

Central venous catheter removal: procedures and rationale

Sarah R Drewett

Abstract

The use of central venous catheters (CVCs) has become fairly commonplace within both the hospital and community setting. The removal of these devices is often a task performed without much teaching and the procedure to follow is passed on from one nurse to another with little or no research on which to base actions. This article describes the potential complications associated with CVC removal and methods to prevent them. It will also give the nurse research-based procedures to follow when removing the various types of CVC. These written procedures should be used as a training guideline only. Practical training and supervision until competent is still required.

The removal of a central venous catheter (CVC) is a common procedure in hospitals and the community. Reasons for removal of a CVC include end of treatment, proven and unresolved catheter sepsis, catheter fracture, occlusion unresponsive to

unblocking techniques/drugs, thrombosis and, in peripherally inserted central catheters (PICCs), thrombophlebitis. There is much research and literature on the insertion and care of CVCs as well as the prevention, detection, and treatment of potential complications (Drewett, 2000). However, apart from brief paragraphs within larger articles, there seems to be no medical or nursing literature on the removal of these devices (Fan, 1998).

Removal of a CVC is often performed by doctors or nurses with little or no teaching; however, there are a number of complications that can occur on or after CVC removal. These complications are listed in *Table 1*. When a complication occurs there is an overall mortality rate of 57% (Kim et al, 1998). A significant factor in the high mortality rate with these complications is the failure of practitioners to appreciate fully these rare but life-threatening complications (Kim et al, 1998). Thus, in order that safe, high quality, patient care is given, literature should be available to nurses and medical staff.

This article will describe a number of complications associated with CVC removal and how these can be prevented or detected. The article ends with the author's suggested, research-based procedures for removal of the various types of CVC. These procedures should, of course, only be carried out by practitioners who, following a period of practice and supervision, have been assessed as competent to undertake the procedure.

Table 1. Complications associated with removal of a central venous catheter

Air embolism
Catheter fracture and embolism
Dislodgement of thrombus or fibrin sheath
Haemorrhage/bleeding
Arterial complications — bleeding, compression of brachial plexus

Table 2. Reasons for removal of a central venous catheter

Proven and unresolved infection
End of treatment
Device has exceeded recommended dwell time
Unmendable/faulty/fractured device
Proven thrombosis
Unresolvable occlusion
Unresolvable phlebitis/thrombophlebitis

ASSESSMENT OF PATIENTS BEFORE CVC REMOVAL

There are a number of basic assessments a practitioner should undertake before any

Sarah R Drewett is Clinical Nurse Specialist, Parenteral Nutrition and Line Insertion Service, Oxford Radcliffe Hospitals Trust, Oxford
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CVC removal. These assessments will reduce the risk of complications during and after removal.

Reasons for removal

First, is there sufficient rationale to remove the device? Many practitioners are unfamiliar with the particular CVC in situ and may ask for removal without trying to treat the problem. The reasons for removal of a CVC are listed in *Table 2*.

Infection: Is the infection proven and unresolved or compromising the patient? Proven infection requires positive blood cultures from both the CVC and peripheral blood or a positive exit-site swab. On advice from the microbiologist (guided by the clinical status of the patient) 48 hours of appropriate antimicrobial therapy can be administered via the CVC. If cultures are still positive after this then the infection is unresolved and device removal is indicated. Too often it is assumed that a CVC is the source of infection and removed only to find the symptoms of sepsis remain. With PICCs especially, phlebitis of the upper arm can be easily mistaken for infection by an inexperienced practitioner. If the infection is proven or the patient is compromised and removal is essential the CVC tip should be sent for microscopy, culture, and sensitivity to ensure correct antimicrobial therapy is being administered.

