CVC Insertion Manual

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Medical Staff, Nursing Staff; RN and EN Endorsed

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Key points

These guidelines standardise the practice of Central Venous Catheter (CVC) insertion and documentation across Austin Health. They are consistent with the NHMRC & Australian Commission on Safety and Quality in Healthcare Australian Guidelines for the Prevention and Control of Infection in Healthcare, 2019 version 11.9. The aim is to minimise the infective, mechanical and thrombotic complications associated with insertion of CVC's.

Please Note: For the purpose of this guideline, CVC refers specifically to Central Venous Catheters.

For insertion information for other Central Venous Access Devices (CVADs) including Peripherally Inserted Central Catheter (PICC) lines and devices required for chemotherapy or renal dialysis, please refer to the CVAD Manual and the relevant documents available in OPPIC (links above in related Austin Health guidelines).

1. PRE-INSERTION

1.1 Central Line Insertion Practice (CLIP)

The central line insertion practice or "bundle" is a group of evidence-based interventions for patients with intravascular central catheters that, when implemented together, result in better outcomes than when implemented individually. The evidence supporting each bundle is sufficiently established to be considered the standard of care19. Central Line Associated Bloodstream Infections (CLABSIs) are considered preventable events through correct placement, timely removal and ongoing management of the central line. The approach is successful when all elements are executed, every time for every patient.

The key components are:

- Hand hygiene
- Maximal sterile barrier precautions
- Chlorhexidine skin antisepsis
- Optimal catheter site selection
- Optimal catheter type selection
- Use of point of care ultrasound guided insertion (POCUS)
- STOP insertion of the line (empowering the assistant/observer to stop insertion if element(s) of the bundle are not being executed.
- Dressing and fixation.

- Daily review of line necessity, with prompt removal of unnecessary lines.

1.2 Clinical alerts

CVC insertion should ideally be performed in "protected time" so there are minimal interruptions to the insertion team.

- At times, urgent central venous access is required, and these guidelines may not be strictly adhered to. In these circumstances, documentation relating to the urgency of the procedure is required. Lines inserted under emergency conditions (e.g. MET calls; urgent access in the Emergency Department) are to be removed or replaced ≤ **24 hours** in an alternate site (15)
- If the patient is admitted with a central line in-situ (inserted at another hospital), the conditions under which it was inserted should be risk assessed and evaluated with regard to the need for and timing of replacement.
- Insertion of a CVC into the subclavian vein or internal jugular vein must be performed in areas with Class A (cardiac protected) wiring to prevent microshock (i.e. critical care areas). Ward patients requiring CVC insertion will need to be transferred to an appropriate area for the procedure if the subclavian or internal jugular vein approach is to be used. Refer to Appendix 1 Ward Patients Requiring CVC Insertion:
- Interventional Radiology is available to provide central venous access in cases where image guided access is required e.g. multiple occluded central veins, other high-risk patients.
- CVCs in patients transferred from the ICU environment should be considered for removal ≤ **72 hours of arrival to the wards**.
- Recommended antiseptic skin preparation is with the tinted chlorhexidine impregnated swab stick (2% chlorhexidine in 70% isopropyl alcohol). For patients with a chlorhexidine allergy, povidone iodine in alcohol is the preferred skin preparation. (1)

MULTIPLE INSERTION ATTEMPTS AND POTENTIAL COMPLICATIONS

- If the first attempt at subclavian vein line insertion is unsuccessful, it is acceptable to attempt an alternative site (for example, internal jugular vein) ON THE SAME SIDE. Due to risk of causing bilateral pneumothoraces, use caution prior to attempting on the opposite side, and first consider an X-ray to confirm that a pneumothorax has not occurred. (18)
    - The presence of existing intercostal catheters in the pleural space will not prevent a CVAD related pneumothorax from occurring. They will however mean that any air leak from such an injury is likely to be decompressed.
    - Bilateral CVC insertion attempts may be considered when bilateral working ICCs are in situ.
    - Refer to the difficult insertion escalation pathway in section 2.3
- If it is necessary to place two lines in the same vessel (e.g. pulmonary artery catheter (PAC) sheath and CVC), it is preferable that both guide wires should be placed into the vessel prior to either catheter being inserted, to reduce the risk of damaging the catheter with subsequent passage of a needle.

Refer to Appendix 2 for Definitions

1.3 CVC selection considerations

The following should be considered prior to CVC insertion:

1. Indication for insertion

- Central venous pressure monitoring.
- Drug and fluid administration (vasoactive drugs, phlebitic medications, TPN)
- Short-term vascular access in cases of difficult peripheral cannulation

2. Insertion site

Choice of insertion site remains at the discretion of the proceduralist.

