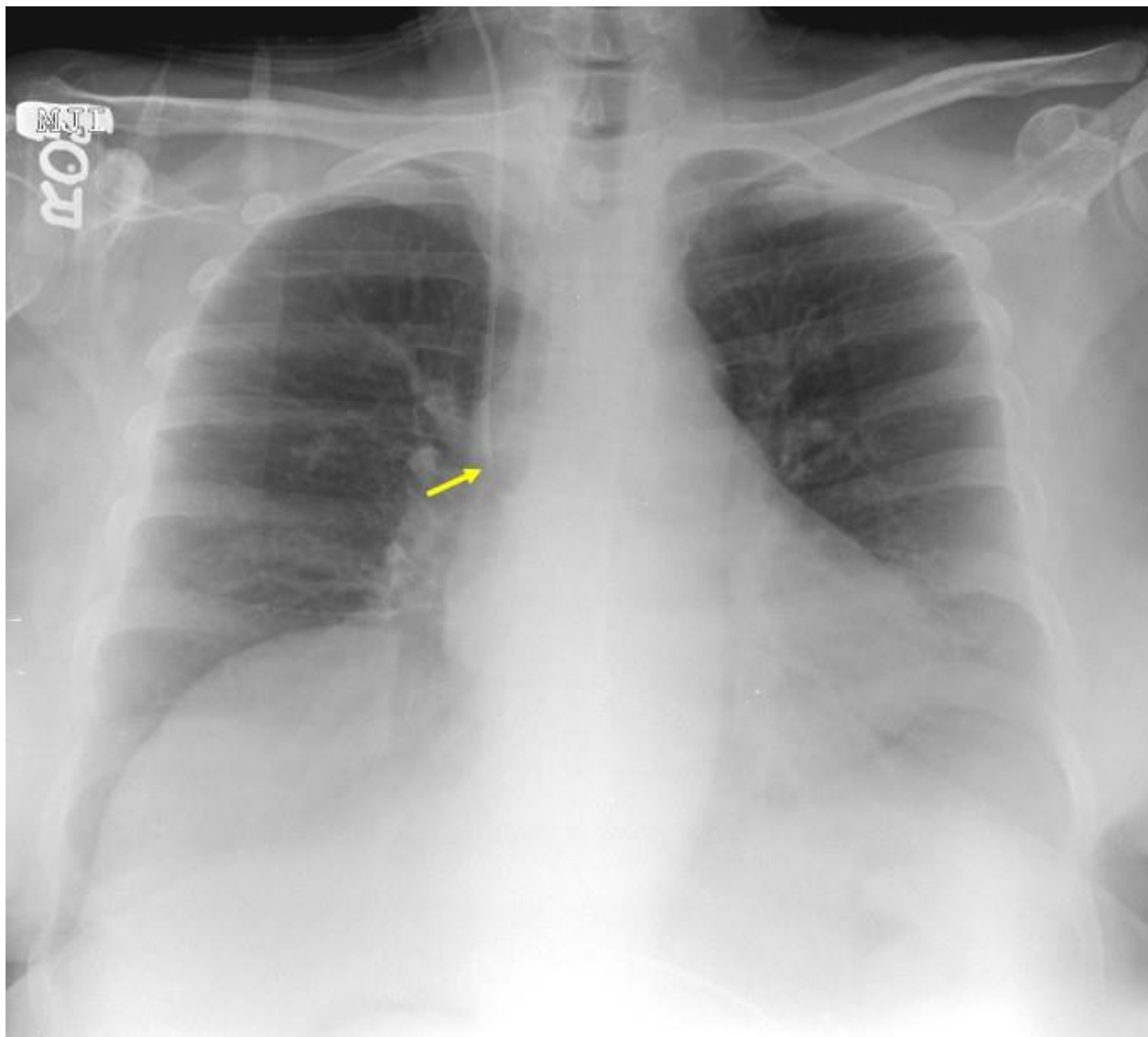
- Date and time
- Indication
- Staff in attendance
- Sedation used
- Technique
- Complications