End of treatment: Occasionally a CVC is removed, only for the patient to require further central venous access a few days later. If the CVC is a long-term access device (PICC, tunnelled) the question should always be asked whether the risks of keeping the CVC in situ (Drewett, 2000) are outweighed by the potential needs of requiring central venous access in the near future. For example, keeping the CVC in for 48 hours post-treatment to ensure that blood/wound cultures are now negative (if inserted for intravenous (IV) antibiotics), the patient is eating/drinking sufficient for their requirements (if for parenteral nutrition) and the patient has sufficient venous access in case of neutropenic sepsis (if being removed after last course of chemotherapy).

Device has exceeded recommended dwell time: There are many IV devices on the market and practitioners are often not familiar with the particular device if they have not

inserted it themselves. For example, PICCs are long-term IV devices suitable for up to 1 year's treatment, but they are sometimes mistaken for shorter-term devices. If the CVC has been in situ for the maximum amount of time (e.g. short-term 'neck' lines are suitable for 5–10 days) then the patient's venous access requirements should be assessed before removal.

If peripheral venous access is required, has this been established? Are there suitable veins for the length of therapy required? If not, or if further central venous access is required, has this been arranged? Is the patient clinically stable for CVC insertion (Drewett, 2000)? Should the CVC remain in situ until further access is established? Occasionally, if central access is known to be problematic then the CVC will be rewired with a new one. For this method, the risks of cross-infection need to be assessed against the risks of attempting new central venous access.

Faulty/fractured device: There are many repair kits available for long-term CVCs. It is therefore rare when a fault in the device (external to the patient) necessitates removal. However, a fault in the portion of the device

Table 3. The actions, and their rationale, a practitioner should perform to prevent air embolism on central venous catheter(CVC) removal

Action	Rationale
Ensure the patient is not dehydrated	A low CVP will allow air to be aspirated into the systemic circulation more easily (Kim et al, 1998)
Position patient in the Trendelenburg position (10–30 degree head down tilt)	The Trendelenburg position elevates the venous pressure above that of atmospheric pressure thus reducing the risk of air being aspirated
Remove while the patient performs the Valsalva manoeuvre (forced expiration with the mouth closed) or during expiration if the patient is unable to perform this technique (Weinstein, 1997)	The pressures involved within the central venous circulation relate directly to the pressures involved with respiration. On expiration the intrathoracic and intravenous pressures are greater than the atmospheric pressure making it less likely that air would enter the venous system. On inspiration it is the opposite and air can be sucked in through an opening into the venous system (Arrow International, 1996)
Apply gentle pressure to occlude exit site of catheter (and vein entry site if different) for 5 minutes unless clotting is deranged (see 'assessment of patients before CVC removal').	Pressure will prevent both blood loss and air entry. Compression can disrupt a blood clot within the venous system or, if over the carotid artery, can cause neurological or cardiopulmonary complications (Kim et al, 1988)
Apply air tight dressing for 24 hours and encourage the patient to remain lying down for 30 minutes	The first time the patient sits up or takes a deep breath in the CVP will be increased to above air pressure. The airtight dressing will prevent air being sucked in while any tract seals

CVP = central venous pressure

Table 4. Symptoms and management of a patient with suspected air embolism

Signs and symptoms	Dyspnoea, cyanosis, hypotension, dizziness, tachycardia, weak pulse, anxiety, neurological deficits (confusion, reduced conscious level), cardiac arrest
Emergency management	<ol style="list-style-type: none"> 1. Immediately occlude air entry point (airtight dressing) 2. Place patient in left Trendelenburg position 3. Administer 100% oxygen therapy 4. Get medical assistance immediately

inside the patient needs careful assessment as to the safest method of removal to reduce the risks of a catheter fragment embolizing (see catheter fracture and embolism). If a fault has occurred in the device the practitioner should note the batch number of the device (from insertion details in the patient's notes) and, if possible, retain the device for investigation. The manufacturers should be advised, an incident form completed, and the medical devices agency (MDA) informed.

