PROTOCOL FOR THE INSERTION OF NON TUNNELLED DIALYSIS CENTRAL VENOUS CATHETERS

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Introduction

When acute renal replacement therapy or plasma exchange is needed, non tunnelled central venous catheters (CVCs) provide the simplest form of vascular access. Significant complications of CVC placement include: local or systemic infection, venous thrombosis, arterial or venous perforation and pneumothorax. This document outlines the protocol that should be followed when inserting a temporary CVC.

Indications

- Renal replacement therapy
- Plasma exchange

Operator

Temporary CVC insertion must be performed independently only by fully competent personnel. “Fully competent personnel” are defined as follows -
• A Consultant Nephrologist with recognised recent (within past 12 months) experience in the insertion of dialysis CVC
  
  Or

• A Nephrology specialist trainee / specialist doctor / SAS grade who has successfully completed at least 2 DOPS assessments for independent insertions (at least one assessment must be by an experienced Consultant, and the second assessment could be by a post-PYA Nephrology Specialist trainee). As a minimum requirement, one DOPS should be for femoral insertion and one for jugular insertion.

**Competent supervisor**

Trainees must perform line insertion under supervision until they are signed off as competent. Only trainees or Consultants who are signed off to perform line insertion independently may supervise trainees. Regardless of DOPS documentation from other units, all specialist trainees rotating to this unit should have their first dialysis CVC insertion procedure supervised. This is to promote uniformity of practice.

**Pre-procedure**

**Consent**

Written consent should be sought, with documentation of major potential complications on the consent form *(please refer to complication on page 5-7)*. In the event of refusal, this should be clearly documented in the medical notes and should be discussed with Consultant Nephrologist in charge of the patient. Before undertaking the insertion of a CVC, an assessment of benefit and risk should be performed, and, if the patient lacks capacity, a “best interests” assessment made and clearly documented. Refer to hospital policy document *(consent to examination or treatment policy under policies section on trust web site)*

**Screening Bloods**

Clotting screen, full blood count and serum urea & electrolytes results should be available prior to performing any procedure. Optima results include:

- **haemoglobin ≥8.0 g/dl**
- **platelets ≥50 x 10⁹/l**
- **PT ≤15 seconds and/or INR ≤1.3**
- **APTT ≤35 seconds**

*(Current Aspirin/clopidogrel treatment is not a contraindication)*

There will be times when a risk benefit assessment suggests that the benefits of line insertion outweigh the risks of delaying the procedure (to correct haematological parameters). In this case consideration of the catheter insertion
Point should be part of risk benefit analysis. These cases should always be discussed with the consultant in charge of the patient, and if necessary with the haematology team. It may also be appropriate to discuss the procedure with an Interventional Radiologist.

**Procedure**

**Line size:**
- Right internal jugular (IJ) vein (length 15 cm)
- Femoral vein (length 20 cm)
- Left jugular vein (IJ) (length 20 cm)

- Non-Tunneled CVC insertion should be performed in the procedure room on ward B5 (unless there is a life threatening emergency requiring bed side line insertion).

- The main operator should, whenever possible, be assisted by a competent assistant (doctor, staff nurse or nursing assistant).

- A competent assistant is one who has assisted with at least 5 CVC insertions. They must also be aware of sterile techniques and the locations of the necessary stock.

- A non competent assistant should be supervised by a competent assistant until they achieve competence.

- Prior to the start of the procedure, both the operator and the assistant must ensure the following:
  - Confirmation of the correct patient
  - Confirmation of the correct procedure
  - Confirmation of written consent
  - Patient should be connected to ECG monitoring (for IJ CVC) and pulse oximetry

- Full aseptic and maximal barrier precautions should be undertaken including strict hand hygiene, donning a surgical gown, use of sterile gloves, surgical cap and face mask

- The patient’s skin should ideally be cleaned with chlorhexidine 2% solution \(^3\) \(^4\). If the patient is allergic to chlorhexidine, povidone–iodine can be used as an alternative
• Preferably patient should be in the trendelenberg position (feet up, head down to increase vein size) for IJ CVC insertion

• For femoral vein CVC the supine position is adopted

• Central Venous cannulation during the procedure must be performed under real-time ultrasound guidance

• Following infiltration of the operative site with local anaesthetic, an introducer needle mounted on a syringe should be inserted into the target vein guided by real time ultrasound imaging

• Once blood is freely aspirated from the vein, set aside the ultrasound probe and remove the syringe from the needle.

