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Central venous catheters and central venous pressure 45-51

Multiple-choice questions and submission instructions 52

Practice profile assessment guide 54

A reader's practice profile 25

Central venous catheters and central venous pressure

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Aims and intended learning outcomes

The aim of this article is to examine the uses and associated risks of central venous catheters (CVCs), focusing on the measurement and interpretation of central venous pressure (CVP). The management of patients with CVCs and possible complications are also explored. This information should help staff to provide safe and effective care for patients with CVCs. After reading this article you should be able to:

- Outline the rationale for central venous catheterisation.
- Explain the importance of accurate fluid management and CVP measurement.
- Describe how to measure a patient's CVP.
- Interpret the significance of high and low CVP readings.
- Discuss the possible reasons for abnormal pressure readings.
- List the possible complications of CVCs.
- Explain the correct procedure for the removal of CVCs.

Introduction

Blood pressure and pulse can be easily and reliably monitored in most clinical areas. While these measurements provide sufficient information to manage most diseases, critical or serious illness might necessitate further monitoring. Traditionally, CVP measurement has been associated with critical care areas, but with increasing numbers of critically ill patients being cared for in a variety of clinical areas

(Haines and Coad 2001), many surgical and medical wards and departments are now caring for patients with CVCs. CVP measurement can provide valuable information about the patient's fluid and cardiac status. A recent government report (DoH 2001) identified a need for increased post-operative CVP monitoring on surgical wards, because fluid management pre- and post-operatively is often suboptimal, together with additional training for nursing and medical staff.

TIME OUT 1

Before reading on, review your knowledge and understanding of cardiac anatomy and physiology. Define the following terms:

- Cardiac function.
- Venous return.
- Venous tone.
- Intrathoracic pressure.
- Central venous pressure.

Reflect on the last two or three patients in your area who have or have had CVCs and find out why they had them inserted. List any other reasons you can think of for CVC insertion. (*Human Anatomy and Physiology*, Marieb 2001)



Central venous catheter

A CVC is a catheter that is inserted into one of the central veins, that is, the superior or inferior vena cava. These, the two main veins of the body, return blood into the right atrium and have the largest blood flow of any veins in the body. There are many

In brief

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Summary

Central venous catheters are increasingly being used in a variety of clinical areas outside critical care. Philip Woodrow examines the indications, measuring techniques and complications associated with central venous pressure monitoring.

Key words

- Clinical procedures
- Intravenous therapy
- Nursing care

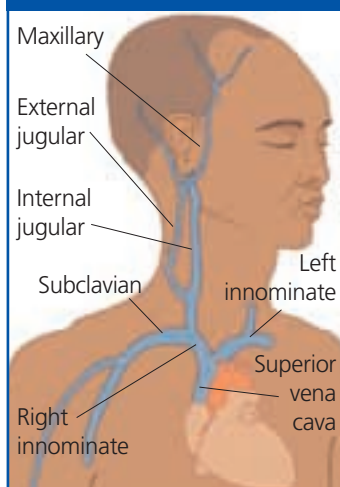
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Fluid management

Fig. 1. Veins forming the superior vena cava



uses for CVCs, but the most common is CVP measurement. Other indications for CVC insertion are:

- Drug and fluid administration.
- Nutrition and feeding.
- Cardiac pacing.

Drug and fluid administration Although most drugs and intravenous fluids can be given safely through peripheral cannulae, some solutions are hypo/hypertonic or vasoactive and should only be given centrally. Hypotonic and hypertonic solutions, such as 20% or 50% dextrose, can cause thrombophlebitis and there is a risk of extravasation. Vasoactive drugs, for example, inotropes such as dopamine, dobutamine and noradrenaline, or fluids containing high levels of potassium can cause damage to peripheral veins and require administration via large vessels with a high blood flow rate (Gourlay 1996). Data sheets will indicate if drugs should be given centrally or into a large vein.

Drugs and fluids are frequently given centrally in cases of severe shock because peripheral cannulation is often difficult, and peripheral blood flow is insufficient for rapid infusion of large volumes.

CVCs are associated with significantly higher infection risks than peripheral lines (van Vliet *et al* 2001, Vost and Longstaff 1997), so unless indicated, drugs should not be given centrally. CVC patency should be checked regularly and immediately before drug administration. Where the CVC is used for monitoring, the pressure and a normal swing in the manometer of trace on the screen should indicate patency.