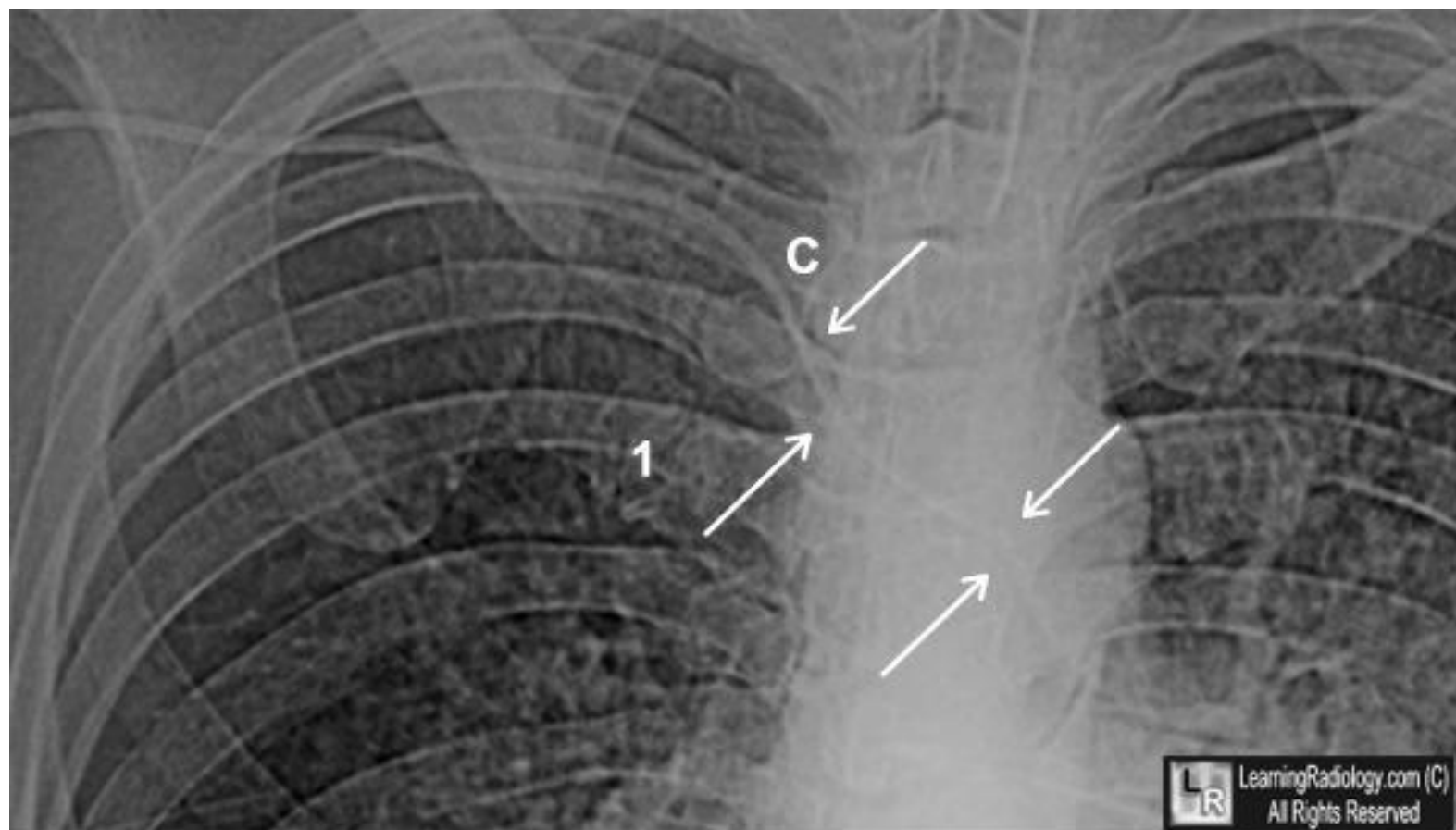


# Complications

- Pneumothorax
- Bleeding / haemothorax
- Infection
- Arterial Puncture
- Haematoma
- Venous thrombosis
- Air embolus (reduced with head down position)

- Thoracic duct obstruction or injury (reduced with right side insertion)
- Catheter malposition
- Pleural effusion
- Nerve injury
- Pericardial effusion
- Cardiac tamponade / myocardial perforation
- Cardiac arrhythmias





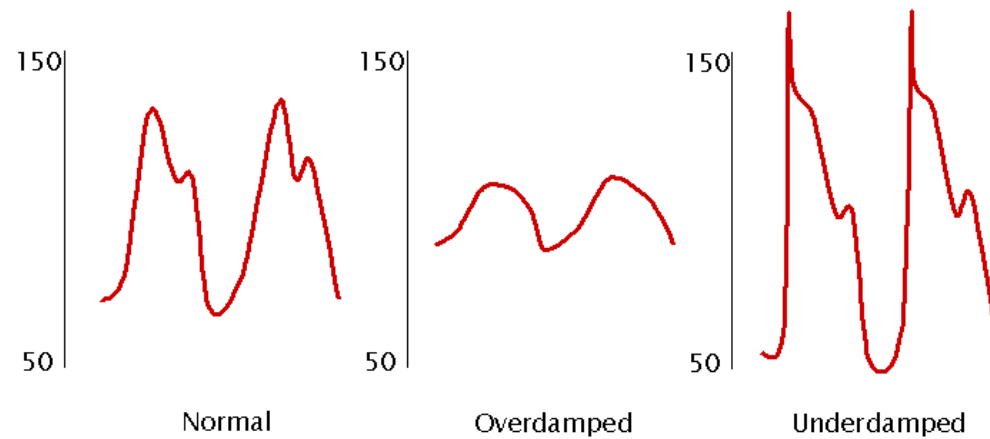


# Arterial Line

- Continuous blood pressure monitoring
- Beat to beat waveform display
- Repeated blood sampling

