PROCEDURE ACCREDITATION

THE CANBERRA HOSPITAL EMERGENCY DEPARTMENT

Central Venous Line Insertion

Goals

- Understand the indications and risks of CVC insertion
- Understand and troubleshoot the seldinger technique
- Understand available sites and select the appropriate site for clinical use

Indications

- Delivery of centrally acting drugs; (pressors, inotropes) or drugs which need to be delivered centrally because of phlebitis
- Poor venous access or need for long term venous access
- Additional monitoring eg CVP, CVO2
- To aid insertion of other device eg pacing wire
- Patient requiring critical transport or anaesthesia where complications anticipated

Consent

- Verbal consent if patient awake, implied consent if unable
- Complications
  - Arterial injury: dissection, rupture, bleeding, haematoma, AV fistula
  - Pneumothorax
  - Nerve injury
  - Thrombosis, embolus
  - Infection
  - Arrhythmias
  - Cardiac rupture

Equipment

- Central venous line
  - Single, double triple or quad lumen (single lumen RICC or sheath for rapid volume resuscitation); triple or quad lumen for drug delivery and monitoring
  - Antiseptic impregnated
  - Size of lumens
  - Length: neck lines (20cm) vs femoral
  - Paediatric vs adult lines

Equipment

- Major procedure pack
- 3 x 10mL syringes (slip tip)
- 1 x 5mL syringe
- N/saline 30mL
- Suture kit
- 4/0 prolene
- Local anaesthetic with 23G needle and drawing up needle
- Chlorhexidine 2% prep
- Gauze squares (Lots!)
- Tegaderm

Equipment

- Ultrasound machine with sterile probe cover
- Monitor capable of accepting CVP tracing (not mandatory)