Nutrition and feeding Patients who are unable to absorb sufficient nutrition from the gut might be fed parenterally (directly into veins). Total parenteral nutrition (TPN) contains large quantities of 50% glucose, so must be given centrally to avoid thrombophlebitis. Peripheral TPN, which contains less glucose, is available for short-term patient use.

Cardiac pacing Temporary pacing might be required to treat patients with cardiac instability. It can be either cutaneous or transvenous. With the transvenous route, a temporary pacing wire is passed through a central vein into the right ventricle, where it paces the ventricular muscle.

Insertion sites

CVCs are inserted at the patient's bedside and patients must be fully prepared for, and informed of, the procedure before insertion begins. There are four main sites used for CVC insertion:

- Internal jugular.
- Subclavian vein.
- Femoral vein.
- Brachial vein – this is usually used for peripherally inserted central catheters (PICC).

TIME OUT 2

Make a list of the advantages and disadvantages of each of the four sites used for CVC insertion. Reflect on which site would be the most suitable for patients in your area. Imagine that one of these patients needs a CVC – describe what information you would give the patient before the procedure begins.



Nurses frequently assist medical staff who have little experience of inserting CVCs, so they need to be aware of the advantages and disadvantages of each insertion site. In most ward areas, the internal jugular is the site most frequently used because, compared with the subclavian site, there is a far smaller risk of causing a pneumothorax on insertion (Polderman and Girbes 2002a) (Fig. 1). Many patients find the weight of a catheter pulling on their necks uncomfortable, and infusion lines can catch on equipment and furniture. Blood flow from the left internal jugular vein to the right atrium is less direct than from the right internal jugular, so theoretically the right internal jugular should provide more accurate readings. In practice, however, differences do not appear significant and reliable trends are provided by both. Where medical staff have infrequent experience of inserting CVCs, internal jugular approaches are recommended because internal jugular insertion is safer than subclavian.

In high-dependency areas, where medical staff gain considerable experience in CVC, subclavian sites are usually preferred. The subclavian vein is generally the most comfortable site for patients (Waldmann 2000), and the risk of infection is reduced (Pratt *et al* 2001). However, the subclavian veins are deep and, therefore, more difficult to cannulate. They are also located near the lungs and subclavian arteries and, because the subclavian arteries are deep, controlling haemorrhage following accidental puncture is difficult. Accidental lung puncture is a potential complication, which is likely to result in a pneumothorax.

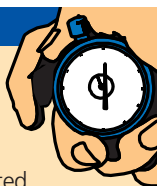
The puncture site for femoral cannulation is in the groin, making this a high-risk site for infection. It also makes frequent observation of the site impractical. The femoral vein is also a deep vein and is located near the large deep femoral artery. Arterial bleeds are difficult to stop, and stopping haemorrhage when removing a femoral line can be problematic. Femoral cannulation is likely to discourage patients from moving, and can cause discomfort, thereby increasing risks from limited mobility. However, if access is difficult elsewhere, for example, during a cardiac arrest, the femoral site might be the best option.



PICCs are inserted peripherally, usually via the brachial vein. This increases the distance between external ports and the catheter tip (in the superior vena cava), thereby substantially reducing infection (Pratt *et al* 2001). PICCs are recommended for TPN and chemotherapy. While the greater length of line used reduces the infection risk, it increases inaccuracy of pressure measurement, making PICCs unsuitable for CVP monitoring.

TIME OUT 3

Make a list of the factors that determine CVP. Reflect on the last time you witnessed CVC insertion and make a list of the equipment used. If you have limited experience in this area, liaise with a colleague working in high-dependency or critical care and ask him or her if you can be present at a CVC insertion.



Central venous pressure

CVP, sometimes referred to as 'filling' pressure, is the pressure of blood returning to, or filling, the right atrium. Venous pressure reflects the venous return to the heart. CVP is the pressure in the superior and inferior venae cavae as they enter the heart and indicates (Hudak and Gallo 1994):

- Blood volume.
- Vascular tone.
- Cardiac function.

Pressure in the vena cava (CVP) is equal to right atrial pressure (RAP). During diastole, the mitral valve opens, allowing blood to flow from the right atrium into the right ventricle. Once the cardiac pressures have equalised at the end of diastole, RAP is the same as right ventricular end diastolic pressure (RVEDP).

Approximately 65 per cent of the body's total blood volume is contained in the veins (Marieb 2001). CVP is usually used to assess blood volume and guide fluid management. It is important to remember that CVP is affected by:

- Intrathoracic pressure and musculoskeletal pump.
- Vascular tone.
- Obstruction.

