What you need to know about central venous lines

A CENTRAL venous line is a device inserted into the superior vena cava or right atrium. A medical practitioner inserts the catheter via the internal jugular, subclavian or femoral veins using strict aseptic technique. Aubaniac (1952) first reported the use of central venous catheterisation and the catheters are now in common use in a variety of health care settings (Drewett, 2000) though they are more commonly used in the high-dependency category patient.

There are several reasons for the insertion of a central venous catheter. These include:
- To monitor central venous pressure in critically ill patients;
- For the rapid administration of intravenous fluids;
- For the administration of drugs, such as antibiotic therapy and cytotoxic drugs;
- For the administration of parenteral nutrition;
- To aid in the diagnosis of cardiac failure;
- To monitor postoperative patients.

Types of catheter and their insertion

The patient’s condition will help the medical practitioner to decide which catheter is most appropriate for the patient’s needs. There are a number of central venous catheters to choose from:
- Single, double, triple and quadruple lumen. Multiple lumen catheters allow more than one infusion to be given separately while facilitating continuous pressure monitoring, thereby minimising the risk of accidental bolus (Singer and Webb, 1997);
- Sheaths for the insertion of a pulmonary artery catheter or pacing wire;
- Tunneled catheters for long-term use.

The patient should be informed about what is to happen during the procedure as well as the rationale behind it. The patient may be very anxious and it is important that the nurse gives a clear explanation and reassurance before, during and after the procedure.

The patient’s position during insertion of the catheter is important. The patient should lie supine and the head of the bed should be lowered to encourage venous engorgement, which makes it easier to puncture the vein (Peters and Moore, 1999). The medical practitioner will decide which type of catheter should be used while the insertion site will determine the length of the catheter.

Before inserting the catheter, all the necessary equipment should be available at the bedside (a manual on local policies and procedures should detail the procedure). After inserting the catheter, a chest X-ray should be performed to check that the central venous device is in the correct position and to rule out pneumothorax, haemothorax and cardiac tamponade.

Measuring central venous pressure

Central venous pressure (CVP) is a measurement of pressure in the right atrium of the heart. Normal CVP range is 3–10mmHg (5–12cmH2O).

A series of measurements needs to be recorded to establish a trend as a one-off measurement would not give a true indication of the CVP. The measurement can be recorded either manually, using a water manometer set, or electronically, using a transducer. Electronic measurement is most common in the critical care environment.

Electronic measurement

When the measurement is recorded via a transducer the recording is constant. Although the transducer has to be calibrated (zeroed), this is carried out electronically via a monitor before each recording. The monitor will display a CVP waveform, which usually ‘swings’ with each respiration.

The measurement should be recorded from the same position each time: the patient should lie flat and recordings can be measured either from the sternal angle or, most commonly, at the mid-axilla point. The nurse should document the site from which the measurement is being recorded to maintain the continuity and accuracy of the trend of the CVP.

Manual measurement

Explain the procedure to the patient and ensure that the patient is comfortable. The water manometer should be attached to intravenous fluid, for example normal saline 0.9 per cent. The three-way tap should be turned to fill the manometer with the fluid. Once full, the tap to the fluid should be turned off and the tap to the patient should be opened. As the fluid drops in the manometer, the fluid level will rise and fall with the patient’s respiration, and as it settles the mean pressure is recorded (that is the central point between the two).

A low reading is usually an indication of fluid loss or hypovolaemia/dehydration. This can be as a result of
haemorrhage, excessive diuresis or excessive extravasation. A high CVP recording is more complex but can indicate the following:

- **Hypervolaemia:** defined as an abnormal increase in the volume of blood circulating in the body and often a result of excessive fluid infusion;
- **Cardiac failure:** for example right ventricular failure, pulmonary embolism, mitral valve failure/regurgitation, cardiac tamponade;
- **Lumen occlusion/obstruction:** for example thrombus, or the catheter lying against the vein wall;
- **High blood viscosity:** which is rare but possible after a massive blood transfusion (Woodrow, 2000).

