

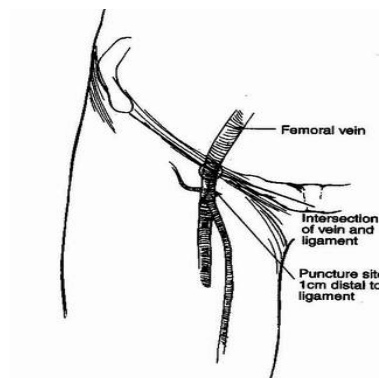
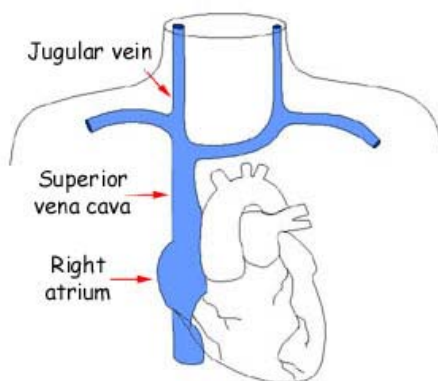
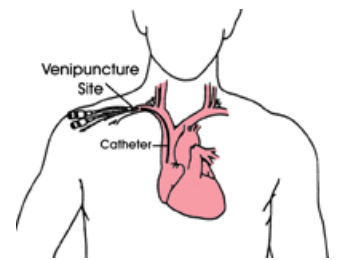
WHAT IS A CENTRAL LINE?

A central line or central venous catheter (CVC) is a catheter placed into a large vein in the chest or groin.

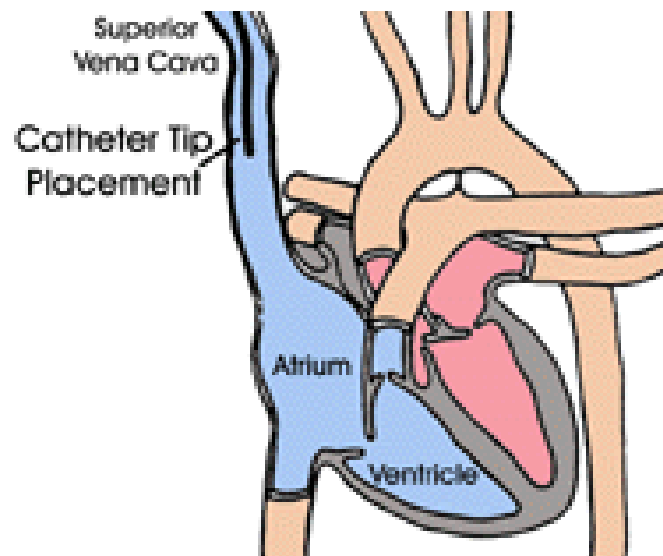
The catheter allows for venous access into these larger central veins, rather than a peripheral cannula that

allows venous access into the smaller veins of the peripheries.

Central lines are most commonly placed into the internal jugular vein, subclavian vein, or sometimes the femoral veins.



The catheter sits in the large vein just above the heart (the superior vena cava), with the catheter tip sitting just above the right atrium.



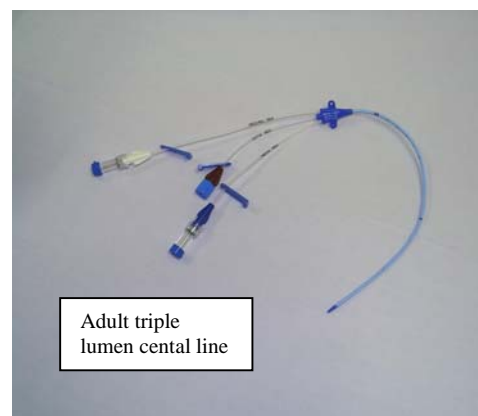
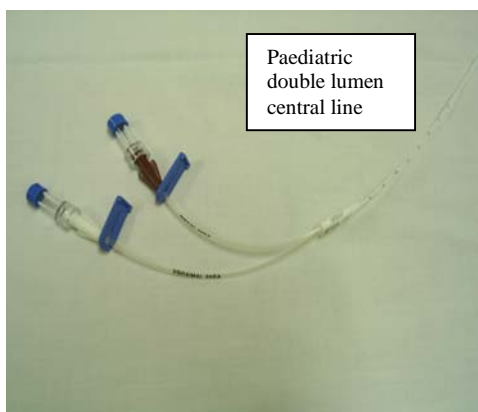
There are different brands and types of central venous catheters available. The catheter may also have one, two, three, or four lumens.