Use of ultrasound guided insertion by the proceduralist is preferred regardless of the site – see section 4.4for further information regarding use of ultrasound.

The following information and the table 1 below are provided to assist in guiding this decision:

- The **subclavian site** has the lowest incidence of infection but greatest risk of bleeding. The vessels are non-compressible, therefore it is relatively contraindicated in coagulopathic and thrombocytopenic patients. It is also associated with a higher risk of pneumothorax. Insertion on the left side is preferred (see explanation below).
- The **internal jugular** site is the most common site of peri-operative line insertion because of ease of access for the anaesthetist, from the head of the bed. Bleeding is more easily controlled and pneumothorax uncommon. There is a risk of carotid or other arterial puncture. Insertion on the right side is preferred (see explanation below). For further information refer to Appendix 3 Internal Jugular cannulation – methods to minimise risk of and management of arterial injury.
- The **femoral site** is preferable for patients who are unable to tolerate lying supine and head down for internal jugular or subclavian line insertion (e.g. dyspnoeic, non-intubated patients, neurosurgical patients with raised intercranial pressure). When the operator is inexperienced at central line insertion, this site may be associated with a lower risk of insertion complications. However, femoral CVCs have been associated with higher rates of infections for several reasons:
    - Tend to be more junior proceduralists o be more junior proceduralists
    - Tend to be inserted more frequently in emergency situations
    - More difficult to prepare a sterile field due to hair and body habitus
    - More difficult to preserve dressings and cleanliness of the site
    - Higher bacterial burden

Due to the stiffness of some catheters and the greater risk of vessel trauma, the right subclavian and left internal jugular sites are the LEAST preferred sites of insertion.

Preferred sites include the right internal jugular and left subclavian veins as these have a smoother course of entry into the Superior Vena Cava (SVC) and are less likely to result in vessel trauma (particularly for haemofiltration and pulmonary artery catheters) (4)

Factors to consider with line insertion site selection

While reducing CVAD infection rates is a meaningful long-term outcome, it is not the only consideration when choosing a line site. Other considerations for the proceduralist include more immediate concerns such as:

1. **Safe imaging of the vessel.** This is overwhelmingly the domain of point of care ultrasound (POCUS). A small minority of cases may utilise image intensifier x-ray instead (e.g. subclavian vein in interventional radiology). Austin Health strongly recommends that dynamic POCUS be a key component of CVAD insertions.
2. **Operator experience** with aseptic technique in general as well as the specific type of CVAD kit and anatomical site.

3. **Immediate mechanical complications** including pneumothorax, air embolism, failed line insertion.
4. **Management of possible haematomas** (either in vein or neighbouring artery). Both jugular and femoral locations can be managed with compression.
5. **Ability of the patient to be safely positioned** and for the operator to access the chosen site. Dyspnoeic patients may not tolerate the head down position required to avoid air embolism with upper-body lines. Concurrent management of the airway or the presence of cervical spine collar may preclude the jugular site. Concurrent chest compressions will preclude the subclavian site.
6. **Time available for insertion**. This may be less of an issue for experienced operators. Time to successful insertion is likely to be reduced at the femoral site for more novice operators.

Table 1 - Insertion site – decision guiding tool

Site	Advantages	Disadvantages
Internal Jugular (right recommended over Left)	• Head of table/bed access • Compressible vascular structures • Excellent target for US guidance • Minimal (but not zero) risk of pneumothorax (especially with US guidance) • Lower failure rate with novice operators • Suitable for lines of various sizes (e.g. 1-2 lumen CVC through to Vascath)	• Patient discomfort during insertion and duration of care • Dressing integrity may be hard to achieve/maintain • Risk of carotid puncture • Risk of injury to thoracic duct on left • Risk of vascular injury from stiff dilators (e.g. with Vascath or PAC sheath) at the junction of left internal jugular vein and left subclavian vein. • Challenging landmarks in obese patients • May have a higher incidence of haematoma (than femoral location) • In an emergent situation with concurrent airway interventions may be challenging to access • Hypovolaemia associated with small venous size. May require careful timing of insertion with phases of respiratory cycle.
Subclavian (only recommended for experienced operators and carefully selected patients, when no POCUS viewable site is available) Left side recommended over right given more direct route to SVC.	• Lowest infection risk (Parienti et al NEJM 2015) • Lower venous thrombosis risk • Ease of dressing maintenance • Can be accessed when airway being managed or spinal collar insitu • Better landmarks in obese patients • Patient comfort (once inserted)	• Highest mechanical risk (pneumothorax, air embolism) • **Not able to be visualised with Ultrasound.** • Requires specific experience and training. Low success rate with inexperienced operators. • Not compressible if unsuccessful venous puncture or inadvertent arterial puncture. • Risk of venous stenosis/occlusion which may impact on future dialysis access
Though subclavian lines offer many potential advantages the inability to utilise POCUS to aid insertion is a substantial barrier to their broader recommendation.		
Femoral	• Ease of access in emergencies (including when airway or CPR required) • Easily imaged with US • No requirement for head down positioning to avoid air embolism. • Zero pneumothorax risk	• Highest infection risk • Limits patient mobility • Difficult to preserve dressings and site sterility • Increased risk of lower limb thrombosis • Should be avoided for administration of TPN