Thrombosis: Before removing a CVC where there is a thrombosis in the blood vessel medical advice should always be sought. A decision should be taken to:

- Remove the device immediately and then start anticoagulation therapy (especially if total venous obstruction)
- Anticoagulate for a length of time (thrombosis dependent) and then remove the device (if there is a risk of thrombus dislodgement with immediate removal)
- Administer anticoagulant therapy via the device (to remove any thrombus attached to the device) and then remove the device. Also, see section on anticoagulant therapy and clotting screen before removal of a CVC.

Occlusion: Before removing a CVC that is occluded ensure that all appropriate methods of unblocking have been tried. For example, urokinase (if available), or alcohol solution for fat occlusion (Drewett, 2000).

Phlebitis/thrombophlebitis: Irritation of the vein wall by a PICC can often be prevented, or treated in the early stages, by the application of local heat to the upper arm. However, removal of a PICC due to phlebitis does occur and has been cited as a reason for a PICC to become 'stuck' during removal (Wall and Kierstead, 1995). See section on problem PICC removal.

Blood tests

Biochemistry: A recent biochemistry sample will alert the practitioner to a patient who is clinically dehydrated or who has an abnormal potassium level. A patient who is dehydrated will have a low systemic pressure increasing the risk of air embolism as it is more difficult to raise the central venous pressure (CVP) above that of air pressure. A potassium level outside normal limits can cause the heart to be more irritable and more susceptible to arrhythmias.

Haematology: Platelet counts of greater than 50 (10^9 litres) are required to reduce the risk of bleeding post-CVC removal. The clotting screen should also be within normal limits to reduce the risk of bleeding post-removal. Anticoagulant therapy should also have been discontinued or titrated to ensure a normal clotting screen. (NB. Fragmin (dalteparin sodium) does not alter the clotting screen but therapy within the last 24 hours can alter the blood's ability to clot.)

Table 5. Symptoms/nursing care of arterial complications

Symptoms and potential reasons	Nursing care
Significant and obvious bleeding from the exit site The artery may have been damaged on insertion but the catheter had plugged the hole (Walden, 1997)	Apply firm but gentle pressure to the area Get medical assistance Monitor blood pressure (BP) and pulse to detect hypovolaemic shock (lowering BP and raised pulse)
Swelling under the skin around the vein access site, e.g. neck if jugular CVC The artery may have been damaged on insertion but the catheter had plugged the hole (Walden, 1997)	As above
Reduced power in a limb (the side of CVC removal) This can be associated with swelling and compression of the brachial plexus due to internal, unseen haemorrhage (Walden, 1997)	Inform the medical team Support the patient during investigations such as magnetic resonance imaging (MRI) scan
CVC = Central venous catheter	

COMPLICATIONS

Air embolism

Air embolism occurs when air is allowed into the venous system. A bolus of air, or a collection of smaller air bubbles trapped in the vein, flows into the right atrium of the heart and proceeds to the ventricle and pulmonary arterioles, thus blocking the pulmonary blood flow. This obstruction of pulmonary blood flow leads to localized tissue hypoxia, decreased cardiac output and the resultant decreased tissue perfusion which, without intervention, rapidly progresses to shock and death (Adriani, 1962).

The amount of air that causes problems is variable but air entering the venous system at 70–105 ml/s is usually fatal and at 20 ml/s the patient will experience symptoms (Mennim et al, 1992). A 14 gauge needle/catheter will allow air to enter at 200 ml/s and this size is commonly used for CVCs.

Fibrin tracts consistently form around catheters, sometimes within 24 hours of insertion, creating a potential portal for venous air entry after catheter removal. The tract of a long-term catheter (in situ for longer than 2 weeks) is likely to seal more slowly, although air embolism has been reported after removal of catheters in place for only 3 days (Mennim et al, 1992). There is also an increased risk of air embolism following removal of a CVC after lung transplantation although the reason behind this is not clear (McCarthy et al, 1995). When removing a CVC, air embolism is an entirely preventable complication although it is not widely known among practitioners (Mennim et al, 1992). *Table 3* describes a number of simple actions, and their rationale, which should be taken to prevent air entering the venous system on removal of a CVC.

