

Central Venous Catheter Insertion

Veins: internal jugular, subclavian (highest bleeding and pneumothorax risk), femoral (highest infection risk)

Indications: intravenous access, central venous pressure monitoring, infusion of irritant medications, renal replacement therapy, transvenous pacing, central venous oxygen saturation monitoring

Contraindications: obstructed vein, overlying infection, haemorrhage from target vessel

Contraindications to internal jugular/subclavian: coagulopathy (INR >1.4, platelets <50, therapeutic anticoagulant <24 hours, clopidogrel <7days), respiratory failure, raised intracranial pressure

Introduction

- **W**ash hands, **I**ntroduce self, **P**atients name & DOB & wrist band, **E**xplain procedure and get **written consent** if possible
 - Risks: pain, damage to surrounding structures (including pneumothorax, cardiac tamponade/perforation), haemorrhage (including arterial puncture, haematoma, haemothorax), infection, arrhythmias, emboli (including air and guidewire), thrombosis, vessel stenosis
- ****Check patients clotting screen, platelet count and if they have been on a therapeutic anticoagulant/clopidogrel****
- Consider pre-procedure analgesia
- Ensure assistant is available and clinical and non-clinical bins are close by to dispose of waste
- Ensure patient is on cardiac monitor (for internal jugular/subclavian veins)



Preparation part

- Wash hands and apply surgical hat and mask
- Clean a large trolley
- Gather equipment onto bottom of trolley (think through what you need in order)
 - Cleansing snap-sponge (iodine or alcohol/chlorhexidine) x2
 - Sterile drape with hole in centre (or 4 drapes without holes in)
 - 10ml syringe and 3 needles (1 orange 25G, 2 green 21G) *for local anaesthetic*
 - 2x 10ml syringes *for flushing and aspirating*
 - Central venous catheter kit
 - Scalpel (no 11)
 - Introducer needle with 5ml syringe
 - Guidewire
 - Dilator
 - Central venous catheter (7Fr triple-lumen 15cm long catheter most common)

Note kits vary and most kits will also have other equipment from the rest of the list included

 - 2x sterile bowls – *one for drawing up saline, one for discarding any blood*
 - Sterile tubing *for manometry to confirm venous placement*
 - Cotton gauze swabs x2 (used whenever needed throughout procedure to dry/clean sterile area)
 - Suture kit (needle holder, scissors, forceps) and 3-0 or 4-0 nylon/silk sutures
 - Sterile clear dressing (e.g. tegaderm film or hypofix)
 - Sterile ultrasound gel and sterile ultrasound probe cover
 - Equipment to be kept outside of the sterile field
 - Ultrasound scanner with linear probe and gel
 - Chlorhexidine hand scrub solution
 - Sterile theatre gown
 - Sterile surgical gloves
 - 50ml sterile saline
 - 10ml 1% lidocaine (maximum 3mg/kg – *note 1ml 1% lidocaine = 10mg*)
- Walk to patient
- Wash hands
- Open the central venous catheter kit to form a large sterile field on the top of the trolley
- Open packets (without touching the instruments themselves) and drop sterile instruments neatly into the sterile field

Patient part

Positioning and exposure

- Expose area
- Position patient:
 - Internal jugular/subclavian: lying with head of bed 10-15° downwards (head turned slightly away from side of insertion)
 - Femoral: lying with foot of bed downwards (slight external rotation of hip)

- Ultrasound area to confirm anatomy and locate insertion point (right side preferred):
 - Internal jugular: apex of triangle formed by the sternal and clavicular heads of sternocleidomastoid muscle and the clavicle, which is around the level of the cricoid cartilage, just lateral to carotid artery (needle at 45° to the skin aiming inferolaterally towards ipsilateral nipple)
 - Subclavian: 1cm inferior to the junction of the outer and middle thirds of the clavicle (needle at 30° to the skin aiming medially towards the suprasternal notch)
 - Femoral: 1cm medial to femoral artery pulsation, 2-3cm inferior of the inguinal ligament (needle at 45° to the skin aiming towards the head)

Note: position ultrasound probe out-of-plane (perpendicular to vein) and confirm the vessel is a vein by ensuring it is compressible and not pulsating – see page 7 of [ultrasound](#) notes