Blood return to the right atrium is assisted by the intrathoracic pressure and musculoskeletal pump. When breathing in, negative pressure in the thorax draws air into the lungs and moves blood from the lower to the upper part of the inferior vena cava. Deep breaths create negative pressures and draw more blood back to the heart. Shallow breathing therefore reduces blood return to the heart. Artificial (positive) pressure ventilation impedes venous return by compressing the thoracic vena cava. Muscles contain a rich blood supply and muscle movement relies

on muscular contraction, which squeezes blood out of the blood vessels in the muscles. For example, walking increases blood return to the right atrium. Critically ill patients usually have little mobility, resulting in more venous blood being pooled in peripheral vessels. Reduced function of the intrathoracic or musculoskeletal pumps reduces blood return to the right atrium, and so reduces CVP.

Vasodilators relax the muscle walls in veins, so reducing vascular tone. As vasodilation increases capacity in the veins, CVP will also be reduced. Exogenous drugs that vasodilate the vessels include nitrates, such as glyceryl trinitrate, isosorbide mononitrate and isosorbide dinitrate.

The body also produces endogenous vasodilators, such as nitric oxide, which are released by ischaemic vascular endothelium. Many critically ill patients have long-standing cardiovascular disease, including atherosclerosis and mitral valve regurgitation. Atherosclerosis limits the ability of the vein walls to stretch, reducing vascular space. Mitral valve regurgitation reduces blood flow through the right side of the heart and increases blood volume in the vena cava. Both of these factors often co-exist and each will increase CVP.

Obstruction to blood flow will increase CVP, and can be caused by:

- Heart failure, especially right-sided failure, as occurs in mitral valve disease.
- Pulmonary congestion, for example, acute respiratory distress syndrome (ARDS) and pulmonary hypertension.
- Increased intrathoracic pressure, for example, as occurs during continuous positive airways pressure ventilation (CPAP).

TIME OUT 4

Write down in order the nursing actions that are necessary to record an accurate CVP measurement. Reflect on and make a list of any difficulties you encountered in measuring CVPs in practice.



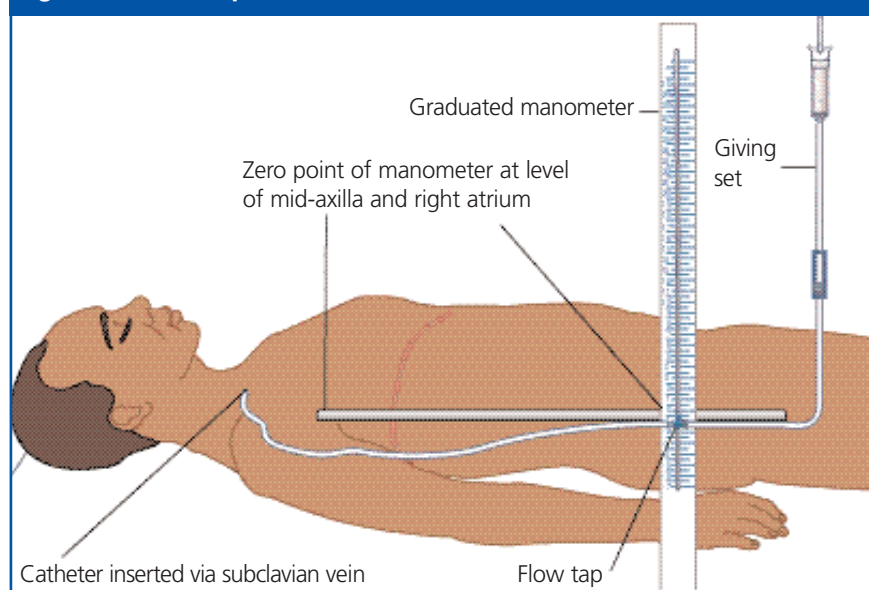
CVP measurement

CVP is usually recorded at the mid-axilla (Fig. 2). Technically, this is the phlebostatic axis, where lines from the mid-sternal fourth intercostal space and mid-axilla intersect. In practice, a small ink mark is usually made on the skin to ensure consistent use of the site. Some staff might have been taught to measure CVP from the sternal notch instead of the mid-axilla, but because the sternal notch is at a higher point on the body than the axilla this measurement results in lower CVP readings (Fig. 3). For this reason, all staff in a clinical area should measure