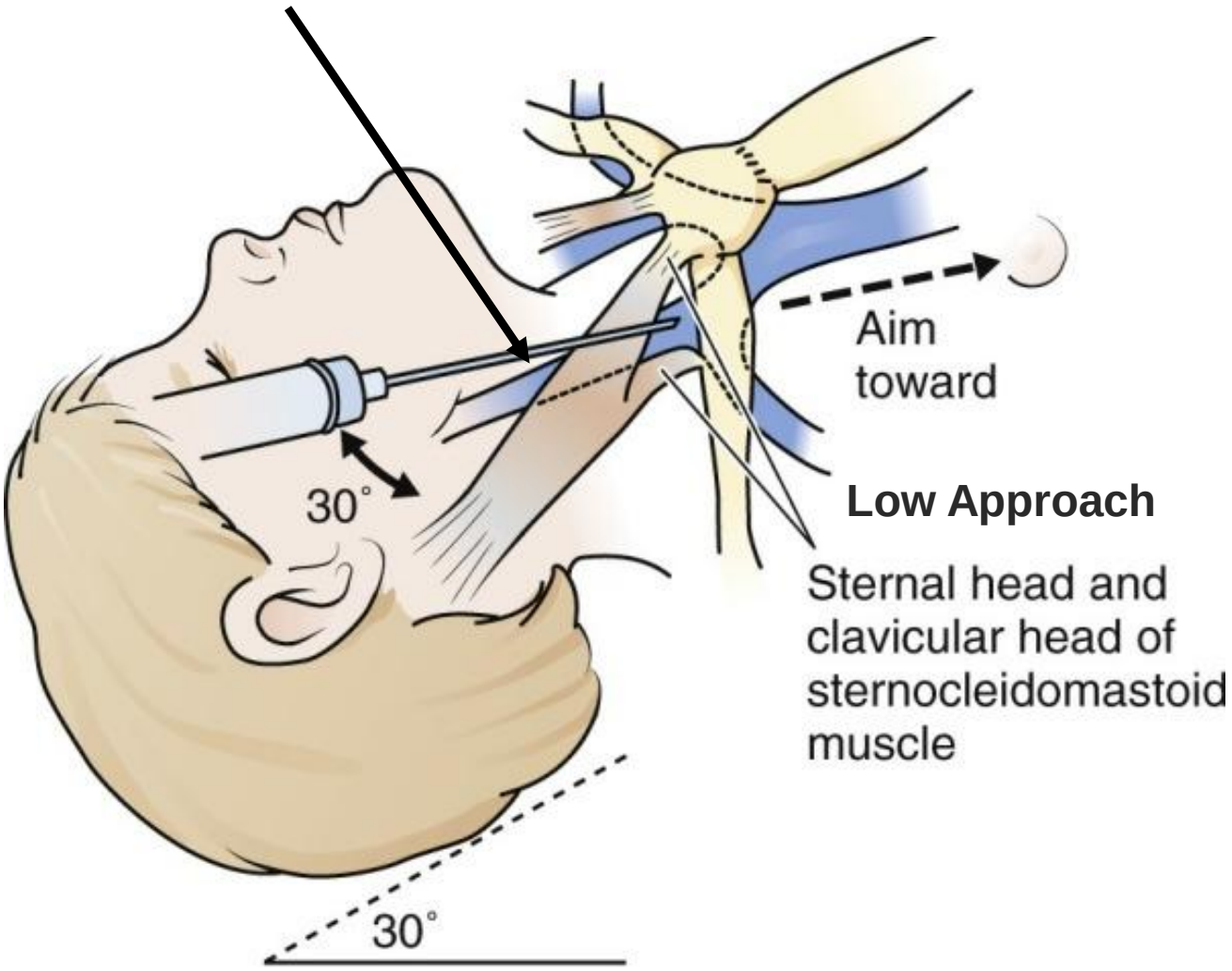
CVC Site Selection

Internal jugular vein CVC (recommended)

- Advantages
  - Low to no pneumothorax rate (with mid approach)
  - USS guiding relatively easy
  - Relatively compressible artery if punctured
  - Relatively comfortable and easy to manage
- Disadvantages
  - Higher infection and thrombosis rate than SCV
  - Not possible if C collar, airway manoeuvres
  - Less comfortable for pt than SCV
  - Capacitance vessel in hupovolaemia
- Contraindications
  - Cellulitis over site

Anatomy IJV

Mid Approach: medial border of SCM



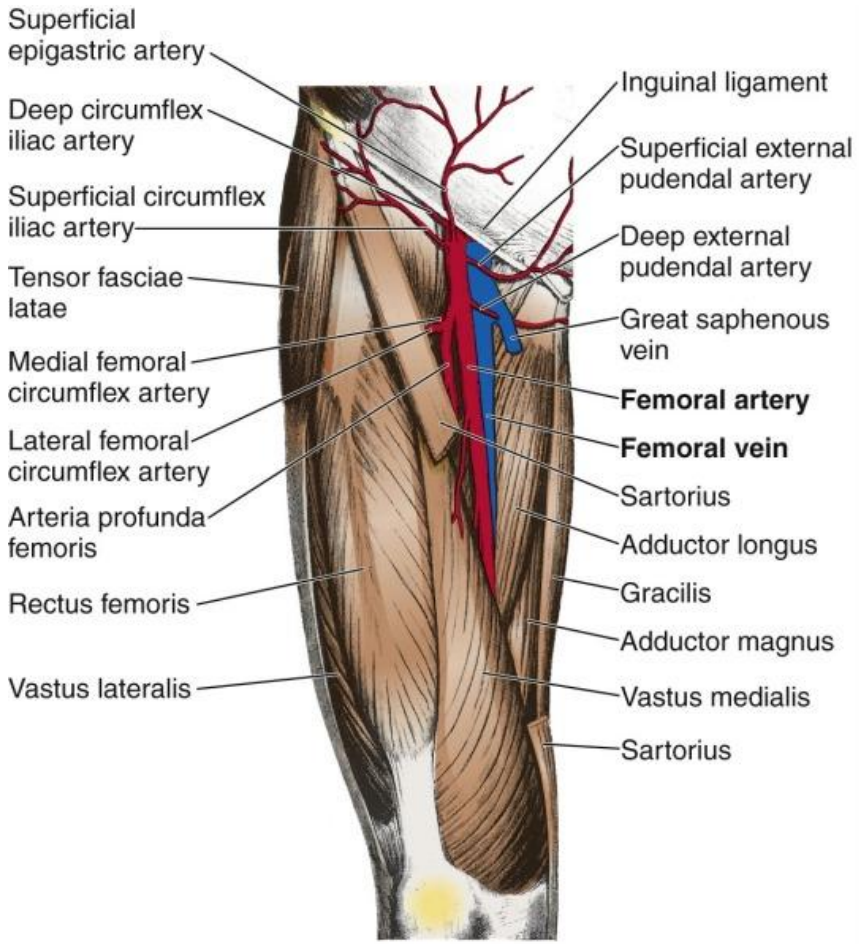
Internal jugular vein insertion

- Mid approach is preferable to reduce pneumothorax rate
- USS guided: single or 2 person operator is preferable
- Unavailable USS: continually palpate carotid artery, vein lies 1cm lateral to artery with non dominant hand
- Aim for ipsilateral nipple at 30 degrees to skin