	• Rapid access with high procedural success rate	
Axillary	• An adaptation of the subclavian approach (a more lateral approach in the delto-pectoral groove) that allows POCUS to be utilised • Low Pneumothorax risk (not zero) • Compressible • Ease of dressing maintenance	• Less well studied in terms of infection, thrombosis and other outcomes than the three other sites above. Quality trials and meta-analyses lacking. • Requires specific training and experience

3. **CVC characteristics**

- **Number of lumens** should be kept to a minimum (12); bearing in mind the possibility of an escalation in treatment requiring more lumens. Single, dual, triple or quadruple lumen catheters are available. Lines with less lumens generally have larger lumens, facilitating more rapid volume administration.
- **Length** – 16 cm catheters are generally suitable for jugular and subclavian sites, while 20 cm catheters are generally used for femoral insertion sites. Some lines are only stocked in 20cm version (I.e. 4 lumen antimicrobial impregnated lines).
- **Coating** - Antimicrobial impregnated CVCs (e.g. silver sulfadiazine, chlorhexidine, and antibiotic) may be preferred for longer-term use4. Hypersensitivity reactions to chlorhexidine-coated central lines have been reported, albeit rarely and these lines should be avoided in patients with documented chlorhexidine allergy.

4. **Type of solutions**

- Lipid-based solutions, e.g. total parenteral nutrition (TPN) should have a dedicated lumen.
- Inotropic medications
- Irritative or vesicant medications

1.4 Pre-procedure safety check

- Ensure the patient is appropriately informed and consented for the procedure as per Austin Health Consent to Medical Treatment Policy
- Ensure procedure is to be performed in an appropriate location (cardiac protected to avoid microshock).
- Review platelet count and coagulation status and treat if appropriate (16)
    - Circumstances where the platelets are less than 50 and INR is > 1.6 are likely to be associated with higher risk of bleeding at insertion. Bleeding risk will likely be proportional to line diameter and skill of operator.
    - Input from an experienced line insertion clinician is strongly recommended to guide site selection and the risk
- Confirm correct patient as per Patient Identification Policy using three approved patient identifiers.
- Perform Ensuring Correct Patient, Correct Site and Correct Procedure Non-Operating Suite Locations prior to commencement of procedure
- Check for any known allergies as per Documenting allergies, intolerances & adverse drug reactions in the Cerner (EMR)
- Select the appropriate CVC device - type of line, number of lumens required, length of line.
- Consider antimicrobial lines for patients likely to have a line in situ ≥ 3 days
- Monitor with a full set of vital sign monitoring, including, ECG.
- Ensure supplemental oxygen is administered where appropriate.
- Optimise patient position (supine, arms by side, 15-20degreeshead down for internal jugular and subclavian insertion).
- Consider a rolled towel between shoulders for subclavian insertion (3).
- Check surface anatomy and landmarks.
- Identify vein and adjacent structures with ultrasound and mark if possible.

2. Insertion procedure

2.1 Preparation

PREPARATION

Ensure patient is educated regarding the risks and benefits of the procedure, is comfortable and will be likely to tolerate the procedure and document in the progress notes.

- Ensure access to all required equipment (including dressing and suture material).
- Ensure continuous access to and monitoring of patient's clinical status including ECG, NIBP or arterial line and pulse oximetry.
- Ensure supplemental oxygen is administered where appropriate.

INSERTION SITE

- **The insertion site should be free of hair – clipping is preferred to shaving.**
- **Area cleaned with 2% chlorhexidine in 70% isopropyl alcohol swab stick and allowed to air dry for at least 30 seconds. Swab sticks are not sterile, so are used for skin antisepsis immediately prior to commencement of procedure and application of sterile gown, gloves and patient drapes.**
- **The prepared area should be surrounded by sterile drapes**.

PERSONNEL

- The proceduralist should wear a surgical hat, gown, mask and eye protection, remove jewellery from hands and arms and ensure sleeves are above the elbows.
- The proceduralist performs a surgical scrub. Refer to Surgical Hand Asepsis, Gowning and Gloving for Medical and Nursing Staff

2.2 CVC Insertion procedure

Note: These guidelines are an adjunct to, and do not replace, adequate bedside training and supervision.