Fluid management



Fig. 2. Manometer position for CVP mid-axilla measurement



Box 1. Steps for measuring a patient's CVP

- Ensure all intravenous infusions running through the manometer line are stopped
- Zero the manometer
- Close the three-way tap to the patient, opening the tap between the fluid and manometer
- Allow the manometer to fill with fluid to a level beyond the expected pressure. Do not fill the line so far that the air filter becomes wet
- Close the tap to the fluid source, opening the manometer to the patient
- Watch the fluid level change. It should fall until gravity pressure equals the pressure from the central veins. When the fluid stops falling, read the CVP measurement

(Woodrow 1992)

Box 2. Converting mmHg and cmH₂O

1cmH₂O = 0.74 mmHg
 1mmHg = 1.36cmH₂O
 10cmH₂O = 7.4mmHg
 10mmHg = 13.6cmH₂O
 20cmH₂O = 14.8mmHg
 20mmHg = 27.2cmH₂O

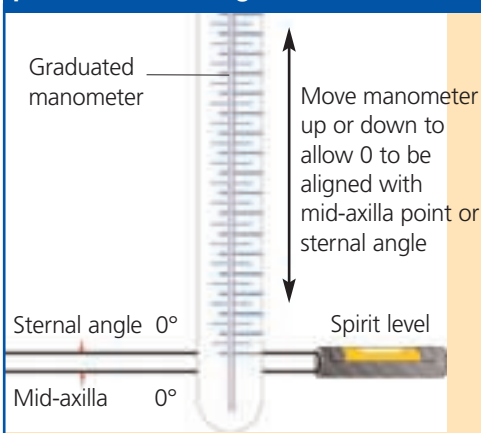
CVPs from the same point to promote consistency. When receiving patients from other clinical areas, staff should check where CVP readings were measured from before comparing them with subsequent readings. This article assumes that measurements are taken using the mid-axilla site, but the same principles apply whichever site is used.

The patient should be fully informed of the procedure before carrying out CVP measurement. Patients should ideally lie flat in a supine position to reflect right atrial pressure. However, many breathless patients cannot tolerate lying supine, so if measurements are taken from a semi-recumbent or upright position, this should be recorded on the patient's chart so that future measurements can, whenever possible, be taken from the same position. The patient's position should be charted carefully as measurements recorded in different positions can vary (Manley 1993). The steps that should be followed when measuring a patient's CVP are outlined in Box 1.

Zeroing the CVP This is a technique that is used to ensure the atmospheric pressure at the point of measurement is read as zero. In high-dependency areas, CVPs are usually measured by monitors that can be set to zero electronically once the transducer is placed at right atrial level, with flow from the transducer open to air, but closed to the patient. CVP measurement with water manometers should align the zero on the scale with the right atrial level. This is usually checked using a spirit level, although commercial light source devices are also available.

Reading CVP Digital monitors display a CVP trace and reading once the transducer is closed to air and open to the patient. Provided the scale is sufficiently large, the trace should have a clear waveform, and there is usually a small respiratory

Fig. 3. Manometer showing mid-axilla point and sternal angle



'swing' – the trace moves up and down in time to the patient's respiratory pattern.

With water manometers, after zeroing, the chamber should be almost filled with fluid by turning the flow tap to allow fluid (saline, dextrose or dextrose saline) to flow into the measuring chamber, while closing flow to the patient. Care should be taken not to get the air filter at the top wet – a wet filter will resist air entry, giving a falsely high reading. The tap should then be turned so the fluid flow is stopped, and the chamber opened to the patient. Gravity will cause the water level to fall until resistance from the patient's CVP matches the pressure of gravity. However, slight changes in pressure caused by the patient's respiratory pattern (usually about 1cm) will make the fluid fall in a 'swinging' pattern, until it oscillates between two figures. Intrathoracic pressure, represented by the fluid level in the chamber, falls on inspiration (unless the patient is artificially ventilated), so the higher figure should be recorded.

CVP can be measured in either millimetres of mercury (mmHg) or centimetres of water (cmH₂O). Millimetres of mercury measurement is used in arterial and other blood pressure measurements, when transduced measurement is available. However, mercury is neurotoxic, so manometers have to use water-based fluids, such as 5% glucose or normal saline, which provide readings in centimetres of water. Both scales will be used in the same hospital, and sometimes within one clinical area.