The central line catheter used for adults is usually the *ARROW-HOWES TLC*, which is a triple-lumen catheter, containing 3 lumens (16g, 18g, and 18g) and measuring 7fg in diameter and 20cms in length. The catheter is made from radiopaque polyurethane with a Blue Flex Tip, ARROWgard, that contains chlorhexidine acetate and silver sulfadiazine, containing

antimicrobial properties to reduce the risk of catheter-related infection.



In paediatric patients the same brand and type of catheter is used, however the catheter is a double lumen catheter, containing only 2 lumens (each 22g), and measuring 4fg in diameter and 13cm in length.



INDICATIONS FOR A CENTRAL LINE

A central line may be indicated and used for a number of reasons, including for:

- Intravenous (IV) access when peripheral access is unsuccessful.
- The administration of IV fluids, blood, or medications.
- To monitor the central venous pressure (CVP) of acutely unwell patients.
- The administration of medications that may be irritant to peripheral veins, such as calcium gluconate, chemotherapy, potassium chloride or amiodarone.
- Collection of blood samples.
- Total parenteral nutrition (TPN).

- In the emergency department (ED), a central line should only be considered for acutely unwell patients, requiring fast access to central circulation.

- A central line in the ED is required if peripheral IV access is unsuccessful or insufficient for trauma resuscitation.

Rather than a triple-lumen CVC, a short and large bore catheter should be used for trauma resuscitation if possible, allowing for more rapid fluid resuscitation.

- Central lines in the ED may also be required for acutely unwell patients when many medications are being used at the one time, decreasing the need for multiple peripheral lines.

- If it is not urgent, a central line does not need to be inserted in the ED, but can rather wait until the patient is transferred to another department, such as ICU.

PREPARING THE PATIENT



When preparing the patient for the insertion of a central line:

- Always remember to explain the procedure to the patient, and reassure.
- Witness informed consent if the patient is able.
- Remove clothing and jewellery from the neck, and collarbone area (or from the groin, if the femoral vein is being used) exposing the area for insertion.
- Maintain patient privacy and dignity at all times.
- ECG dots may need to be moved behind the shoulders to expose the area for insertion. Move all leads and wires, etc away from the area.
- A central line should only be inserted in the resuscitation bay, make sure that all resuscitation equipment is readily accessible.
- Make sure the patient is connected to the cardiac monitor.
- Place the patient in supine position (lying flat) and tilt the bed in the Trendelenburg position (approx 15 degrees head

tilted down, and turn the patient's head away from the site of insertion). This will distend the neck veins.

- Remember to consider the patient's injuries – This position will increase intracranial pressure (ICP), if the patient has a head injury it should not be done. If the patient has a suspected c-spine injury, the head cannot be turned, c-spine immobilisation should be maintained at all times until the c-spine is cleared by a medical officer.

- If the patient is able, teach them the Valsalva manoeuvre. The patient bears down, with their mouth closed and holds a breath. This increases intrathoracic pressure and reduces the risk of air embolism during insertion. If able the patient may be asked to perform this manoeuvre during insertion.

- Prime all IV lines and infusions, ready to be connected once the central line is insitu.

- Set up equipment ready for insertion of the central line.

EQUIPMENT & SET-UP

To prepare for insertion of a central line, you will need the following: -

- 1 x metal dressing trolley
- 1 x sterile gown XF9
- 1 x sterile large fenestrated drape XF10
- 1 x large sterile trolley drape
- 1 x pair sterile gloves
- 1 x multi-lumen CVC set (or paediatric two-lumen CVC set for paediatric patients)
- 1 x sterile dressing pack
- 2 x extra gauze pads
- 1 x chlorhexidine solution
- 1 x betadine solution
- 1 x suture set
- 1 x 10ml syringe
- needles size 18G, 23G and 25G (x 1 each)
- scalpels sizes 11 and 23 (x1 each)
- prolene sutures sizes 2.0, 3.0 and 4.0
- 2 x lignocaine 1%
- 2 x heparin saline 50units in 5mls (central line package being updated maybe altered to normal saline after review 2009)
- Opsite IV 3000 dressing