Femoral vein CVC (recommended if IJV not amenable)

- Advantages:
  - Quick, safe,
  - No PTx risk ,
  - Compressible vessels if arterial puncture,
  - Can be performed during CPR and airway procedures (no head down required)
  - Easily augmented with USS
- Disadvantages:
  - Higher infection and thrombosis risk,
  - Limits patient mobility
  - Easy to kink or accidentally remove
  - Capacitance vessel in hypovolaemia
- Contraindications
  - Cellulitis over site

Anatomy


Superficial epigastric artery
Deep circumflex iliac artery
Superficial circumflex iliac artery
Tensor fasciae latae
Medial femoral circumflex artery
Lateral femoral circumflex artery
Arteria profunda femoris
Rectus femoris
Vastus lateralis
Inguinal ligament
Superficial external pudendal artery
Deep external pudendal artery
Great saphenous vein
Femoral artery
Femoral vein
Sartorius
Adductor longus
Gracilis
Adductor magnus
Vastus medialis
Sartorius

Femoral vein technique

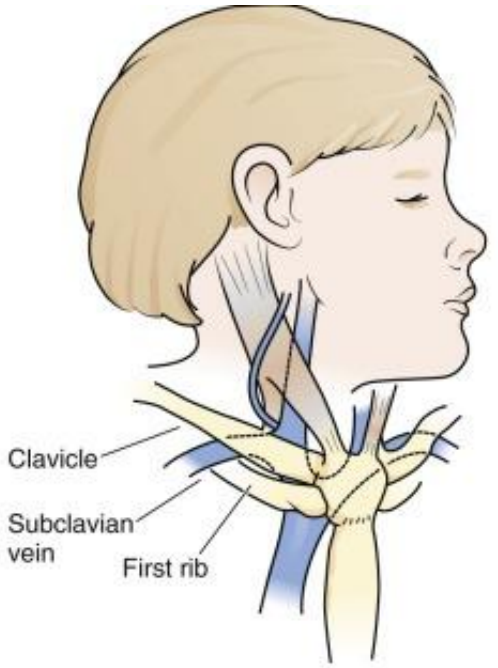
- USS guided preferable (single or two person operator)
- If no USS: palpate femoral artery with non dominant hand and insert 1-2cm medial to pulse
- Insert at or below inguinal crease (not above)
- Ideal vein for insertion of rapid infusion catheters

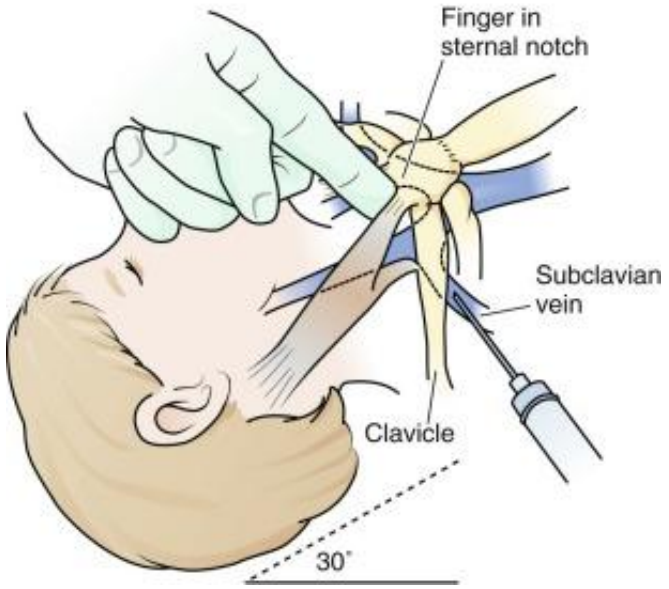
Subclavian vein CVC

- Advantages:
  - Lowest infection and thrombosis risk,
  - can be rapidly inserted if experienced
  - easy to secure and comfortable for patients,
  - direct route to R heart for pacing,
  - non capacitance vessel in shock etc
- Disadvantages:
  - Pneumothorax rate 2-3%
  - Non compressible in event of arterial injury
  - Blind and difficult to ultrasound
  - Stenosis when dialysis catheters used (avoid)
- Contraindications
  - Severe respiratory dysfunction where a pneumothorax would be life threatening
  - Coagulopathy
  - Known vascular stenosis such as thoracic outlet syndrome