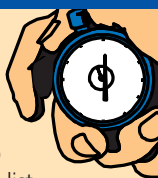
At low figures, the two scales are almost compatible: 1cmH₂O = 0.74mmHg and 1mmHg = 1.36cmH₂O. Figures are rounded to the nearest whole number, so a reading of one on either scale is rounded to one on the other. The difference increases with higher figures (Box 2).

Comparisons between cmH₂O and mmHg scales are outlined in Table 1. When receiving patients from other clinical areas it is important to know which scale has been used for CVP measurement.



TIME OUT 5

Find out the normal range for a mid-axilla CVP measurement in cmH₂O and mmHg. Make a list of as many factors as possible that might contribute to a high CVP and make a separate list of possible causes of low CVP readings.



Normal pressures

The normal CVP value should be 5-10 mmHg (mid-axilla) or 0-5 mmHg (sternal angle) (Henderson 1997), which is 7-14cmH₂O (mid-axilla) or 0-7cmH₂O (sternal angle). Critically ill patients often have abnormally high or low CVP measurements, and treatment will frequently aim to maintain a slightly higher than normal CVP to ensure sufficient blood return to the heart. A single CVP measurement has limited significance, but trends provide important information about the patient's response to treatment and/or disease progression.

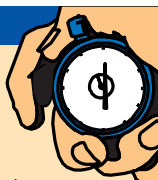
A low CVP usually indicates fluid loss through haemorrhage, as occurs in trauma or during surgery, excessive diuresis, as a result of diabetes or diuretic therapy, or poor venous return, for example, in cardiogenic shock. Peripheral vasodilation as a result of septicemia or vasodilatory therapy, such as glyceryl trinitrate, can also lower the CVP.

A high CVP reading can be caused by various factors including:

- Hypervolaemia – as occurs with excessive fluid infusion.
- Cardiac failure – due to right ventricular failure, pulmonary embolism, mitral valve failure/regurgitation or cardiac tamponade (accumulation of blood or fluid within the pericardial sac).
- High blood viscosity – this is rare, but possible following massive blood transfusion.
- Lumen occlusion/obstruction – the cannula might be kinked or resting against the vein wall, or the patient might have a thrombus.
- Artefact – caused by mechanical interference, for example, viscous drugs or fluids remaining in the CVP line or in progress while the CVP is being measured.
- User error – the air filter in the water manometer can become wet.

TIME OUT 6

From your clinical experience, think of four complications that could occur to patients as a result of having a CVC. How could you minimise the risk of each of these problems occurring?



Complications CVCs are highly invasive and expose patients to various risks. Nurses should be aware of these risks and take appropriate action to minimise them whenever possible. The main risks associated with CVP lines are:

- Injury during insertion.
- Air embolus.
- Infection.
- Dislodgement.
- Fluid overload.
- Central vein thrombosis.

Injury during insertion During CVC insertion it is important that nursing staff observe the patient for signs and symptoms of complications and alert medical staff if any arise. Patients should be given reassurance and detailed explanation before the procedure begins and they should be asked how they feel during catheter insertion. Monitoring a patient's ECG, observing his or her breathing pattern and feeling his or her pulse are useful when checking for problems, such as pneumothorax or arterial puncture.

During insertion, the surrounding tissue, including arteries, the lungs and myocardium, can be punctured accidentally. Puncture of any of these tissues could be immediately life threatening for some patients. Pneumothorax is a real risk because of the close proximity of the lungs and the cardiac tamponade. Abnormal cardiac rhythms can occur if the catheter is inserted too far into the heart.

Once inserted, the CVC should be secured. Most CVCs are manufactured with two sets of fixation points for sutures, both of which should be secured with two stitches each. The set of fixation points furthest from the patient is manufactured to slide along the line, to allow patients to move their necks without excessive traction on the line. The site should then be covered with a moisture-permeable dressing (Pratt *et al* 2001), leaving the site easily visible.

Infusing drugs or fluids intended for intravascular use into extravascular tissue can cause harm. A chest X-ray should be taken following insertion to check the position of the catheter tip – it should be as near as possible to the right atrium, without actually entering it. The X-ray should also be used to exclude pneumothorax.