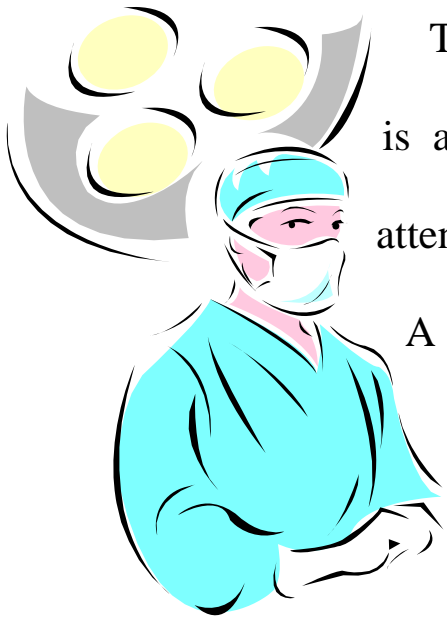
STEPS FOR SETTING UP & ASSISTING WITH THE PROCEDURE

1. Open the large sterile drape up onto the metal dressing trolley - this is now the sterile field.
2. Open sterile equipment onto the sterile field, except for the central line set and sharps. Take care not to contaminate the sterile field. Ask the MO if chlorhexidine or betadine solution is to be used for skin preparation and pour the solution into sterile dressing pack on the sterile field.
3. Assist medical officer (MO) with gown.
4. Assist with drawing up of local anaesthetic and heparin.

5. Open central line set, scalpels, needles and sutures directly to MO (check what sizes of scalpel, needles and sutures MO would like to use before opening).
6. Once central line is insitu, check with MO if CVP monitoring is required.
7. Document the procedure in the nursing notes.



THE PROCEDURE



The procedure for inserting a central line is a skilled technique and must only be attended by a qualified medical practitioner.

A junior medical officer may also insert a central line under the supervision of a senior qualified medical practitioner.

A basic explanation of the procedure is as follows:

- The MO should obtain consent from the patient and explain the procedure if possible.
- The MO assists with positioning the patient and will inspect the patient for the best site for insertion.
- After thoroughly scrubbing, the MO wears a sterile gown and gloves, (as well as protective eyewear).
- The patient is covered with a sterile fenestrated drape exposing the site for insertion.

- The patient's skin around the site for insertion is cleaned with either chlorhexidine or betadine solution. (*Remember to check the patient's allergies especially to betadine, seafood or iodine based products!*)
- Local anaesthetic is administered.
- A small incision is made with a scalpel at the site for insertion.
- The catheter is threaded into the vein, usually over a guide wire.
- The guide wire is removed, and the catheter remains in the vein. This is when the patient may be asked to perform the Valsalva manoeuvre.
- The catheter is sutured in place.
- A sterile dressing is placed over the site.
- Blood sampling may be taken from the catheter at this stage.
- Each lumen is flushed with heparinised saline.
- A chest x-ray is usually obtained to check positioning of the catheter and to exclude an accidental pneumothorax.

Central Venous or Right Atrial Pressure

The pressure in the right atrium, commonly referred to as the central venous pressure, measures how much pressure the blood returning to the heart is under. The venous system has a high capacitance - can adapt to various volume states. Veins, have thinner walls that lack muscles, stretch when the pressure increases. This stretch allows the veins to hold more, but increases the venous pressure, leading to swollen ankles and increased jugular venous distention. When more blood tries to enter the right atrium than the right atrium can hold, the result is an increase in the CVP. Thus CVP can be an indicator of fluid status. More blood volume causes the veins to stretch and increases the intravenous pressure; less blood volume causes the veins to constrict and decreases the intravenous pressure.

Though the CVP pressure can inform about fluid balance, it is a late indicator. Excessive fluid takes awhile to increase the CVP and frequently there are other indicators such as rales or pulmonary edema. The CVP also represent the preload of the

right ventricle. Preload is the amount of stretch in a chamber just before contraction. In most instances the more the stretch, the better the next contraction. Thus, if the CVP is elevated then the pressure in the right ventricle, just before contraction is elevated. Conversely, if the CVP is low, then the preload of the right ventricle is low and the next contraction will be less efficient.

Just before the right ventricle contracts, the tricuspid valve is open, allowing blood to move freely between the right atrium and right ventricle. Therefore, the pressure in the right atrium and right ventricle should be identical, since they are openly connected.