# Indications

- Haemodynamically unstable patients
- Patients requiring vasopressors or vasodilators



# Sites

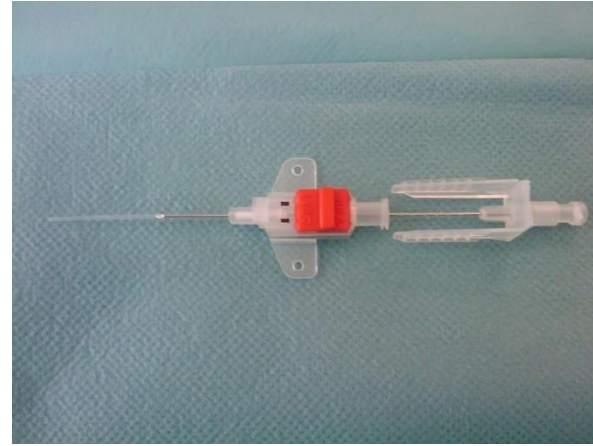
- Radial artery
- Femoral artery
- Dorsalis pedis
- Brachial artery



# Complications

- Temporary occlusion of artery
- Permanent occlusion of artery (rare)
- Haematoma
- Bleeding
- Infection
- Pain

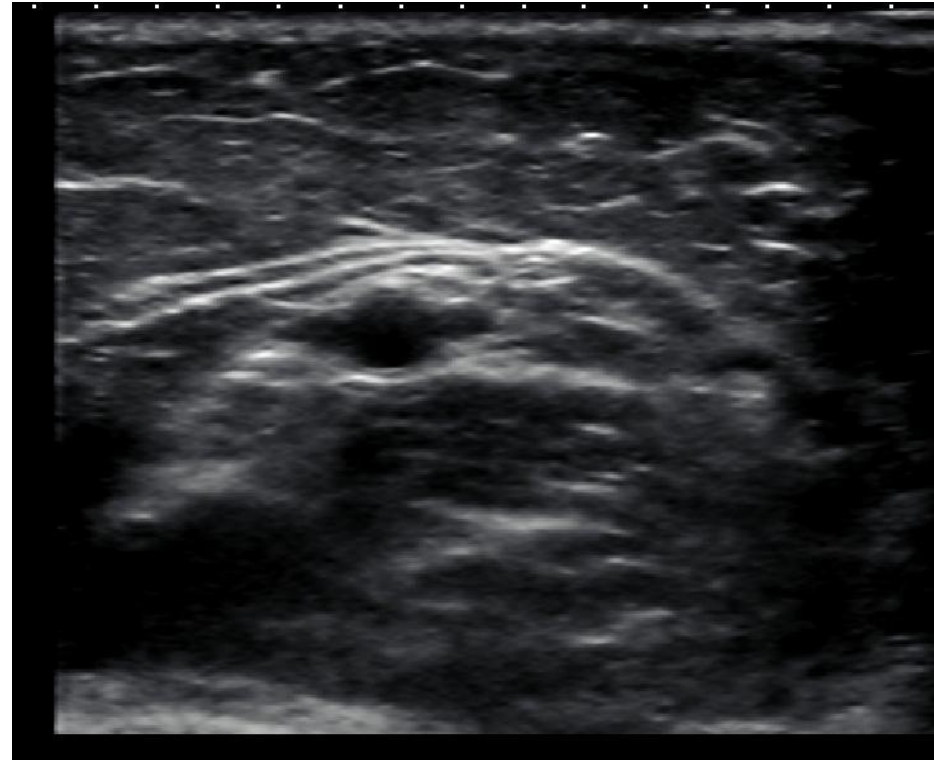
# Equipment



# Technique

- Dependant on equipment
- Could be similar to venous cannulation
- Seldinger Technique
- USS guidance can be helpful
- Always aseptic technique