Air embolus Negative intrathoracic pressure during inspiration draws air into the thorax through any patent orifice. If a CVC lumen is open to air, air will be drawn into the vena cava. Although emboli of 10-20ml rarely cause significant problems (Hudak *et al* 1998), larger volumes can cause pulmonary emboli and death. A deep breath could cause a fatal air embolus. CVCs and connections should be easily visible whenever possible, and the insertion site and connections should be checked at least once on each shift and whenever there is

Table 1. Comparison of cmH₂O and mmHg scales

cmH ₂ O	mmHg (exact)	mmHg (rounded)
1	(0.74)	1
2	(1.48)	1
3	(2.22)	2
4	(2.96)	3
5	(3.70)	4
6	(4.44)	4
7	(5.18)	5
8	(5.92)	6
9	(6.66)	7
10	(7.40)	7
11	(8.14)	8
12	(8.88)	9
13	(9.62)	10
14	(10.36)	10
15	(11.10)	11
16	(11.84)	12
17	(12.58)	13
18	(13.32)	13
19	(14.06)	14
20	(14.80)	15

mmHg	cmH ₂ O (exact)	cmH ₂ O (rounded)
1	(1.36)	1
2	(2.72)	3
3	(4.08)	4
4	(5.44)	5
5	(6.80)	7
6	(8.16)	8
7	(9.52)	10
8	(10.88)	11
9	(12.22)	12
10	(13.60)	14
11	(14.96)	15
12	(16.32)	16
13	(17.68)	18
14	(19.04)	19
15	(20.40)	20
16	(21.76)	22
17	(23.10)	23
18	(24.44)	24
19	(25.82)	26
20	(27.20)	27



any cause for concern. All unused lumens should be securely clamped with the clamps made by the appropriate manufacturer. Artery forceps are not recommended as these can damage the plastic, creating a means for air to enter. The hub of each unused lumen should also be covered with a Luer-lock cap. If an air embolus is suspected, the patient should be placed in the left lateral position, with the head lower than the feet, and help should be summoned immediately. This position will help prevent air passing into the right side of the heart (and pulmonary circulation).

Infection This can be local or systemic (Elliott *et al* 1994). Infection rates from CVCs vary widely: van Vliet *et al* (2001) report infection rates ranging between 1 and 14 per cent. Even the lowest rate of infection for CVCs (1 per cent) exceeds the reported infection rate (0.69 per cent) for peripheral lines (Vost and Longstaff 1997). Central lines should, therefore, be removed as soon as they are no longer required.

Evidence is conflicting regarding whether multi-lumen catheters increase the risk of infection (Pratt *et al* 2001). Tunnelled catheters, such as Hickman lines, reduce the risk of infection in patients who require long-term use (Vost and Longstaff 1997), but routine tunnelling of short-term subclavian lines has no proven benefit (Pratt *et al* 2001). In contrast to peripheral lines, flushing central lines with heparinised, rather than unheparinised, saline flush appears to reduce infection significantly (Pratt *et al* 2001). Administration of prophylactic antibiotics before or after insertion is not recommended (Pratt *et al* 2001).

CVCs should be changed or removed according to the manufacturer's guidelines and local protocols and standards. Generally current practice is to change CVCs within seven days (Cunha 1995). If infection is suspected, a different site should be used for the new CVC. Insertion of new lines into the same site using a guidewire that is inserted through the old catheter before removal is likely to infect the new CVC (Elliott *et al* 1994). Sepsis frequently results from skin surface bacteria that gain access to blood through cannulation (Polderman and Girbes 2002b).

If the CVC site looks inflamed or infected, a swab should be sent for microscopy, culture and sensitivity. Blood cultures should be taken through the catheter (Elliott *et al* 1994), and after removal 5cm of the tip should be sent for culture (Elliott *et al* 1994). Some clinicians argue that catheter tips can become infected by skin commensals on removal and, therefore, culturing removed tips is of dubious value. Routine culturing of all tips is unnecessary (Elliott *et al* 1994).

Dislodgement Extravasation can occur with CVCs,

as well as with peripheral cannulae. This will cause falsely high CVP readings, with no waveform and little, if any, respiratory swing. However, if drugs are being infused through an unmonitored line, blood should be drawn back before the drug is given to ensure the tip of the line is still in the vein (Simcock 2001).

Movement of the CVC tip into the right atrium is likely to cause ectopics and dysrhythmias. The sino-atrial node is in the wall of the right atrial muscle. Catheters entering the right atrium can cause direct mechanical irritation to the muscle surrounding the node. Although there are other possible causes, sudden development of abnormal cardiac rhythms could indicate displacement of a CVC. Abnormal rhythms can be detected using ECG monitoring, although this limits mobility and might increase the patient's levels of stress and anxiety. Continuous ECG monitoring is not desirable solely to detect central line dislodgement. Feeling the patient's pulse is a simpler and more practical way to assess cardiac rhythm.