The CVP is reported as a mean pressure measurement, not a systolic and diastolic. Normal range for the CVP varies from textbook but a normal range is 2 to 6 mmHg. Henry Geiter, Jr, RN, CCRN. In ED Normal CVP is 4-12mmHg (Hudak et al 2005) is utilized- Haemodynamic Monitoring package.

◦ CVP MONITORING

- CVP stands for central venous pressure.
- CVP is the pressure in the right atrium and in the great vessels as they enter the right atrium.
- CVP is used to evaluate right ventricular function, right atrial filling pressure, and circulating blood volume.
- CVP is measured from the tip of the catheter, located just near the right atrium, by a transducer through the distal (brown) lumen

CVP READINGS

- CVP can be measured by a pressure manometer in cmH₂O, or with a transducer in mmHg.
- At TMH ED a transducer is used and CVP is measured in mmHg.
- Normal CVP measured in the right atrium is between 0-8mmHg when measured with a transducer.
- A high CVP reading may indicate fluid overload or poor myocardial contraction and right-heart pump failure.
- Patients with cardiac tamponade or tension pneumothorax may have an elevated CVP.
- A low CVP reading is consistent with hypovolemia.

INACCURATE READINGS – this may occur as/due to:

- Systemic vasoconstriction elevates CVP.
- Decreased right ventricular compliance.
- Obstruction of large veins.
- Tricuspid valve disease or cardiac structural abnormalities.
- Mechanical ventilation may elevate CVP.
- Differences in right to left heart function.
- Line occlusion (eg. From clots or kinking of the line).

EQUIPMENT NEEDED

If a patient requires CVP monitoring, you will need the following equipment:

- ◆ 1 x red spacelab adaptor line
- ◆ 1 x transducer cable
- ◆ 1 x IV pressure bag
- ◆ 1 x 500ml bag Normal Saline
- ◆ 1 x transducer IV line

HOW TO SET UP & MONITOR CVP

1. Make sure the central line is properly secured.
2. Hang the bag of normal saline inside the pressure bag, and hang on an IV pole.

3. Connect the transducer IV line to the normal saline bag, and prime the line. This is done by squeezing the chamber like a normal IV line to fill to approx



1/3 of fluid in the chamber. Make sure the lever is switched off to the side port, leaving the line open to be primed. Squeeze the plastic sides of the diaphragm to prime fluid through the line. Ensure there is no air in the line.



4. Pump the pressure bag to a pressure of 300mmHg (green area). The line is now ready to be connected to the distal lumen of the central line for CVP monitoring. Make sure the transducer IV line is properly secured to the patient to prevent accidental dislodgement of the central line.



5. We now need to set up the spacelab for monitoring. Connect the red spacelab adaptor line to the spacelab into the red connector site, marked P1-2.



6. Connect the transducer cable to the end of the red spacelab adaptor line.



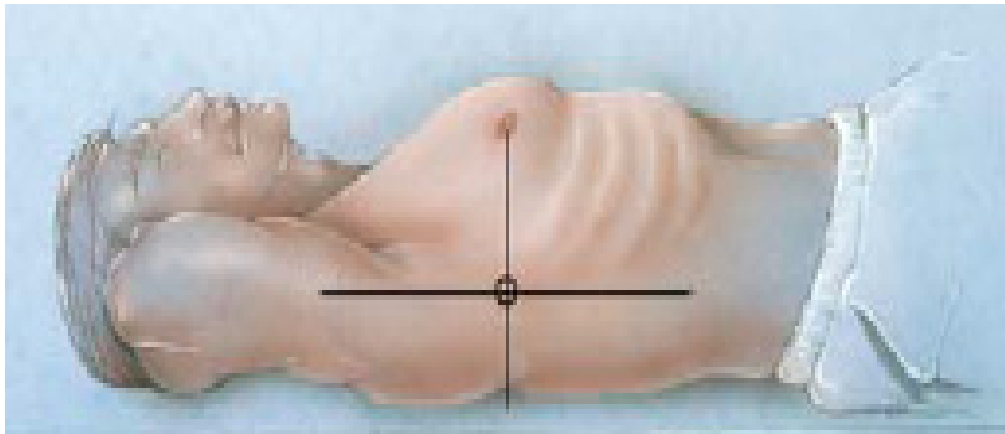
7. Connect the end of the transducer cable to the connection on the transducer IV line.