# Remember Ultrasound



# Vascaths



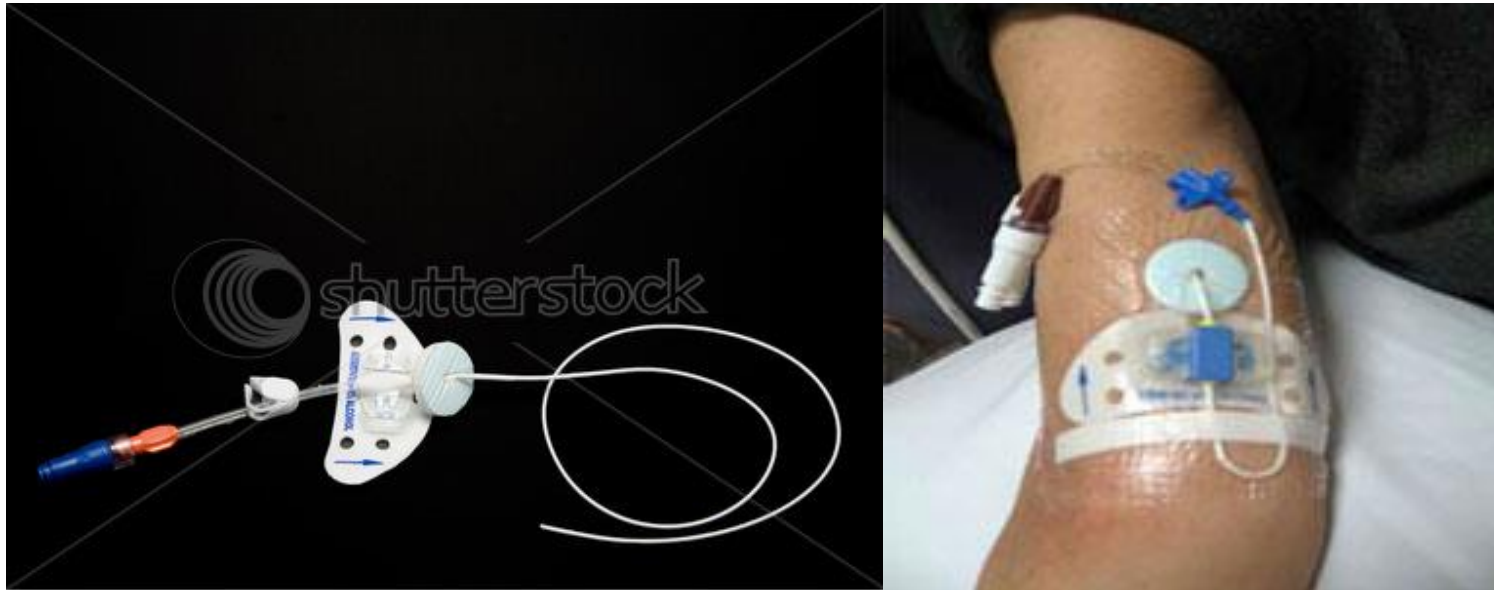
# Indication

- To perform dialysis or haemofiltration (CVVHDF)
- Large bore vascular access

- Same seldinger technique as central line
- Same potential complications

# PICC line

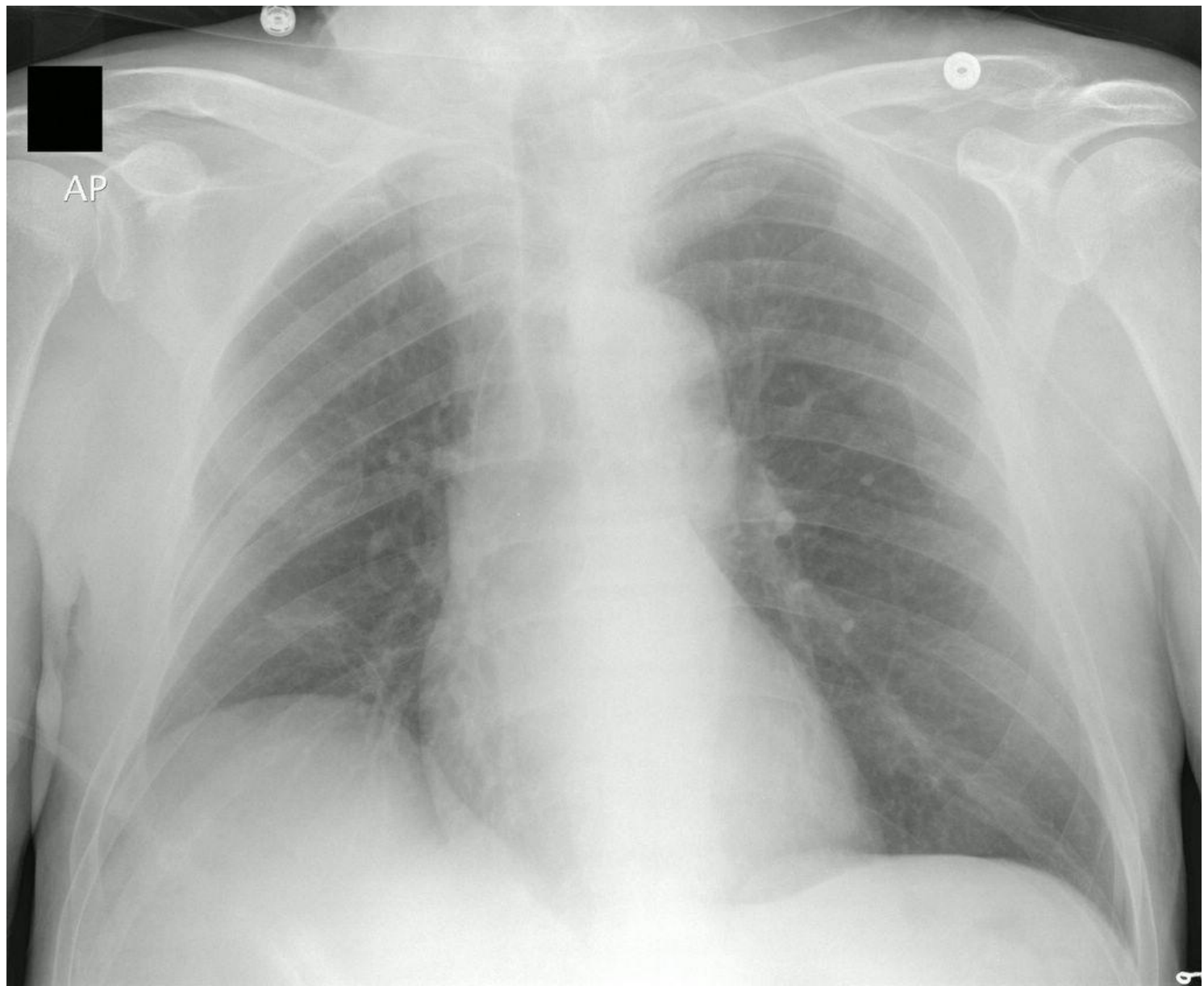
- Peripherally inserted central catheters