Fluid overload The large size of central veins permits very rapid infusion if the clamps on fluid lines are inadvertently left open, so extra care should be taken when commencing and administering fluid and drug infusions. Many high-dependency areas use volumetric pumps when infusing fluids into CVCs, although, in the author's experience, the relatively high cost of giving sets for most volumetric pumps creates a disincentive to do this. Nearly half the infusion pump malfunctions reported to the Medical Devices Agency were related to overinfusion, although 80 per cent of these were owing to user error (Williams and Lefever 2000). Therefore, pumps should be checked hourly. Outside high-dependency areas, limited availability of volumetric pumps often necessitates manual control of infusions by gravity.

Central vein thrombosis Thrombosis occurs in 4 to 35 per cent of patients who have central lines (Kaye and Smith 1988). This wide variation reflects wide variations between good and poor practice. Recent attempts to introduce heparin-coated lines to reduce thrombus formation have not been widely accepted in clinical practice (Wright *et al* 2001). Thrombus formation can occur anywhere, but likely sites are at the tip and inside the catheter. Attempting to dislodge the thrombus with a forced flush is dangerous, as this could create emboli which, with the catheter situated just outside the right atrium, could rapidly enter the pulmonary and coronary circulation. Staff with limited experience of managing CVCs are advised to report the problem. Urokinase and percussive technique are two options used to remove thrombi (Stewart 2001). Urokinase is a thrombolytic agent, similar to streptokinase, that

REFERENCES

- Cornock M (1996) Making sense of central venous catheters. *Nursing Times*. 92, 49, 30-31.
- Cunha B (1995) Diagnosis and prevention of intravenous central line-associated infections. *Heart and Lung*. 24, 4, 261-262.
- Department of Health (2001) *National Confidential Enquiry into Perioperative Deaths (CEPOD)*. London, The Stationery Office.
- Elliott T *et al* (1994) Guidelines for good practice in central venous catheterization. *Journal of Hospital Infection*. 28, 3, 163-176.
- Gourlay D (1996) Central venous cannulation. *British Journal of Nursing*. 5, 1, 8-15.



can disrupt clotting. As many critically ill patients have prolonged clotting, this could cause significant complications. The percussive technique involves drawing up 1ml normal saline in a 10ml syringe and pulling back the plunger and allowing it to snap back (Stewart 2001).

This should draw the thrombus into the catheter lumen, where the percussion from the snap will cause it to disintegrate, allowing it to then be drawn back into the syringe. Stewart (2001) claims a 94 per cent success rate and no reported complications. This technique should only be attempted by staff who are experienced in managing CVCs. If catheters with blocked lumens are left in place, they should be clearly labelled so that other staff do not attempt to use them.

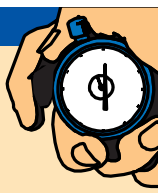
Stewart's article (2001) is a practice-based report, rather than a research report. It does, however, report that the method described has been successful on more than 50 occasions over a period of four years. It describes the three reported failures; in each of these cases, although the catheter could not be unblocked, the patients do not appear to have been harmed by the procedure. No fractures of catheters have been reported and, for the first ten lines successfully unblocked, the catheters were subsequently examined (under pressure). No leaks were found.

The report does not identify any complications from systemic embolus formation, so, provided the research was undertaken with integrity, it can be inferred that no emboli were released. Remembering the individual accountability of each qualified nurse, this technique should not be attempted by someone who is not used to caring for patients with central lines.

For nurses who have this experience, potential risks and benefits of each option should be evaluated carefully before attempting to unblock a central venous catheter. Stewart's article (2001) describes one option, and provides a little, albeit largely descriptive and anecdotal, evidence. This is an area that merits further research to establish reliable evidence-based care.

TIME OUT 7

Describe the correct procedure for CVC removal. Discuss with a colleague how you would help to relieve the patient's fears and anxieties.



CVC removal

The removal procedure should be carefully explained to the patient, to reduce anxiety and promote

patient co-operation. Patients should lie flat and be positioned head down, at an angle of 10-20° (Cornock 1996), so that if an air embolus occurs during removal, it will rise to the highest point – the feet, not the head.

Lying head down is disconcerting. Patients with orthopnoea might be particularly distressed, so they need to understand the rationale for this position. If patients are unable to tolerate this position, they should do the Valsalva manoeuvre during catheter removal. The patient should breath in, close the mouth and bear down, thereby raising the intrathoracic pressure.