Now we must 'zero' the system to atmospheric pressure. Secure the diaphragm at the level of the phlebostatic axis for zeroing.



Figure 8 - The location of the phlebostatic axis.



The aim is to compare the pressures inside the heart-lung system. Therefore, we want to eliminate the atmospheric pressure at the level of the heart. To accomplish this, we level the transducer to the level of the right atrium. (This is not technically correct, but using this point is close enough and easier to locate than the actual point.)

When the patient is supine, the point of the junction of the vena cava and the right atrium, is at the point where the nipple line and the mid-axillary line meet (see figure 8). This point is called the phlebostatic ("phlebo" = blood, and "static" = still) axis. This is the point where the blood will have the lowest pressure. If we set this point's pressure to represent our "zero" level, then we are

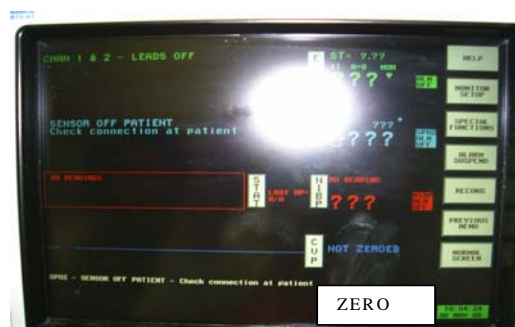
saying that this is the point where the blood has no pressure, and therefore is not moving or is stationary.