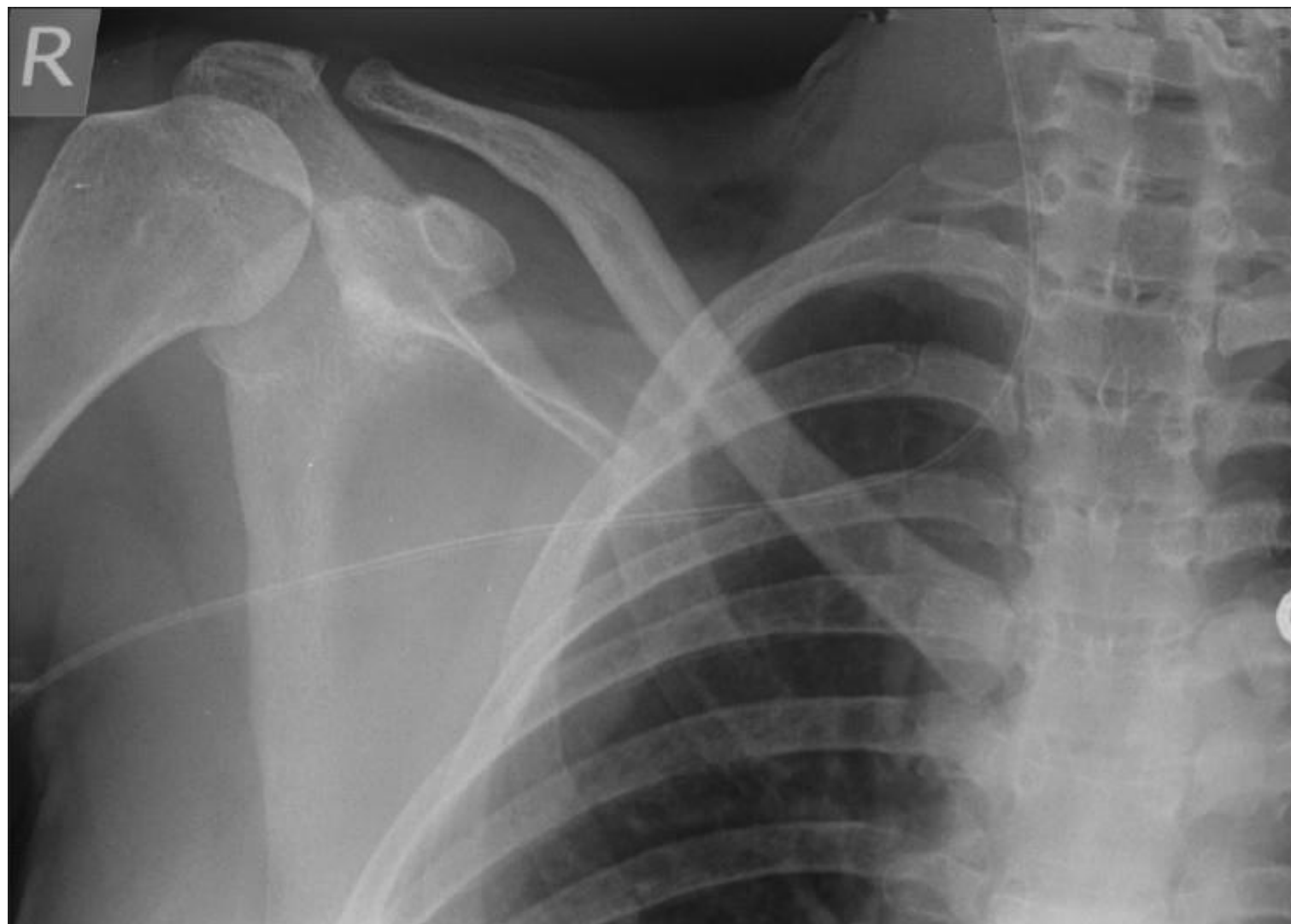


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- Central access
- Suitable for long term use
- Cannot use CVP monitoring
- Same seldinger technique best with USS
- Higher complication rate (e.g.thrombus formation) in the antecubital vein\ better to use vein in upper arm
- Always flush with nothing smaller than a 10ml syringe