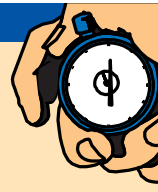
The dressing and the sutures should be removed first. Patients need to hold their breath during CVC removal, so it is advisable to encourage them to take some deep breaths to ensure they are adequately oxygenated. For most patients, three is a reasonable number, but this might need to be modified for breathless patients. A few patients might benefit from receiving oxygen before the procedure. When the patient appears calm, well-oxygenated and comfortable, he or she should be told to breathe out and hold the breath. The CVC should then be removed rapidly and a sterile swab placed over the puncture site. Once bleeding has stopped, the site should be covered with a sterile dressing, such as a sticking plaster. Scales (1999) recommends a transparent dressing. If unexpected resistance occurs during removal, it is best to stop the procedure, ensure all lumen hubs are securely closed and seek help.

Conclusion

CVCs provide a valuable means of monitoring and delivering fluids to critically ill patients. With the increased dependency of patients in most clinical areas, ward staff are increasingly caring for patients with central venous access. CVCs can be managed safely in many clinical areas, but staff need to use reliable, up-to-date evidence so they can be knowledgeable about their uses and potential complications and can provide safe, effective care. Staff also need to be able to assess and monitor when the risks associated with CVCs outweigh the benefits, so that unnecessary lines can be removed as soon as possible ■

TIME OUT 8

Now that you have completed the article, you might like to write a practice profile. Guidelines to help you are on page 54.



- Haines S, Coad S (2001) Supporting ward staff in acute care areas: expanding the service. *Intensive and Critical Care Nursing*. 17, 2, 105-109.
- Henderson N (1997) Central venous lines. *Nursing Standard*. 11, 42, 49-54.
- Hudak C *et al* (Eds) (1998) *Critical Care Nursing: A Holistic Approach*. Seventh edition. Philadelphia, Lippincott.
- Hudak C, Gallo B (Eds) (1994) *Critical Care Nursing: A Holistic Approach*. Sixth edition. Philadelphia, Lippincott.
- Kaye C, Smith D (1988) Complications of central venous catheterisation. *British Medical Journal*. 297, 6648, 572-573.
- Manley K (1993) Care of the acutely ill adult. In Hinchliff S *et al* (Eds) *Nursing Practice and Health Care*. Second edition. London, Edward Arnold.
- Marieb E (2001) *Human Anatomy and Physiology*. Fifth edition. San Francisco CA, Benjamin Cummings Publishing Company.
- Polderman K, Girbes A (2002a) Central venous catheter use. Part 1: mechanical complications. *Intensive Care Medicine*. 28, 1, 1-17.
- Polderman K, Girbes A (2002b) Central venous catheter use. Part 2: infectious complications. *Intensive Care Medicine*. 28, 1, 18-28.
- Pratt R *et al* (2001) Guidelines for preventing infections associated with the insertion and maintenance of central venous catheters. *Journal of Hospital Infection*. 47, Suppl, S47-S67.
- Scales K (1999) Vascular access in the acute care setting. In Dougherty L, Lamb J (Eds) *Intravenous Therapy in Practice*. Edinburgh, Churchill Livingstone.
- Simcock L (2001) Central venous catheters: some common clinical questions. *Nursing Times*. 97, 19, 34-36.
- Stewart D (2001) The percussion technique for restoring patency to central venous catheters. *Care of the Critically Ill*. 17, 3, 106-107.
- van Vliet J *et al* (2001) A comparison between two types of central venous catheters in the prevention of catheter-related infections: the importance of performing all the relevant cultures. *Clinical Intensive Care*. 12, 3, 135-140.
- Vost J, Longstaff V (1997) Infection control and related issues in intravascular therapy. *British Journal of Nursing*. 6, 15, 846-857.
- Waldmann C (2000) Cannulation of central veins for resuscitation and monitoring in the ICU. *Anaesthesia and Intensive Care Medicine*. 1, 3, 105-107.
- Williams C, Lefever J (2000) Reducing the risk of user error with infusion pumps. *Professional Nurse*. 15, 6, 382-384.
- Woodrow P (1992) Monitoring central venous pressure. *Nursing Standard*. 6, 33, 25-29.
- Wright F *et al* (2001) Antibiotic-coated central lines: do they work in the critical care setting? *Clinical Intensive Care*. 12, 1, 21-28.