**Complications**

Many complications can occur immediately after the insertion of a catheter and it is the nurse’s responsibility to observe the patient carefully when the procedure is being carried out. These complications include:

- **Arterial puncture:** accidental puncture of the carotid, vertebral, subclavian, basilic, axillary or femoral arteries can occur during insertion. Arterial blood is bright red and blood flow is substantial;
- **Pneumothorax:** may occur if the catheter punctures the chest wall, allowing air to enter the pleural cavity;
- **Cardiac dysrhythmias:** can occur if the tip of the catheter touches the cardiac wall. The nurse should observe the heart rate and rhythm, and inform the medical practitioner of any changes (Drewett, 2000).

Air embolism, where air enters the venous system, can also occur on insertion or up to 48 hours after removal. The medical team and nurses should ensure that all lines are primed with fluid before connection and that there is no leakage in the system. All ports should have luer lock connections and be clamped off if not in use. If a patient shows symptoms of an air embolus (for example acute dyspnoea, low blood pressure), the medical practitioner should be informed immediately. Air emboli of less than 10–20ml rarely cause problems (Hudak et al, 1998), but a large pulmonary air embolus can cause death.

A central venous catheter can act as a conduit for infection, which may result in sepsicaemia, if it is not cared for appropriately. The site should be observed daily for any redness or discharge. A rise in the patient’s temperature is a good indication that there may be infection around the catheter site or tip. Occlusion can also occur for a number of reasons, including kinking in the line, thrombosis and the precipitation of drugs in the line.

If a patient has a catheter with more than one lumina inserted there is a possibility, especially if the patient is critically ill, that ramps (extension sets) may be attached to the line to administer a number of drug infusions. If these lines are not adequately secured to the patient there is the potential for them to become tangled or kinked, causing occlusion.

The catheter is a foreign body and the physiological response to a foreign body is a build-up of fibrin. Over time this can cause a thrombosis in the vein or within the lumen of the catheter. Early detection of this problem is vital to the patient’s well-being. If it is left untreated there is the likelihood of emboli dispersing to the lungs and other vital organs.

Critically ill patients are often administered a concentration of highly potent drugs which have the potential to form solid deposits. This is sometimes caused by a chemical reaction and sometimes by an alteration in the solution so that the substance becomes less soluble (Koenigsberg, 1989). The advice of a pharmacist should be sought to ascertain that the drugs administered are compatible with one another and lines should be flushed with normal saline 0.9 per cent before and after the administration of intravenous drugs to ensure that a bolus of drug infusions is not given.

**Nursing care**

The patient should be closely monitored and the catheter site and the system observed. The patient’s vital signs should be monitored and recorded. Any handling of the line should be kept to a minimum to reduce the risk of contamination and the line should be securely fastened to the patient.

The dressing on the central venous site should be changed in accordance with hospital policy and procedures. It should always be changed using aseptic techniques and a transparent dressing is often used to allow evidence for evidence of redness or discharge. The nurse usually removes the catheter after the medical practitioner has given an instruction to do so. The patient should be informed and reassured and the procedure explained. The patient should lie flat in bed with the foot of the bed elevated to prevent air emboli. The removal procedure is carried out using an aseptic technique. After removal of the sutures from around the catheter, a wad of sterile gauze should be held under pressure over the site. The catheter is pulled gently until it is removed, while the nurse continues to apply pressure to the site for up to five minutes until bleeding has stopped. The site is sealed with an airtight dressing, which should be left in place for 48 hours, and the patient can be returned to a comfortable position.

**Conclusion**

The insertion of a central venous catheter is a highly invasive procedure, so a decision to insert such a device should take into account the patient’s condition, symptoms and illness. The device plays an important part in the patient’s recovery as it can aid diagnosis and treatment. At the same time, the use of such devices can put the patient at risk of the complications discussed. The nurse has a vital role to play in helping to safeguard the patient against the potential risks associated with central

**REFERENCES**