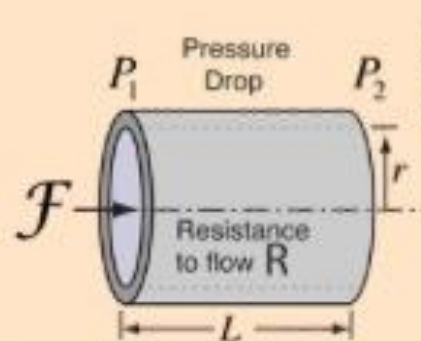
# RIC Line

- “Rapid Infusion Catheter”
- The absolute opposite of a PICC



## Poiseuille's Law

The biggest surprise in the application of [Poiseuille's law](#) to fluid flow is the dramatic effect of changing the radius.



Suppose the original flowrate is  $100 \text{ cm}^3/\text{sec}$ . The effect of changes in the parameters is as follows:

- \* Double length  $\Rightarrow 50 \text{ cm}^3/\text{sec}$
- Double viscosity  $\Rightarrow 50 \text{ cm}^3/\text{sec}$
- Double pressure  $\Rightarrow 200 \text{ cm}^3/\text{sec}$
- Double radius  $\Rightarrow 1600 \text{ cm}^3/\text{sec}$**

\* With other parameters held at original values

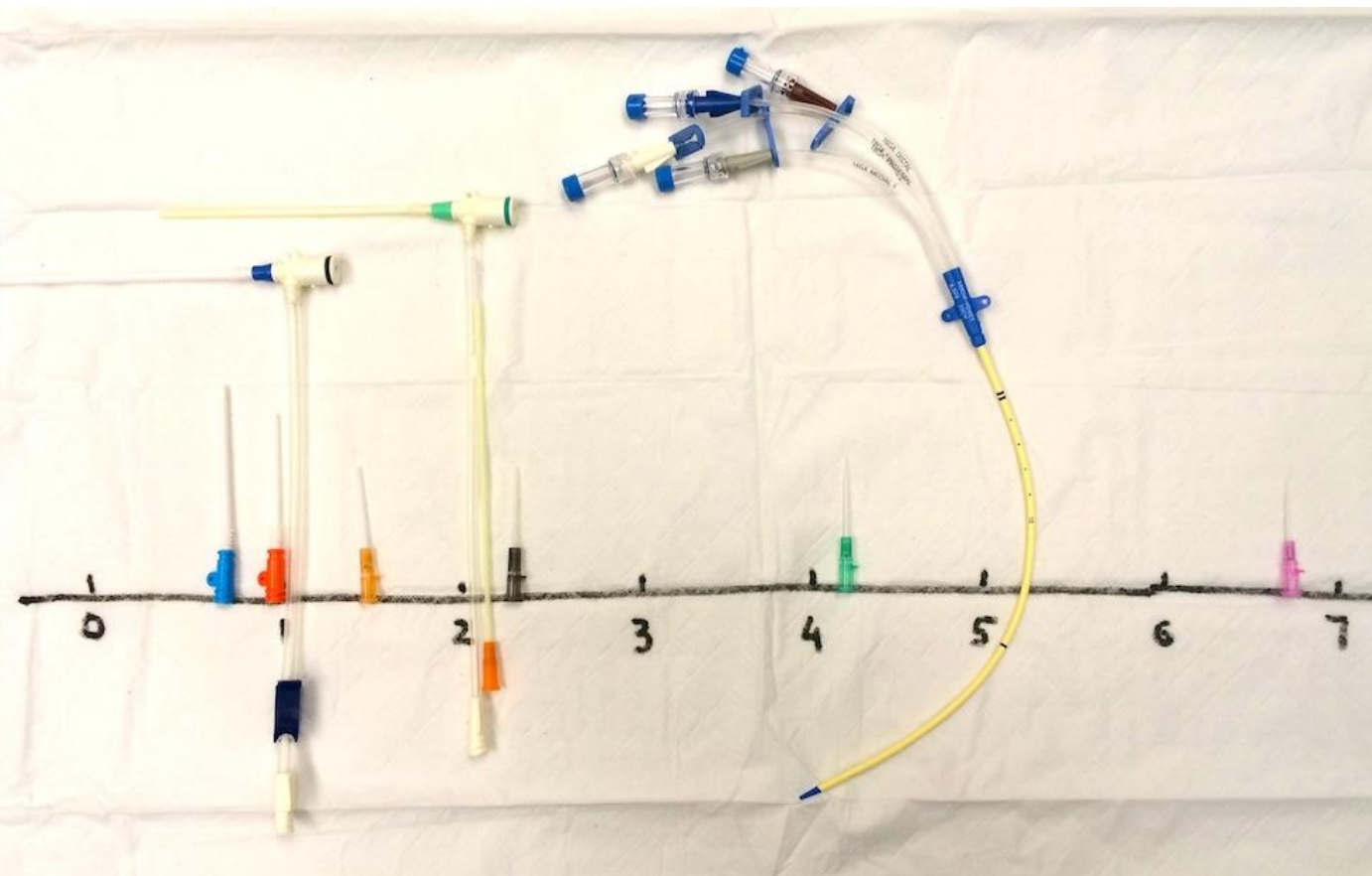
$$R = \frac{8\eta L}{\pi r^4} \text{ where } \eta = \text{viscosity}$$