8. Turn the lever on the transducer IV line 'off' to the patient.

9. Now loosen the cap on the side port of the transducer IV line.

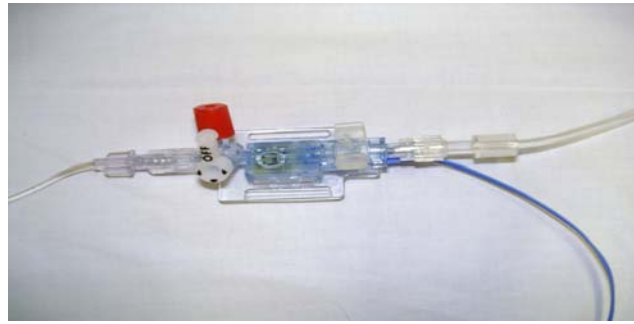


10. The monitor will show 'not zeroed' – press 'CVP' then press 'ZERO' on the spacelab monitor.

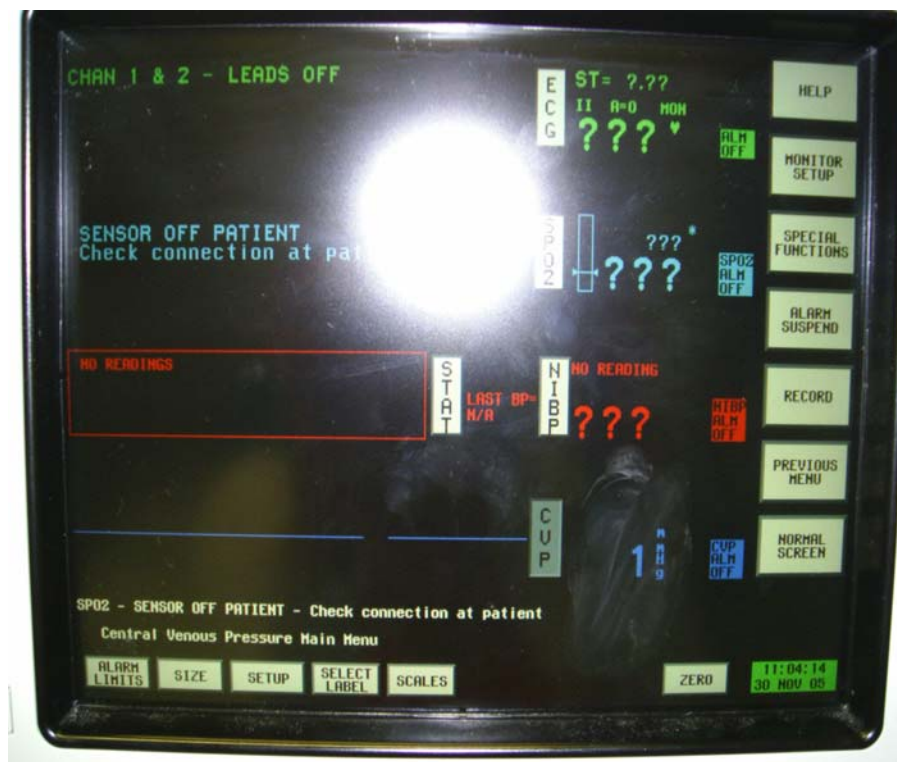


11. Replace the cap on the side port of the transducer IV line.

12. Switch the lever 'off' to the side port, leaving the line now open to the patient.



13. The patient's CVP reading should now be displayed on the spacelab monitor.



NURSING CARE OF THE PATIENT WITH A CENTRAL LINE

- Now that the central line is inserted and CVP monitoring is set up, what next?
- A registered nurse working in the resuscitation area of the ED needs to be familiar, qualified, and competent when looking after the patient with a central line.
- Here are a few things to remember whilst caring for the patient with a central line:

OBSERVATIONS

- Basic nursing observations should be monitored and documented frequently depending on the patient's hemodynamic status, including:
 - Blood Pressure
 - Temperature
 - Pulse
 - Respiratory rate
 - Oxygen saturation

- Continuous cardiac monitoring should be displayed, and an ECG should be attended.

- CVP should be monitored and recorded if indicated.

- The site of insertion of the central line must be closely monitored and documented, observing the condition of the site, including looking for any redness/swelling, blood or ooze from the site.

- The central line itself must be frequently observed:
 - Make sure all clamps are closed on any unused lumens to prevent potential air embolus.
 - Make sure all unused lumens are flushed/locked with heparin saline.

- Make sure IV fluids/infusions are attached to the appropriate lumen and working. Label the lumens with the solution being administered through it, and document this in the notes.

- If CVP is being monitored, make sure the pressure bag maintains a pressure of 300mmHg at all times.

➤ Any other observations that may be relevant to the patient's condition needs to be attended and may include:

- Neurological status – GCS and pupil assessment.
- Fluid balance - monitoring all IV fluids and urine output.
- Limb observations, etc.

⚡*NOTE: Any abnormality or change in the patient's observations or hemodynamic status should be reported to the medical officer immediately!*

NURSING RESPONSIBILITIES

➤ It is the role and responsibility of the registered nurse in the ED to adhere to the following whilst caring for the patient with a central line:

- Universal/standard precautions (including the use of protective eyewear, gloves, gown and mask when appropriate).

- Maintain safety in the workplace for yourself, your colleagues, and your patients and visitors.
- Documentation – it is essential that all documentation is completed and a record of all patient care whilst in the ED. The insertion of a central line must be documented, including the time and date of insertion, as well as the site of insertion.
- The patient, if able, should be educated regarding their central line.
- Maintain patient privacy and dignity at all times.
- Provide reassurance and comfort to the patient and their relatives.
- Provide effective communication with medical and other hospital staff.

NURSING PROCEDURES

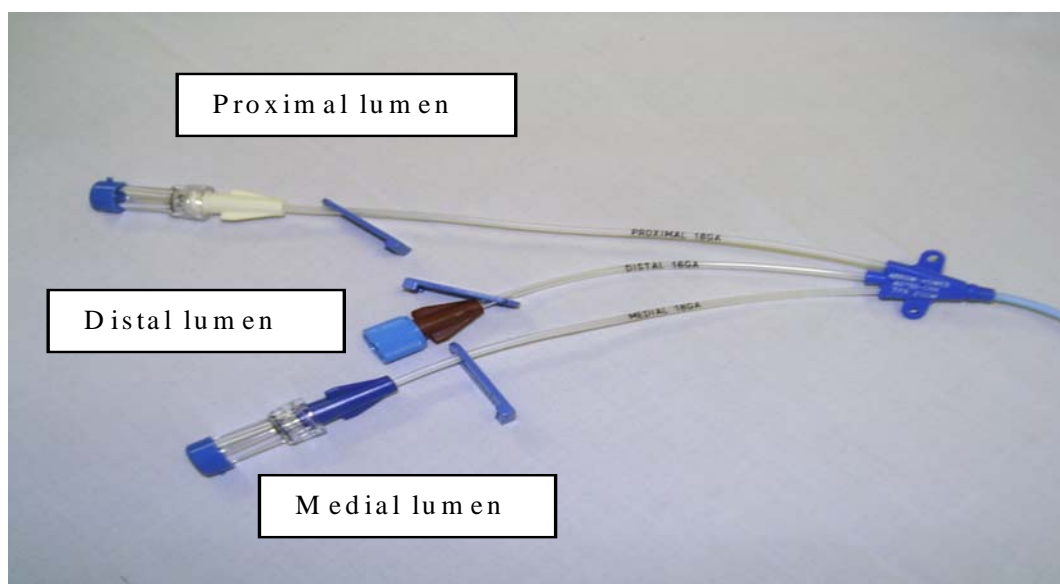
As the registered nurse caring for a patient with a central line in the ED, there may be some procedures that may need to be attended, such as administering IV fluids, bloods and medications through the central line, collecting blood samples from the central line, or heparin locking the unused lumens. The following is a basic guideline on how to do these procedures.