Central line insertion is only to be undertaken by a Consultant, Fellow or Registrar or by HMO doctors under the direct supervision of a Registrar, Fellow or Consultant. HMO doctors are not permitted to insert haemofiltration catheters or PAC introducer sheaths unless specially authorised and directly supervised by a Consultant.

To facilitate compliance with this guideline, all equipment for the procedure has been standardised across Austin Health and should be made readily available to the CVC insertion team.

- Sodium chloride 0.9% is used to prime the all the catheter lumens and clamped.
- Recheck surface anatomy, and landmarks.
- Strongly recommend the demonstration of static US anatomy using appropriately positioned POCUS device. Confirm relationship of vein to surrounding structures using compressibility and doppler flow. Always place the Ultrasound beam in an anterior to posterior direction such that the Artery sits medial to and at the same level as the Vein. Always scan the whole length to identify the optimal site of insertion, the presence of anatomical variations and the absence of clots or scar tissue from previous intravascular devices or surgery. If there are significant anatomical variations, clots or stenoses in the vein then these should be documented in the electronic record and the presence of these anomalies discussed with a Consultant so that the best vascular access plan may be formulated. In such circumstances it may be appropriate to have a central line placed by Radiology.
- In selecting the site of insertion specific anatomical pitfalls need to be considered:
    - **Internal Jugular Vein**
    - Aim to start high in the neck on the border of the Sternocleidomastoid muscle combining both the ultrasound images and the landmark anatomy. The needle should be moving in the direction from medial to lateral towards the nipple on the ipsilateral side. This will ensure that the needle is passing towards the vein and away from the artery and other vital structures thereby reducing the risk of accidental arterial puncture. Should accidental puncture and dilatation of the artery occur the Vascular Surgical Team can undertake a quick and uncomplicated repair

in the upper and middle parts of the neck. However, if the CVC line is accidentally sited in arteries in the lower neck or chest then a combined Vascular and Cardiac Surgical repair is needed who can result in significant risk to the patient.
    - **Femoral Vein**
    - Always start low in the leg and away from the pelvic brim. This will allow easy compression of the vein or artery in the event of accidental puncture with the needle. Once the artery and vein pass beyond the pelvic brim then compression of these major vessels becomes much more difficult.
- In conscious patients, infiltrate the skin and subcutaneous tissues with 1% lignocaine using a small (23 to 26) gauge needle.
- Consider use of a fine bore scout needle (e.g. 23 gauge blue needle) to locate vein. A longer seeker needle (e.g. 22 gauge 50 mm black needle or needle from cannula provided in kit) may be required in large patients and with some approaches.
- The use of real time dynamic US (in a sterile sheath) to identify the vein before, during and after needle puncture and wire passage is now a widely accepted standard for all CVAD insertions in critically unwell patients. Deviations from this standard may be acceptable in instances of acute patient deterioration where time or equipment is not readily available
- Strongly consider dynamic ultrasound-guided cannula/needle insertion especially for neck line insertion. **In order to confirm non-pulsatile flow It is NOT recommended that the syringe with a central hole that allows passage of the guide-wire (Raulerson syringe) provided in some kits, is utilised for CVC insertion**. The design of the Raulerson obscures inadvertent and unrecognised arterial puncture.
- When advancing/withdrawing needle/cannula, do so within a straight line. Altering the direction of the needle/cannula after entry through the skin may lacerate the vessel wall.
- If no "flash-back" of blood occurs, remove the needle/cannula and ensure the lumen is patent by flushing with 0.9% sodium chloride before rechecking landmarks and reinserting needle.
- The risk of complications increases with the number of needle passes. If unable to cannulate the vein reconsider approach and consider seeking assistance
- Ensure easy aspiration of blood before attempting guide-wire insertion.
- Ensure the J-wire is retracted into the introducer point of the coiled delivery device before attempting to feed the wire into the needle (straightens the tip).
- When advancing J-tip guidewire down needle/cannula, insert the 'J' end first, and do not proceed if abnormal resistance is felt. The needle tip (not the middle of the needle) **should be on view on the Ultrasound at all times**. It is preferable to cannulate the vein and then detach the syringe thereby checking that the pressure of the blood in the cannula is venous and not arterial. If in doubt connect a sterile IV extension that has been flushed with normal saline to the cannula to act as a manometer prior to placing the wire and dilating the vein. Arterial pressure and pulsation will be clearly discernible within the flushed IV extension.
    - If resistance is felt, carefully remove guidewire and recheck position of needle/cannula by repeat aspiration.
- Withdrawing the wire within the needle can lead to shearing of the wire. If ANY resistance is felt, remove wire and needle together.
- Insert the guidewire no more than 15 cm into the patient, using the markings on the wire as a guide, unless under image guidance.
    - Take care to avoid entry of guidewire into RA or RV (which may cause arrhythmias).
- Once the position of the wire is confirmed to be within the vein (and simultaneously absent from surrounding arteries) using ultrasound in both long and short axes if possible. Use the scalpel blade to enlarge the skin entry point and the dilator to expand the tract through the skin and superficial tissues. Dilation should not occur until the wire position has been confirmed. Where concerns exist around bleeding it is possible to try a "no cut technique" using sustained torsion force on the dilator. If time and patience allows this technique can permit substantial dilation.
- Advance the dilator in a gentle rotating motion to avoid bending of the guidewire and/or dilator. Do not insert dilator to its full length. 2-3 cm centimetres into the vessel is sufficient. Regular "jiggling" of the wire in and out by a centimetre or so as you dilate should demonstrate that it remains intravascular and free of kinking.