- Wipe off ultrasound gel and mark insertion point with skin pen/indentation

Preparation

- Wash hands using Chlorhexidine solution, then apply sterile gown and gloves using the [surgical scrub technique](#)
- Prepare equipment
- Sterilize area
 - Work from middle outwards in one spiral motion (using cleansing snap-sponge)
 - Repeat this with 2nd cleansing snap-sponge
 - *Discard used snap-sponges as they are no longer sterile, but note all equipment used after this (including all needles) can be returned to the sterile field after use*
 - Apply the sterile drape over the patient's body so that the hole is in the correct place to allow access to the insertion site (or apply 4 drapes centred around exposed insertion site if no holes) – if patient is conscious explain their face will be covered but they can signal for attention by raising hand
- Prepare ultrasound probe
 - Ask assistant to put gel on ultrasound probe and hold it still while you apply the sterile probe cover over the top
 - Apply sterile gel to outer surface of the covered probe and rest in sterile field
 - Note: you should always use your non-dominant hand to hold the ultrasound probe whenever required, so you can use your dominant hand to do things at the same time*
- Anaesthetise tract
 - Ask assistant to snap open lidocaine bottle and hold open upside-down
 - Draw up lidocaine using 1st green needle on 10 ml syringe and expel any air, then change to the orange needle
 - Use ultrasound to confirm the entry site
 - Insert orange needle at an acute angle to form a single subcutaneous lidocaine bleb around insertion site in order to anaesthetise the skin
 - Change to the 2nd green needle
 - Using direct ultrasound guidance, anaesthetise the subcutaneous tissues and around the vein (always aspirate before injecting lidocaine to check you are not in a vessel)
- Now **wait 1 minute** for the anaesthetic to work, while you prepare the equipment:
 - Arrange into order
 - Slightly retract the guidewire in its sheath to straighten the J-tip it using the plastic nozzle
 - Ask assistant to pour 100ml sterile saline into sterile bowl
 - Draw up saline in 10ml syringe and flush all lumens of the central venous catheter and clamp the all ports except the brown port (distal port where the guidewire will come out) – leave cap off this port

Seldinger insertion procedure

- Introducer needle insertion
 - Under direct ultrasound guidance (keeping the needle tip in the field), insert the introducer needle with the empty 5ml syringe attached
 - Slowly advance the needle aspirating during infiltration and stop as soon as blood is aspirated (do not put needle in more than half way)
 - Now put ultrasound probe down
 - Holding the needle steady by the skin with your non-dominant hand, detach syringe
 - Confirm you are not in an artery by either:
 - Asking the assistant to run the aspirated blood through a blood gas machine (you can insert guidewire while waiting for the result but not proceed beyond this)
 - Or, by manometry by attaching a length of sterile tubing to the needle and holding it below the neck allowing it to fill with blood, then elevate the tubing observing the fall of the column of blood to a level consistent with venous pressure
 - Or, by pressure transduction
- Guidewire insertion
 - Place the guidewire nozzle into the end of the needle and use your thumb to seed the guidewire out of its sheath directly into the end of the needle while you watch the cardiac monitor for ectopics/arrhythmias (if using internal jugular/subclavian vein)
 - Aim to insert 15cm of wire (there is usually three black marks to signify 15cm) but if you see ectopics/arrhythmias stop and withdraw guidewire slightly until they resolve
 - From now on, keep hold of the guidewire at all times with one hand, as close to the skin as possible – you can hold it in a loop to make things easier

Note: if you need to move the hand holding the guidewire to the other side of an instrument on the wire, then ensure your other hand has hold of the guidewire temporarily while you move it so you never let go of the guidewire

- Withdraw the needle and thread it right the way off the end of the guidewire, ensuring the guidewire remains in place
- Now confirm the guidewire is in the vein using ultrasound (this can be done using in-plane view)
- Make a 5mm skin incision where guidewire enters skin (with the scalpel perpendicular to the skin, press the scalpel blade straight in and out)
- Tract dilation
 - Place gauze near insertion site in sterile field so you can dab blood as needed (a lot of blood will ooze out after the tract is dilated)
 - Thread the introducer over the guidewire and insert into the tract
 - Go in and out multiple times with a rotational movement
 - Withdraw the introducer and thread right the way off the end of the guidewire, ensuring the guidewire remains in place
- Catheter insertion
 - Thread the central venous catheter over the guidewire until the tip is near the skin
 - Now retract the guidewire slowly until the end comes out of the brown central venous catheter port
 - Holding the end of the guidewire, insert the catheter all the way into the vein
 - When the catheter is in place, remove guidewire
- Flushing
 - For each port in turn (starting with brown as it is already open):
 - Unclamp and remove cap
 - Aspirate blood to confirm patency
 - Flush with 10ml saline
 - Clamp and replace cap

Securing catheter

- Suture in place to allow 4 points of fixation (i.e. suture all holes of central catheter's hub to the skin)
 1. Suture under skin near hole
 2. Bring most of the needle end of suture out from skin (leaving ~7cm)
 3. Tie an 'air knot' (this is done by tying the first throw of the knot slightly loose to the skin)
 4. Thread needle through hole of hub with the blunt end first
 5. Tie in knot with free end
 6. Cut ends and repeat process for next hole

Note: see [suturing](#) notes for how to tie knots

- Apply sterile dressing over the line

To complete

- Thank patient and cover them
- Bin waste and gloves, dispose of sharps safely in sharps bin, clean trolley and wash hands
- Order a post-insertion CXR for internal jugular/subclavian lines (check positioning and for pneumothorax/haemothorax)
- Fully document procedure in patients notes
- **Removal:**
 - Check clotting status
 - Patient must be lying supine to prevent air embolus
 - Close catheter clamps
 - Wash hands and apply gloves
 - Remove dressings
 - Remove gloves, wash hands and apply sterile gloves
 - Clean area using chlorhexidine 2%/alcohol 70% wipe
 - Remove sutures
 - Ask patient to do Valsalva manoeuvre or expire and remove line while holding sterile swab over insertion site
 - Hold gentle pressure over area for 5 minutes or until bleeding has stopped
 - Apply dressing
 - Ensure patient remains supine for 30 minutes
 - Send catheter tip to microbiology