ADMINISTERING IV FLUIDS, BLOODS & MEDICATIONS

- Administering IV fluids, bloods and medications through a central line is fairly simple and is much the same as for a peripheral IV line.
- Remember to flush the lumen you are going to use with normal saline before and after administration of IV fluid, blood or medications.
- Make sure the blue clamp is closed, then remove the cap, and connect the IV fluid/blood line or the syringe to one of the lumens on the central line, open the blue clamp, and start administration as normal. *Remember to make sure that the unused lumens are clamped shut.*

WHICH LUMEN TO USE?

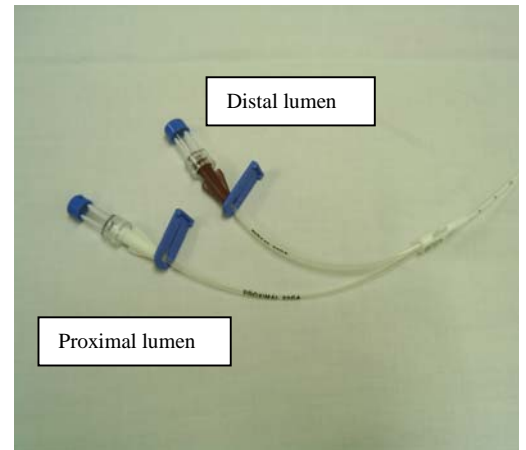
The triple-lumen CVC contains 3 lumens – a proximal, medial, and distal lumen. In paediatric patients, the CVC has 2 lumens, a proximal and distal lumen. The same principles apply for both adult and paediatric patients.



- The Proximal (white) lumen– is used for the administration of medications and bloods.
- The Medial (blue) lumen – is usually used for TPN, so is not usually accessed in the ED.
- The Distal (brown) lumen – is used for CVP monitoring, so this is where the transducer IV line is usually connected if CVP monitoring is required. This lumen can also be used for the administration of blood and colloids, medications, and high volumes or viscous fluids. The distal lumen is the largest

and closest to the heart, and is the best lumen to use if the central line is being used for fluid resuscitation.

- Label each lumen with the appropriate label of the fluid or medication being administered through it.
- Record and document in the nursing notes what is being administered through each lumen.



➤ DRAWING BLOOD SAMPLES

- Remember to explain the procedure to the patient, and maintain standard precautions and strict aseptic technique.
- Turn off all infusions and fluids administered via the central line at least one minute prior to collecting blood sample.
- Place the patient in supine position and if able, turn the patient's head away from the catheter site.
- The proximal (white) lumen is used for collecting blood samples.

✦ Make sure the blue clamp is closed, then remove the cap off the end of the lumen, attach a 10ml syringe, unclamp the blue-clamp, and remove 5-10mls of blood

central line. Close the blue clamp and discard the blood.

✦ *For paediatric patients, the blood is not discarded, it is kept to be put back into the central line!*



➤ *Take caution not to withdraw the blood too fast as rapid withdrawal can damage/collapse the catheter or blood vessel.*

✦ Using the same process again, draw off blood required for sampling, filling the appropriate blood collection tubes.

- ✦ Re-heparinise the lumen, replace the cap, and clamp the blue clamp closed again, or re-start fluids/infusions as ordered through the lumen.

- ✦ Record and document the procedure.