- Right subclavian and left internal jugular sites are prone to vessel injury/laceration due to angulation of vessels distal to insertion point if the dilator is inserted too deeply into the vessel.
- Moderate flow of blood is to be expected in the interval between dilator removal and definitive line insertion. This can be minimized with good preparation. Preparing for this may include having sterile gauze ready to provide (minimal) compression as well as ensuring the line itself is readily within reach. Some operators choose to both loosely coil the wire and press on insertion site with gauze using one hand. This keeps the other hand free to thread the line onto the wire. Excessive pressure at the insertion site is to be avoided as it can cause kinking of the wire and may make passage of the line difficult.
- Insert the catheter over the wire to the desired distance whilst maintaining control of the wire **at all times. The guide wire must extend out of the Luer lock hub of the catheter and held firmly before advancement of the catheter into the tissues.**
- The desired distance will vary depending upon the site of line insertion and the size and anatomy of the patient. Generally, the following distances will result in the tip of the catheter lying in the correct portion of the vena cava:
    - Right subclavian/internal jugular: 12-15 cm
    - Other sites (Left subclavian; left internal jugular): 15-20 cm
    - Femoral: Insert to full length of catheter.
- Remove the guidewire.
- Secure access valves to hub(s), aspirate blood from all lumens, and flush each lumen with sodium chloride 0.9%.
- Connect, cap or clamp all lines whilst securing (see below) and dressing CVC.

Sharps disposal: It is the proceduralist's responsibility to dispose of all sharps appropriately. Use instrumentation to handle sharps where possible to minimise the risk of needle stick injuries.

2.3 Difficult Insertion Escalation Pathway

Multiple attempts at locating the vessel can have mechanical and infectious risk to the patient. Challenging insertions may benefit from in-person guidance or substituting for a more experienced inserter. Escalation to senior clinician assistance can be sought by either the inserter, the assisting RN or any other relevant clinical staff. It is an expectation that difficulty with insertion is identified early and escalation for assistance is actively sought.

Anaesthesia has a mandatory notification process (to a consultant) if there is an unexpected complication of a CVC (such as carotid artery puncture) when performed by a registrar or fellow.

3. POST INSERTION

3.1 CVC securement

The following methods are acceptable for securing the CVC:

Image 1. Single securement by suturing BOTH eyelets of anchor hub, if the central line is inserted all of the way in. (Image 1)

Image 2. '4 point fixation' where 2 sutures affix the box clamp to the skin at the point of insertion, and 2 additional sutures secure the eyelets of the anchor hub to the skin

Image 3: 4point fixation using securement device: 2 sutures affix the box clamp to the skin at the point of insertion and a securement device (i.e. statlock or griplock) secures the eyelets of the anchor hub to the skin