Performing the actions in *Table 3* will prevent air embolism occurring. However, an awareness of the signs, symptoms, and management of a patient with an air embolism is vital when any manipulation of a CVC occurs. These are briefly outlined in *Table 4*.

Catheter fracture and embolism

If a CVC fractures this can lead to embolization of the distal catheter fragment. The catheter fragment usually stops in the right atrium or the pulmonary artery leading to thrombotic embolism, pulmonary embolism,

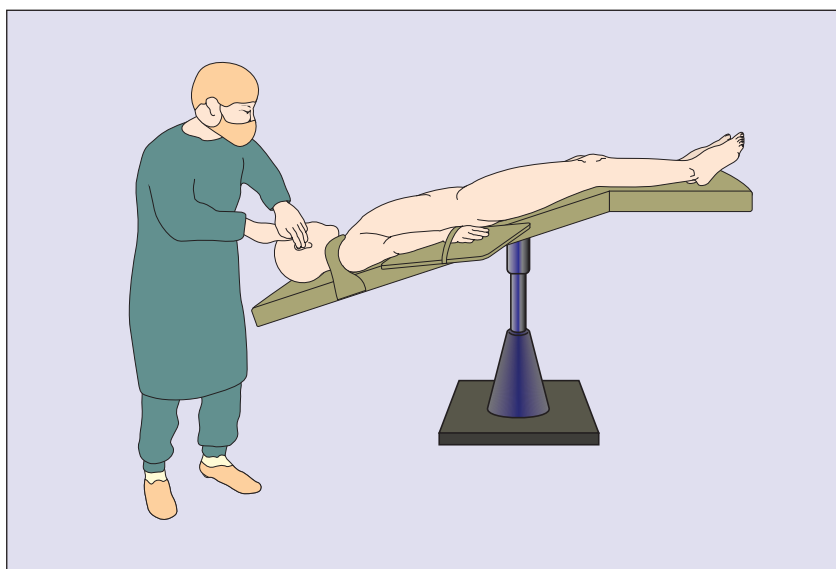


Figure 1. The Trendelenburg position.

stroke, and death. Catheter fracture and embolization can occur spontaneously due to pinch-off syndrome (Rubenstein et al, 1985) but can also occur on removal of the catheter.

To avoid catheter embolism during removal the following three steps should be followed:

- *Never* pull a CVC out against resistance
- *Always* ensure the correct removal procedure is used (see end of article)
- Ensure CVC is intact on removal.

Dislodgement of thrombus or fibrin sheath

The normal response to a foreign body, such as a CVC, in a vein is the accumulation of fibrin leading to thrombus formation. Fibrin deposition occurs at the end of the CVC as a fibrin sheath along the length of the CVC, resulting in occlusion, or along the wall of the vein, resulting in thrombosis of the blood vessel (Drewett, 2000).

When a catheter is removed there will be some degree of fibrin build up, even after a few days, although symptoms may not be apparent (Decicco et al, 1997). During removal the thrombus or fibrin sheath may dislodge and embolize causing pulmonary

embolism or stroke (Kim et al, 1998). To avoid thrombus or fibrin sheath embolization during removal the practitioner should:

- Apply *gentle* pressure only to the exit site, as heavy compression can dislodge a thrombus
- *Not* massage the exit site to ensure haemostasis as this can dislodge a thrombus (this can also cause neurological deficits due to inadvertent carotid massage when a jugular CVC is removed (Kim et al, 1998).

Haemorrhage/bruising

Whenever a device is removed from a vein there is a risk of haemorrhage and bruising. Bruising can be external (visible) or internal (haematoma) causing potential problems, such as pressure on nearby structures and an increased risk of infection, as it provides a focus for the adherence of bacteria (Tait, 1999).