- *Make sure that you clamp the blue clamp whenever opening/removing the lumen cap to ensure no air is allowed to enter the central line.*

- **HEPARIN LOCKING**

- ✦ Using the same process as for blood collection, use a 10ml syringe to draw off 5mls of blood from the lumen and discard (*except for paediatric patients!*).

- ✦ Flush the lumen with 5mls of heparinised saline 50IU.

- ✦ Label the lumen with a heparin label with the time and date.

- ✦ Heparin locking must be ordered, documented and signed by the medical officer on the IV fluid order chart.



POTENTIAL COMPLICATIONS

There are many potential complications that can occur during or after insertion of a central line. Some of these include:

- Pneumothorax/haemothorax – this can occur when central lines are placed in the chest. A chest x-ray should be ordered post insertion of a central line to check positioning of the catheter, and to rule out pneumothorax or hemothorax.

■ Infection – because insertion of a central line disrupts the body’s natural barrier against infection, the skin, infection can occur either inside the central line or around the site. Insertion of the central line and application of sterile dressings should always be under strict aseptic technique.

■ Sepsis – central lines can introduce bacteria into the bloodstream, causing infection that may lead to sepsis. This is why insertion of a central line must be under strict aseptic technique, and a sterile occlusive dressing applied. Sepsis can cause hemodynamic changes, organ dysfunction, and death.

■ Air embolism – may occur if any air is allowed into the central line. Caution must always be taken with central lines to prevent the risk of air entering the central line, making sure all unused lumens are clamped, and an occlusive dressing is over the site of insertion.

■ Haemorrhage – may occur if a vein or artery is punctured during insertion. Observation for any bleeding or haematoma

around the site of insertion, close observation of the patient's hemodynamic status, and observing for any other signs of bleeding may enable the early detection of haemorrhage.

- Arrhythmias – as the catheter tip is introduced just above the right atrium, there is a potential risk of causing lethal arrhythmias. Cardiac monitoring during and after the insertion of a central line is essential!

- Nerve injury – this may occur especially if the central line is inserted into a femoral vein, given its close proximity to nerves.

- Accidental dislodgement of the catheter may occur – care must be taken to ensure the central line is properly secured.

- An accidental cut or break may occur to the central line – care must be taken to never use scissors or sharps near the

central line. If this occurs, clamp the line above the break and notify a medical officer immediately.

➤ *The medical officer must be informed if any signs or symptoms of complication from the central line occur.*

Reference List

Arrow International, (12/94), Arrow Multi-Lumen Central Venous Catheter Care.

Cochran, S. 2000 *Central Lines “The What, When, How, and Why behind Central Catheters”*.

Emergency Nurses Association, 2000 *Trauma Nursing Core Course, (5th edn)*.

Potter, P. and Perru, A., 1997 *Fundamentals of Nursing – concepts, process, and practice*. St. Louis, Mosby.

Monahan, F. and Neighbors, M. 1998 *Medical-Surgical Nursing – Foundations for Clinical Practice, (2nd edn)*. Philadelphia, W.B. Saunders Company.

Mosby, 1998, *Mosby’s Medical, Nursing and Allied Health Dictionary*. St. Louis, Mosby.

Roberts and Hedges, 1998 *Clinical Procedures in Emergency Medicine (3rd edn)*. W.B. Saunders Company.

Central Line

Available URL: http://en.wikipedia.org/wiki/Central_line

<Accessed November 12, 2005>

Central Line Placement – Procedure Guide

Available URL: <http://note3.blogspot.com/2004/02/central-line-placement-procedure-guide.html>

<Accessed November 23, 2005>

Central Venous Catheter or Lines Available URL:

<http://www.link.med.ed.ac.uk/RIDU/Cvc.htm>

<Accessed November 19, 2005>

Definition of Central line

Available URL:

<http://www.medterms.com/script/main/artxasp?articlekey=14394>

<Accessed November 21, 2005>

Hemodynamics lecture notes

Available URL:

http://www.staff.vu.edu.au/CriticalCare/Critical%20Care/lecture2_notes.htm

< Accessed November 21, 2005>

Management of a central line

Available URL:

<http://0www.cancerbacup.org.uk.library.newcastle.edu.au/Treatments/Chemotherapy>

< Accessed November 23, 2005>

Procedures

Available URL:

<http://0-venousaccess.com.library.newcastle.edu.au/procedures.htm>

<Accessed November 23, 2005>