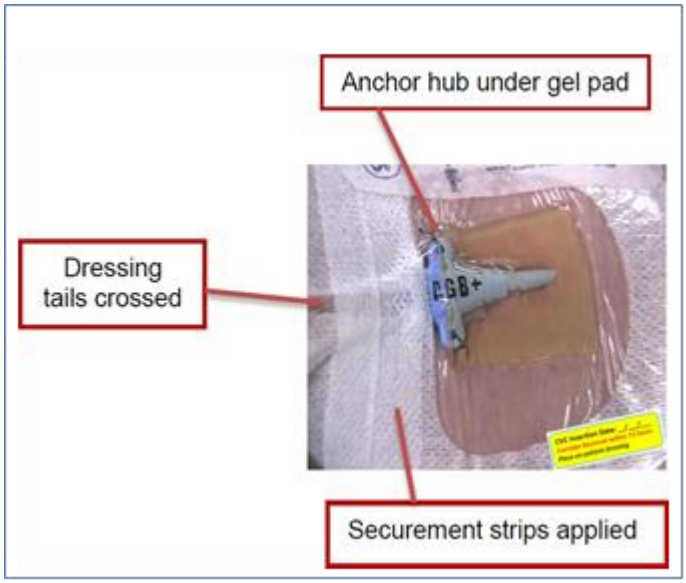
Image 4: 'Roman Sandal' method: Two sutures affix the box clamp to the skin at the point of insertion. A third suture passes through the eye of the box clamp (without piercing the skin) and is passed around the central line, through each eyelet of the anchor hub and back to the box clamp. This prevents the line from being 'pulled through' the box clamp in a similar way to the 4-point fixation

3.2 CVC dressing

- This is performed using aseptic non-touch (ANTT) technique at the completion of the line insertion
- Remove any debris or blood, by cleansing site with 0.9% sodium chloride.
- Apply antiseptic skin preparation and allow to completely air dry. Skin that will be covered by dressing should be cleaned.

A skin barrier agent such as 3MTM Cavilon or BARD® Barrier Film product is to be used prior to applying the dressing to protect the skin. Do not apply to the skin covered by the Chlorhexidine Gluconate (CHG) gel pad.

Ensure the patient adhesive label has been placed on the CVC dressing indicating date of insertion and suggested removal, on completion of dressing.



CVC Dressing

Application of 3M CHG Dressing

		
Remove backing tape from dressing, and handle with frame delivery	**DO NOT stretch the dressing**. Place the dressing in a way that aligns the chlorhexidine gel component of the dressing **over**	Conform the chlorhexidine impregnated gel to the catheter insertion site. Ensure anchor hub is under the gel pad.

	the catheter insertion site and sutures	
		
Lift catheter extensions and Affix dressing under catheter lumens	Ensure overlap of the dressing behind the catheter lumens and ensure the dressing is well adhered to the patient's skin.	Commence removing the frame dressing, ensuring it is well adhered to the patients skin. Smooth the dressing from the centre to the edges.
		
Apply the first of the two securement tapes behind the catheter lumens, as shown	Apply the second securement tape over the top of the catheter lumens as shown	Affix the CVC Insertion Dressing Label has been placed on the CVC dressing indicating date of insertion and suggested removal.

3.3 Catheter tip confirmation

- Following insertion of internal jugular and subclavian lines, a chest X-ray (CXR) is taken as soon as practical to confirm correct placement of the line and to exclude a pneumothorax.
- It is the responsibility of the proceduralist to promptly order and check the CXR and document the findings in the patient record. Post line insertion check CXR must be reviewed by a registrar, fellow or consultant. The tip should ideally lie within the lower third of the SVC, parallel to the vessel wall, immediately above the junction of the SVC and right atrium (at the level of the carina on CXR). If the tip of the catheter has entered the right atrium it should be withdrawn into the lower third of the SVC. If inserted from the left side and the tip is impinging on the right wall of the SVC it should be withdrawn 1-2 cm.
- If the central line has been reviewed and is not positioned correctly on the CXR, it is NOT appropriate to advance the line in further due to the risk of infection. If necessary, replace the line via guide-wire exchange. Refer to section 4.1 Guide-wire exchange.
- Femorally-inserted CVCs do not require an X-ray.

3.4 Documentation

Intensive Care Proceduralists:

- CVCs inserted by Intensive Care should be documented on a M50.01 Central Venous Access Insertion Form.

Anaesthesia Department:

- CVCs inserted by the Anaesthetics Department should be documented on a M50.01 Central Venous Access Insertion Form.

Emergency Department:

- Document CVC insertion electronically in Cerner.

Serious complications during or post insertion should be further documented in the patient's clinical notes M16 and entered as a Riskman incident.
The M16.10 Central Venous Access Device Care Plan should be commenced on the day of insertion and completed daily until catheter removal.

ONJ Building

- Document CVC insertion electronically in Powerchart. Oncology nurse view.

Serious complications during or post insertion should be further documented in the patient's clinical notes in Cerner and entered as a Riskman incident.
The M16.10 Central Venous Access Device Care Plan should be commenced on the day of insertion and completed daily until catheter removal.

Radiology

- CVCs inserted by Radiologist should be documented on the M50.0 Special Procedure form.