• Blood flow from the needle should be non-pulsatile, but non-pulsatile blood flow does not always exclude arterial penetration. If suspicious of arterial puncture then remove the needle and apply firm pressure at entry site for at least 5-10 minutes before attempting new puncture.

• If confident that introducer needle is within a vein then advance the guide wire through the needle into the vessel whilst observing the ECG monitor for any arrhythmias (for IJ puncture). The guide wire should pass easily into the vein if correctly cannulated. If there is any resistance to passing the guide wire then the needle and guide wire should both be removed and if appropriate cannulation attempted again.

• Remove the needle after guide wire insertion and attempt to confirm the guide wire position with ultrasound imaging.

• Make a small incision with a scalpel along the track of the introducer needle (blade size 11) to facilitate the passage of the dilator. Pass the dilator over the wire to a depth a little greater than the predicted vessel depth. Maintain control of both the guide wire and dilator at all times. The operator must ensure that the guide wire is mobile within the vein during insertion of the dilator.

• The dilators should NOT be inserted all the way into the vein.

• Remove the dilator and apply pressure to the puncture site to minimise blood loss. Pass the central venous catheter over the guide wire and withdraw the
guide wire until it protrudes from the end of the catheter and advance the catheter into the vessel and remove the guide wire.

- Following the procedure, line lumens must be locked with Heparin 1000 units/ml heparin, using saline to dilute it if required

- Secure the catheter by applying 2 stitches through the securing wings either side of the catheter hub and place a clear dressing over the insertion site.

**Post Procedure**
- The details of the insertion procedure should be documented in the CVC insertion renal electronic database, the medical notes, and the patient diary in the procedures room.

- The following details must be documented in the notes— Side (left/right) and the site (IJ/femoral) of insertion, type of consent, confirmation of aseptic precautions and use of ultrasound guidance, volume and concentration of lidocaine used, the number of cannulation attempts, any difficulties encountered during guide wire and CVC insertions, the length of the CVC inserted, type of line-lock used, and any immediate complications recognised. Any special instructions to follow post-procedure must also be documented.

- A chest X-ray (CXR) must be requested following an internal jugular CVC insertion and this should be carried out using a portable machine on ward B5. The CXR is to check for the position of the tip of the CVC / ensure that is within the vessel contours and to visualize any features of pneumothorax or haemothorax. The CXR must be checked by the operator or delegated doctor prior to the use of the CVC for dialysis. The X-ray result must be documented in the patient’s notes.

- Patients returning from the procedure room should have standard vital observations recorded immediately and at 30 minutes. The main operator should be contacted if there are any concerns.

**Complications and Principles of their Management**

The Consultant in charge of the patient must be informed immediately of any serious complications.

a. **Inadvertent arterial puncture with the introducer needle** - Exert direct pressure over the puncture site for at least 5 - 10 minutes.
b. **Inadvertent catheterization of an artery with the CVC** is a serious complication. Seek urgent vascular surgery advice and discuss with an interventional radiologist. Do not remove the line until the above is carried out.

c. **Bleeding** – superficial bleeding can usually be controlled by applying firm pressure over entry site, additional suture is sometimes required to achieve haemostasis.

d. **Pneumothorax**– follow BTS guidelines for management of pneumothorax\(^6\)
  - Small pneumothoraces (size <1 cm), can be managed by observation for 24 hours, high flow oxygen.
  - Aspiration (if size 1-2 cm).
  - If size is >2cm and patient is symptomatic then likely requires chest drain
Consult with radiology if in doubt about the size of pneumothorax and respiratory physician opinion should be sought in case of large pneumothorax.

e. **Haemothorax**– Intercostal drainage will be required in most cases. Haemothorax can be a sign of more severe intra-thoracic venous damage. Therefore, urgent cardiothoracic surgical review must be requested.

f. **Air embolism** – This should be suspected if the patient complains of breathlessness or chest pain, or if there is cardiovascular collapse. If air embolism is suspected, place the patient in a left lateral position and “head down” position to prevent air embolism to the brain and pulmonary circulation. Request urgent bedside echocardiography to aid diagnosis. If there are neurological signs and/or haemodynamic compromise, intensive care treatment and transfer to a hyperbaric oxygen unit may be required\(^7\)

g. **Cardiac tamponade** – This is a rare but serious complication and usually presents as cardiovascular collapse or cardiac arrest in the context of CVC insertion. Immediate cardiopulmonary resuscitation measures must be started with the help of the hospital cardiac arrest team. Urgent cardiology and cardiothoracic surgical review must be requested.