$$\text{Volume Flowrate} = \mathcal{F} = \frac{P_1 - P_2}{R} = \frac{\pi(\text{Pressure difference})(\text{radius})^4}{8(\text{viscosity})(\text{length})}$$

**A 19% increase in radius will double the volume flowrate!**

A decrease in radius has an equally dramatic effect, as shown in [blood flow examples](#).

### [Poiseuille's Law calculation](#)



## Results

Size	Type	1000ml infusion time
8.5 Fr	RIC Line	0:46 sec
7 Fr	RIC Line	1:00 min
8.5 Fr	Sheath introducer	1:05 min
14 Ga	Standard IV cannula	1:30 min
6 Fr	Sheath introducer	2:10 min
14 Ga	Angiocath (13.3cm) IV	2:10 min
16 Ga	Standard IV cannula	2:20 min
18 Ga	Standard IV cannula	4:23 min
14 Ga	4-Lumen CVC	5:20 min
20 Ga	Standard IV cannula	6:47 min

# RIC Line Kit

- Seldinger kit to convert 20 gauge cannula that has been already placed to a 7 or 8.5 French catheter. (about 11 gauge).
- Very useful for rapid fluid / blood replacement

# Interosseous Access

- Indication
  - Patients who require urgent vascular access where venous routes are difficult or have not been successful



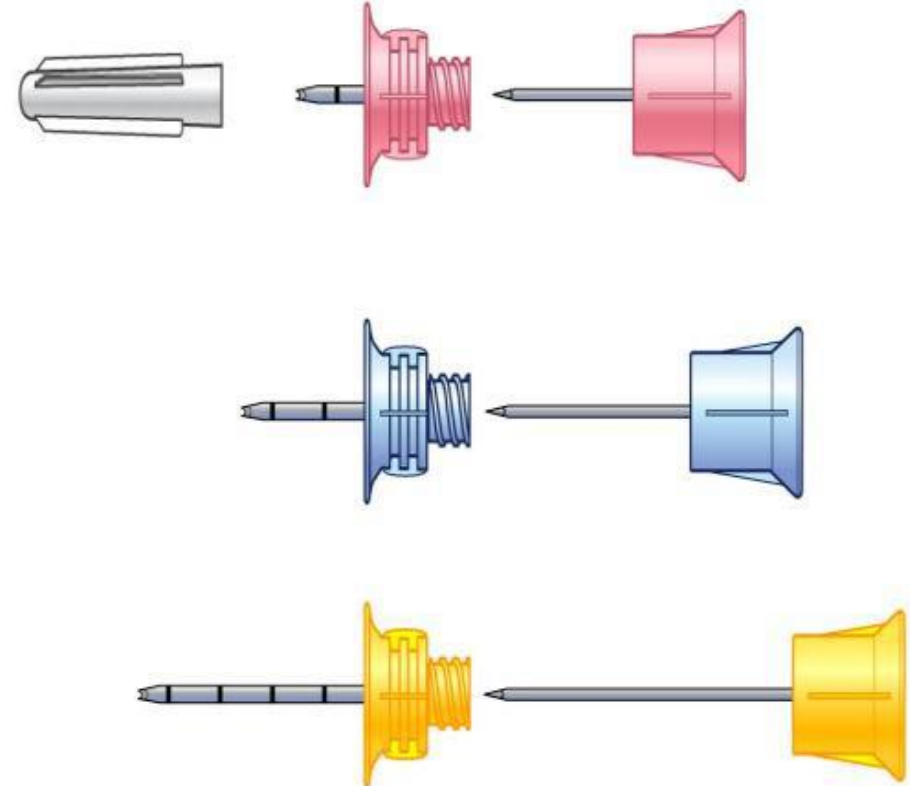
- **Contraindications**

- Fracture of the bone
- Previous I/O in the bone within 24 hours
- Previous orthopaedic surgery at site such as prosthesis
- Unable to locate landmarks
- Infection at site (acute burns overlying site are not a contraindication)