Anatomy and Landmarks

- Use index finger of palpating hand to feel the sternal notch
- Slide your thumb along the clavicle until you are at the halfway point
- Aim to insert the needle where the angle of incidence to the clavicle is as close to perpendicular as possible





Insertion technique SCV

- Enter the skin at the distal 1/3 of the clavicle, aiming to 'walk' your needle down the middle of the clavicle
- Keeping your needle as parallel to the skin as possible, aim for the suprasternal notch…keeping your index finder in the notch will assist this
- Apply continuous back pressure on the syringe until the vein is entered and good flow results
- If the artery is entered, do not dilate, apply pressure by grabbing above and below the clavicle

Other sites

- External jugular
  - Can be difficult due to valves
  - Useful alternative esp for coagulopathy
- Supraclavicular brachiocephalic
  - Advantage is it a non capacitance vessel thus useful in shock
  - Not for routine use until experienced with other sites

CVC insertion Technique

CLAB principles

- 2 minute hand wash with 2% alcoholic chlorhexidine
- Full bed coverage with drapes (unless impractical)
- USS use when available
- Strict asepsis
- Complete a record of insertion

Initial Preparation

- Sterile field with sterile gloves, gown ,mask and sterile drapes.
- Chlorhexidine prep wide coverage:
  - from contralateral nipple to jawline to trapezius to deltoid to axilla to ipsilateral nipple
- Identify landmarks and position patient accordingly (see specific site insertion advice)
- Local anaesthetic using 23 G needle over insertion site, deep to vein and to either side for suturing.
- Massage anaesthetic to disperse bleb

Initial Preparation

- Flush all CVC lumens with saline
- Change bungs to hospital issue
- Leave bung off brown lumen
- Prepare the guidewire by taking the cap off and retracting the curly tip into the sheath
- Place equipment in order you will need it:
  - Needle with syringe—guidewire--dilator—central line—

Important positioning for neck lines

- Prior to puncturing the vein, ask your assistant to adjust the bed to make the patient head down 15-30 degrees to allow the neck veins to fill

Seldinger Technique

- The seldinger technique is used for invasive placement of lines and tubes
- It works on a 4 step process
  1. Use a small needle to find the vessel/pleural space etc
  2. Pass a guidewire through the needle
  3. Dilate the tissue
  4. Pass the big line/tube over the guidewire

Seldinger Technique part 1

The NEEDLE

Seldinger technique: NEEDLE

- Fill the 10mL syringe with 1mL of saline and attach to the insertion needle

- **PRACTICE TIP:** Use a 'slip tip' not luer lock syringe to allow easy removal of needle
- **PRACTICE TIP:** The small amount of saline allows clot to be flushed out of the needle. Too much saline changes venous blood to a 'red arterial' colour
- **PRACTICE TIP:** initially use a 21G "spotter" needle for Internal Jugular or Femoral Vein

- Hold the needle and syringe in your dominant hand ensuring you can withdraw and push and pull on the plunger with one hand (see picture)

One-handed technique for syringe holding. People with smaller hands may prefer a 5mL syringe

Seldinger technique: NEEDLE (no USS)

- Use your non dominant hand to remain palpating your landmarks
- Insert the needle through the skin, applying continuous backward pressure on the plunger.
- Ensure good communication to inform the patient what you are doing, that they may feel pain and request staying still!

Seldinger Technique: NEEDLE (USS guided)

- Use vascular probe with sterile probe cover
- Use sterile gel inside probe cover (not on skin)
- Use saline on skin for extra acoustic enhancement
- Ensure probe pressure is not compressing vein
- Always insert the needle just in front of the probe

Seldinger Technique (USS guided)

- Remember you ideally need 0-60 degrees of angle between US beam and needle. You will not see it at >60 deg
- Ideally obtain a **longitudinal** view of vein and puncture under direct vision in line (ideal for femoral)
- If difficulty obtaining long view (often for IJV) use a **transverse** view
  - You must move the probe distally **first** and then advance the needle
  - Do NOT move the needle and then 'catch up' with the probe
  - Vein must be punctured under direct vision

PRACTICE TIP: ULTRASOUND

- Avoid ‘stepping your way’ down to the vein
- This often occurs in deep, difficult lines in obese patients
- The needle displaces soft tissue like a staircase
- When the needle is removed the guidewire kinks and often makes dilating or line insertion IMPOSSIBLE

- If you need to change direction, come back to the skin and progress smoothly

PRACTICE TIP: SAFETY

Confirming venous placement

- Ultrasound direct vision
- Dark, non pulsatile blood in syringe
- Send rapid ABG for PO2 (sterility maintained)
- Transduce waveform (sterility maintained)
- Use an extension tube to act as a manometer