h. **Catheter tip malposition** – The ideal position for the tip of the non-tunnelled IJ CVC catheter at the junction of right atrium and superior vena cava (SVC). The tip must be directed inferiorly on a CXR. If the catheter tip appears to be “turned” to one side or the other on the CXR, and it is possible to aspirate blood from the catheter lumens, it is likely
that the catheter tip has entered a smaller vein (e.g. azygos vein) \(^{(8)}\). If no blood can be aspirated from the catheter, then the tip may lie in the pleural / pericardial space or the mediastinum. If a malposition is suspected or if there is any doubt regarding the position of the catheter tip, do not use the catheter for dialysis. Seek advice from an interventional radiologist as soon as possible. A venogram / linogram or a CT scan may be required to ascertain the anatomy. The rule to follow is “if in doubt, don't take it out”. Malpositioned catheters need careful consideration before these are pulled out as great vessels may have been traversed during insertion. There is a risk of serious haemorrhage if removed on the ward. In the short term, it is generally safer to leave the catheter in situ and consult a vascular surgeon and an interventional radiologist.

i. **Infection** – Infection of non tunnelled catheters should be treated by catheter removal and systemic antibiotics. Ideally patient should be kept line free to allow infection to respond with antibiotics but if catheter clinically indicated then a new catheter should be inserted at different site.

**Post Procedure care**

- The dressing and the line should be inspected regularly for erythema or discharge to identify exit site infection early. Transparent, semi-permeable polyurethane dressings should be changed every 3 days, or sooner, if they are no longer intact or if moisture collects under the dressing.
- During dressing changes, 2% chlorhexidine should be used to clean the skin. If there is a contraindication to chlorhexidine, povidone–iodine or 70% alcohol can be used as alternatives \(^{(9)}\)
- Handling of the CVC should be done in a sterile manner, and the ports cleaned with 2% Chlorhexidine in 70% Isopropyl Alcohol prior handling.
- In case of displacement or part removed catheter, no attempt should be made to push it back as carries risk of introducing infection.
- The results of a meta-analysis of 12 randomized, controlled trials assessing CVC management failed to demonstrate any reduction of catheter related blood stream infection (CRBSI) rates through routine replacement of CVCs by guidewire exchange compared with catheter replacement on an ‘as needed’ basis \(^{(10)}\)
- Routine exchange of catheters over guide wire is not recommended (risk of introducing bacteremia) but in exceptional circumstances it can be performed after discussion with Consultant in charge of the patient.
• Clinical signs for catheter related blood stream infections are unreliable. Fever is the most sensitive clinical finding but is not specific. Consider a diagnosis of Catheter Related Bloodstream Infection in patients with signs of systemic infection in the absence of another identifiable source or who develop signs of systemic infection after flushing of the line.

• Maintain a high index of suspicion when blood cultures are positive for organisms associated with central venous catheter infection: *Staphylococcus aureus*, coagulase negative staphylococci, or candida with no other obvious source for bacteraemia

• If CVC infection is suspected, then peripheral blood cultures should be taken and blood removed via the central line immediately before its removal. The tip can be sent to bacteriology for analysis.

• Antimicrobial advice should be sought from Microbiology in the event of CVC infection.

• A central line should be removed when it is no longer necessary.

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**Criteria for the diagnosis of central venous catheter related infections**  
(Centre for Disease Control and Prevention (CDC) definitions)

Presence of an intravascular device  
Evidence of systemic infection—pyrexia, tachycardia, or hypotension in the absence of another source of infection  
Laboratory evidence that the catheter is the source:  
If the catheter has been removed: quantitative or semiquantitative culture of the catheter

If the catheter remains in situ: quantitative paired blood cultures (peripheral cultures and cultures drawn from central catheter) or differential time to positivity of paired blood cultures  
Central line associated bloodstream infection*  
Evidence of systemic infection  
Central line has been in situ during the 48 hours before blood being cultured  
Laboratory confirmed bloodstream infection on peripheral blood culture  
No evidence of infection from another site
References