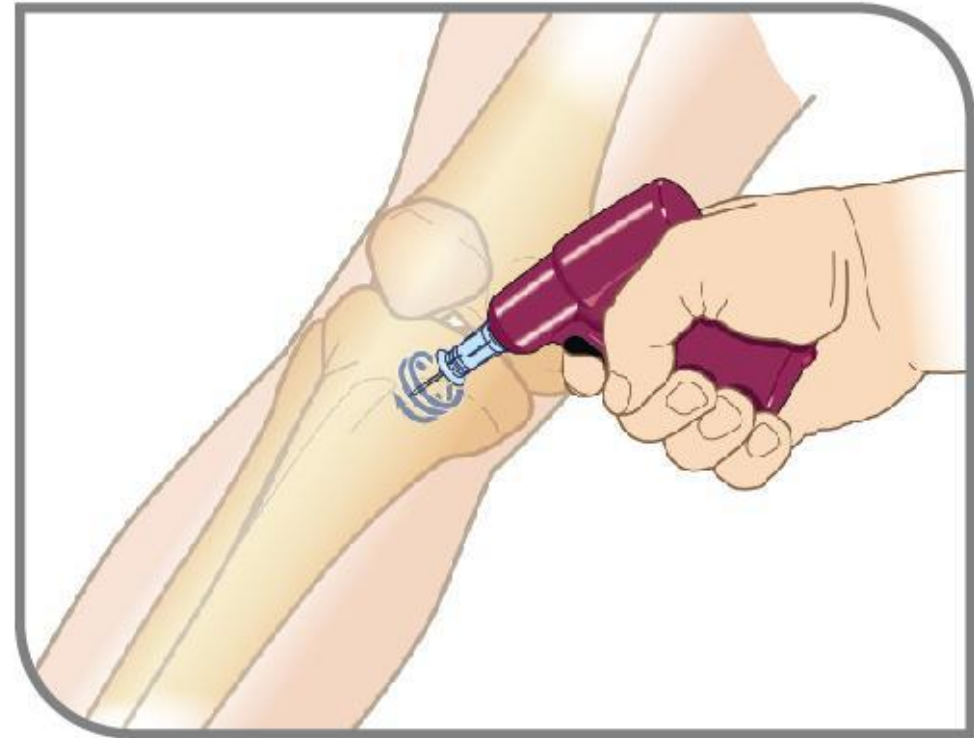
- Any intravenous medication can be safely given by the IO route.
- IO and IV doses are the same but follow each medication with a 3-5 ml fluid flush.
- The medullary space has a higher pressure than the venous circulation, so volume
- administration is enhanced with a pressure bag or volumetric pump.
- The humeral site is said to provide the most rapid flow into the right atrium.
- Blood can also be taken for pathology tests, but discard the first 2ml as waste.
- The EZ

- Technique
  - Determine site
    - Distal tibia
    - **Proximal Tibia**
    - Proximal Humerous
- Select Needle

- All needles are the same gauge (15G) but vary in length (15mm, 25mm and 45mm), so selection is based on the estimated thickness of soft tissue, muscle or oedema overlying the bone.
- When you insert the needle into the skin, if at least one black line is not showing, then a longer needle is required.
- The 45mm is used for the proximal humerus site in patients over 40kg.



- **Prepare driver, needle, tubing and insertion site**
- Attach driver to needle set and leave cap on needle till ready to proceed.
- Attach the EZ-Connect extension tubing to a 20mL syringe filled with saline and prime the tubing. Leave attached to the syringe.
- Identify and swab insertion site.



- **Flush**

- If a needle stabilizer (triangular pad) is available, apply first.
- Connect the EZ-Connect tubing to the needle hub.
- Aspirate to confirm placement.
- A rapid and vigorous flush with at least 10mL of saline will clear the thick fibrin mesh in the medullary space and ensure a good flow rate is subsequently achieved. Some initial resistance will be felt.

- ***Suggestions***

- 1. "EZ-does it." Use gentle pressure and allow the drill to do the work.
- 2. "Stop when you pop." Release trigger when you feel the needle give.
- 3. "No flush = no flow." Failure to appropriately flush the IO catheter may result in limited or no flow. Push through the initial resistance.
- 4. If insertion fails, try the alternative limb, not the same bone.
- 5. A small dose of plain Lignocaine can be instilled prior to flushing, to anaesthetize the medullary space, if patient is pain sensitive. In most emergency cases this will not be necessary.





Back to our cases.....

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- 71 year old female
- Productive cough for 1 week
- Temp 39
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- 50 year old male
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Questions?????