4. ADDITIONAL INFORMATION

4.1 CVCs inserted via Guide-wire Exchange

Guidewire exchange may be indicated if a catheter change is required or for catheter dysfunction. This procedure is associated with lower risk of mechanical complications but with higher risk of associated infection compared with conventional insertion at a fresh site (4, 6)
Guidewire exchange should only be considered in the following circumstances (12, 6)

- Where the risks of using another site outweigh the risk of infection using the same site
  - procedure technically difficult due to swelling
  - coagulopathic patient for whom central line replacement is necessary before coagulopathy can be corrected
  - patient has burn injuries and no other unburned site
- The CVC has been in situ **≤72 hours AND**
  - there is no suspicion of CLABSI, **AND**
  - The line was inserted with strict adherence to aseptic technique.

4.2 Extravasation of vasoconstricting agents guidelines

The extravasation of infused drugs from an intravenous catheter is potentially very serious. Complications may include:

- failure to deliver essential medications
- severe tissue injury, ischaemia and necrosis

The risks of extravasation can be minimised by careful line insertion, dressing, securement and management. Regular evaluation and appropriate response to potential problems is essential.

Should extravasation of infused vasoconstricting agents occur, staff should take the following actions

- Cease infusions and seek alternate access for key drugs e.g. vasoactives
- Escalate to senior medical staff and ANUM immediately. If possible, leave the line insitu to facilitate both senior review and possibility of further treatment with phentolamine directly to the affected tissues
- Consider phentolamine through extravascular lumen if line remains in position (avoid if any possibility of intravenous administration). Phentolamine is available in the theatre fridge for emergency use. **Special Access Scheme approval is required.** The recommended dose for extravasation is 5mg phentolamine in 10ml 0.9% sodium chloride to be injected subcutaneously into the affected area, within 12 hours of extravasation. Dose should not exceed 0.2mg/kg or 5mg total.
- Consider plastic surgical review
- Arrange open disclosure to patient and family
- Document clinical findings and management plan
- Maintain assessment and documentation of relevant clinical findings every shift
- Complete RiskMan report

4.3 Replacing pulmonary artery catheter with a central line through an existing sheath

This should only be done

- if the sheath has been in situ **≤72 hours AND**
- there is no suspicion of CLABSI, **AND**
- the line was inserted with strict adherence to aseptic technique.

Purpose-made central lines with a locking cap that fits over the pulmonary artery catheter sheath are recommended (5).

Special care must be taken not to contaminate the new central line; i.e. do not contaminate sterile field, change sterile gloves after removing pulmonary artery catheter.

4.4 Internal jugular cannulation - methods to minimise risk of and management of arterial injury

Introduction and Scope

Internal Jugular central venous cannulation (IJ CVC) is a core procedural skill in critical care medicine. As with all procedures, IJ CVC insertion has inherent risks including inadvertent carotid arterial cannulation, which can result in stroke from either hypoperfusion or thromboembolism. The risk of carotid puncture and dilation or cannulation are 6% and 0.1-1% respectively (1,2).

The goal of this document is to outline strategies to a) minimise carotid arterial injury and b) manage iatrogenic carotid arterial dilation and cannulation. This document supplements existing documents on CVAD insertion.

Methods to Minimise Carotid Arterial Injury

1. **Use of Ultrasound (US)**

Traditionally landmark based techniques have been used for IJ CVC insertion. These techniques are based on knowledge of anatomical structures but are limited by anatomic variation and the presence of venous thrombosis.

Meta analyses performed by the American Society of Anesthesiologists (ASA) and Cochrane Database both indicate that US guidance during IJ CVC insertion results in higher insertion success rates, reduced access time, higher first pass cannulation rates and decreased arterial punctures (3,4). Recently published ASA, AAGBI and Scandinavian guidelines support the routine use of US for IJ CVC insertion (3,5,6)

However, ultrasound use does not eliminate complications and should not lead to complacency. Training in ultrasound use in short axis, long axis and/or oblique axis is essential.

*Practice tip: Anatomical knowledge gained from landmark-based techniques are essential. **A medial to lateral** angulation is safer even with US-guided IJ CVC insertion. Note that **neck rotation tends to being the carotid artery directly under the IJV** instead of being medial to the IJV.

2. Confirmation of Venous Placement of the Initial Needle or Cannula

Methods for confirming that the catheter or thin-wall needle resides in the vein include, but are not limited to: US, venous blood gas measurement, manometry or pressure-waveform analysis (3). Blood colour or absence of pulsatile flow can be useful, but guidelines suggest that these measures should not be solely relied upon to confirm that the catheter or thin-wall needle resides in the vein (3,5,6)

US is limited by operator error and true identification of the needle or cannula tip. Venous blood gas measurement can be difficult to interpret in patients with left to right shunt or oxygen supplementation.