Troubleshooting

- If you hit an artery
  - Remove needle (do not insert wire, do NOT dilate)
  - Place firm pressure over site for 5 minutes
  - Obtain senior help
  - If unable to control bleeding: continue with firm pressure, urgent vascular surgical review

Seldinger Technique part 2

The GUIDEWIRE

Seldinger technique: GUIDEWIRE

- When the vein is entered aspirate continually to ensure good flow
- Disengage the syringe then insert and progress the guidewire
- With the guidewire passed easily, hold the proximal tip of the guidewire and remove the needle, then hold the distal end of the guidewire and remove the needle completely
- Use USS to confirm guidewire placement prior to dilating

SAFETY: Guidewire technique

- Part of the guidewire must remain visible and in control of the operator at all times
- To minimize air embolism risk, once the vein is entered the syringe or cannula must not be open to air
- To minimize air embolism risk, ask the patient to hold their breath prior to disengaging the syringe when inserting the guidewire

Troubleshooting

- If the guidewire does not easily pass
  - You are in the vessel wall or
  - You have gone out the back/front of the vessel
  - Remove the guidewire
  - Microadjust the needle with syringe reattached in or out until good flow is obtained and pass the guidewire again

Seldinger Technique part 3

The DILATOR

Seldinger technique: DILATOR

- Pass dilator over the guidewire, until wire is out the proximal end of the dilator (you may need to nick the skin with a scalpel or needle tip to easily insert the dilator through the skin)
- Using a twisting motion, dilate until just before the vein is entered
- Grasp the proximal end of the guidewire, remove the dilator

SAFETY: the dilator

- **Never** dilate until you are sure you are in the vein
- Ask for assistance if you are unsure

Seldinger Technique part 4

The CVC

Seldinger technique: The CVC

- Feed the catheter over the guidewire ensuring the skin is not entered until guidewire is able to be grasped protruding from the brown lumen
- Insert catheter to predetermined length
- This is usually to full 20cm for a femoral vein and 12-16cm for an IJ or SC vein

Finishing the CVC

- Remove the guidewire
- Kink the brown lumen over when the guidewire leaves until syringe attached
- Using a 10mL syringe full of saline, aspirate each lumen until blood just in syringe tip and then flush
- Bung each of the lumens after flushing
- Suture in place
- Large tegaderm x1 or x2
- Connect to monitor and zero
- CXR to confirm position prior to using (if neck line)
- Write up your procedure in the notes

Troubleshooting

- If you have trouble inserting the catheter:
  - Inadequately dilated
  - Wire has been removed from vessel
  - Wire never placed correctly
  - Abnormal anatomy
  - Wire kinked

  - Use an ultrasound to check the guidewire location
  - Ask for senior help

MCQ

Evaluation

- 1. Which is NOT an indication for triple lumen CVC insertion?
  - A. Administration of centrally acting drugs
  - B. Rapid fluid resuscitation in trauma
  - C. IV access not otherwise possible
  - D. To closely monitor unstable patients

- 2. The most appropriate antiseptic for skin prep is
  - A. Povidine-Iodine
  - B. 1% chlorhexidine
  - C. 70% isopropyl alcohol
  - D. 2% chlorhexidine

- 3. The most important principle of the seldinger technique is
  - A. Maintaining visual and physical contact with the guidewire at all times
  - B. Using appropriate amounts of local anaesthetic
  - C. Having the patient head up 15 degrees when puncturing the vein
  - D. Flushing all lumens twice

- 4. When dilating you should dilate the vein as well as the subcutaneous tissues
  - True
  - False

- 5. Confirmation of venous placement is achieved by
  - A. Inserting the catheter and transducing
  - B. Watching it on USS and seeing dark non pulsatile blood
  - C. Absence of large haematoma
  - D. Watching blood come out the end of the needle for 30 seconds

- 6. If you hit an artery
  - A. Remove the needle and put pressure on for 5 minutes
  - B. Insert the guidewire and put pressure on for 5 minutes
  - C. Remove the needle and call for help
  - D. Consult vascular surgery

- 7. In severe respiratory failure the most appropriate sites for a CVC include
  - A. Subclavian and jugular
  - B. Jugular and femoral
  - C. Femoral and subclavian

- 8. In coagulopathy the most appropriate sites for a CVC include
  - A. Subclavian and jugular
  - B. Femoral and subclavian
  - C. Jugular and femoral