Category B2 evidence exists supporting manometry analysis of the needle or cannula in confirming venous residence. In a retrospective review of >9,000 CVC placements over 15 years at a single institution after manometry was mandated, the rate of arterial injury was 0% (7).

*Practice tip: If sterile pressure tubing is not available for transduction, any IV line (for example intravenous extension tubing) can be used as a fluid manometer. Even the casing that the CVC way comes in can be used. (ref 1). Care must be made to avoid air embolus when performing fluid manometry, especially in spontaneously ventilating patients.

*Practice tip: Manometry may be practically difficult to perform if a needle technique (rather than cannulation) is employed initially and a cannulation technique is therefore preferred by the authors.

- If needle is used initially, and the central line wire inserted through the needle, a catheter can be placed over the wire to transduce pressures.
- If a wire has not been inserted, the green transduction probe in the CVC kit can be inserted through the rear of the plunger of the Raulerson syringe to transduce pressures.

3. Confirmation of Venous Residence of the Guide Wire

Methods for confirming that the guide wire resides in the vein include: US, echocardiography, continuous ECG identification of narrow complex ectopy and fluoroscopy (3).

US remains the most practical of these given resource limitations on echocardiography and fluoroscopy

*Practice tip: On ultrasound, the **absence** of the guide wire in the **artery** should also be looked for. Note that a guide wire in the vein may not be able to be followed to its tip. Also, wire migration can occur with dilation. Circumspection is still required.

After final catheterization and before use, confirmation of residence of the catheter in the venous system must occur as soon as clinically appropriate. This can be done using manometry or pressure waveform measurement (3). This step will prevent inadvertent arterial infusion and subsequent potential for neurologic injury (8).

*Practice tip: Don't use a CVC line without checking that the tip is in the vein by performing manometry or transducing the **distal** lumen.

5. Management of Arterial Puncture and Dilation

Despite the above measures, arterial dilation may still occur. The line should NOT be used and any infusions currently running should be immediately ceased.

Principles of management depend on: the size of the dilator/cannula and the urgency of situation (e.g. emergency surgery). Consensus guidelines from the ASA, AAGBI and Scandinavia together with other recommendations for management (8-11) provide the following principles:

- Needles / cannulas / devices less than 7 French can be managed by removal of the needle and immediate external pressure compression.
  - External compression is recommended for 5-10minutes.
  - Neurological follow up is necessary for the next 24 hours.
- Devices greater than 7 Fr **or when the dilator or sheath has been inserted** require urgent vascular surgical or interventional radiological consultation for definitive treatment. The 'pull and pressure' approach has a high complication rate in this group, with an immediate stroke risk of 5.6%. This method is to be avoided (8).
  - Leave the device in situ with a cap and contact vascular surgical registrar / consultant; or interventional radiology registrar / consultant regarding further management.
  - Consider heparinisation if there will be delay to treatment.

Authorised/endorsed by

2022 Review endorsed by Anaesthesia, Intensive Care Unit, Emergency Department, Radiology Department and Infection Control.

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Primary Person/Department Responsible for Document

Chief Medical Officer

5.1 Appendix 1: Ward Patients Requiring CVC Insertion:

Ward patients requiring line insertion will need to be transported to an appropriate Class A cardiac protected area for the procedure organised as follows:

1. Parent unit requests CVC insertion as soon as possible in working day by referring to ICU referrals registrar.
2. ICU registrar calls ESPC (Emergency Surgery Patient Coordinator) on ext 5170 to ensure Operating Suite capacity is such that the line can be inserted in Procedure Room 1.
    a. A suitable time is arranged.
    b. After hours/weekend - call the Floor Coordinator on ext 3446
3. ESPC allocates a procedure room with appropriate monitoring required for line insertion used via Anaesthesia Machine.
4. The ICU Registrar informs ward nurse of the time that the patient should arrive in Procedure Room 1.
5. ICU Register to provide and setup own equipment
6. Ward nurse remains with patient in Procedure Room 1 during line insertion to support the proceduralist and the patient during insertion
7. ICU registrar performs line insertion in Procedure Room.
8. Catheter insertion documented on a M50.01 Central Venous Access Insertion Form
9. ICU registrar corrects position of CVC if required.
10. ICU registrar documents success of procedure and gives permission to use the CVC after CXR.
11. ICU registrar hands over patient and CVC procedure to requesting team.

NOTE: If anaesthesia support is required/requested the Anaesthetist in Charge (AIC) must be contacted on ext 3186

5.2 Appendix 2: Definitions

Central Venous Catheter (CVC): A CVC is a catheter inserted into a central vein. Examples include CVCs used for infusions and monitoring pressures, sheath introducers for PA catheters and dialysis or haemofiltration catheters.