Prevention of haemorrhage starts with the assessment of the patient's clotting screen and anticoagulant status. As the device is removed from the vein gentle pressure should be applied to reduce bleeding. It is important to note that when a subclavian vein has been used direct pressure on the vein access site may be difficult due to the clavicle's position superior to the vein. In this case gentle pressure should be applied as near to the supposed exit site as possible. The area should be compressed for 5 minutes to allow the vein to heal, then carefully observed for signs of swelling for the next 30 minutes. Swelling should be reported immediately and gentle pressure applied.

Arterial complications

Arterial complications, such as puncture, during insertion of a CVC are well documented. Complications, during or after removal, are less common but have a high morbidity rate (Walden, 1997). These removal complications usually occur with catheters which were difficult to insert and often occur several days following line removal (Walden, 1997). Arterial complications include obvious haemorrhage, swelling (due to internal haemorrhage), and brachial plexus damage (due to compression from internal haemorrhage). Although not preventable, arterial complications need to be detected and treated to prevent compromising the clinical status of the

Table 6. Procedure for removal of a short-term central venous catheter (CVC) (often known as neck line)

Set up trolley for aseptic technique
Explain procedure to the patient
Disconnect infusions
Position the patient in the supine position — Trendelenburg if the patient is slightly dehydrated (Mennim et al, 1992)
Wash hands and remove the old dressing
Scrub up (aseptic technique)
Prepare the site
Cut sutures
Explain the Valsalva breathing technique to the patient
As the Valsalva manoeuvre is performed withdraw catheter in slow constant motion. As the catheter is removed gentle pressure should be exerted on the exit site (for 5 minutes) which should be immediately occluded (until air occlusive dressing is applied)
Inspect catheter for completeness. The tip should not have a ragged edge
Apply sterile dry dressing and airtight dressing to exit site (Mennim et al, 1992)
The patient should remain lying down, under observation, for 30 minutes
Air tight dressing to remain in situ for 48 hours

The supine position increases the central venous pressure (CVP) to higher than that of air pressure. The Trendelenburg position increases the CVP further and should be used in a patient who is dehydrated and will have a lower CVP than normal...A CVP higher than air pressure will prevent air being aspirated into the venous system.

Table 7. Procedure for removal of a tunnelled, cuffed CVC (often known as a Hickman line)

Set up trolley for aseptic technique
Explain procedure to the patient
Disconnect or turn off infusions
Position the patient in the supine position (Mennim et al, 1992) (or Trendelenburg if the patient is dehydrated)
Wash hands and remove the old dressing
Locate the cuff using finger tips (some catheters can be measured from the hub or bifurcation). This ensures the cuff can be felt and will be easily accessible once the procedure commences
Wash hands and apply sterile gloves
Prepare the site using antimicrobial cleanser. This removes skin flora and prevents infection of the site
Infiltrate around and underneath the cuff with 1% lignocaine (5–10 ml). This ensures the procedure is not painful although it does sting as it is administered
Drape the area to produce sterile field — to ensure asepsis is maintained at the surgical incision point
Using a scalpel make a small incision just above and to one side of the cuff. The incision allows access to the cuff. The position of the incision avoids accidentally severing the catheter
Blunt dissection with mosquito artery forceps should then be used to expose the cuff from the tissues. Blunt dissection reduces trauma and bleeding of the tissues. The cuff is the only portion of the CVC that adheres to the tissues. Using a scalpel here may accidentally fracture the catheter. A small catspaw retractor may assist with this process. Occasionally, the area where the cuff meets the catheter may need a firm rub with dry gauze to expose it as a membrane will be covering it
Using the aneurysm hook locate catheter above the cuff (heart side). This is the portion that will be removed first to ensure patient safety
Explain the Valsalva breathing technique to the patient
As a Valsalva manoeuvre is performed, withdraw catheter in slow constant motion from the vein using the aneurysm hook. As the catheter is removed gentle pressure should be exerted on both vein exit site and tunnel. The exit site should be immediately occluded
Inspect catheter for completeness. An open-ended catheter should not have a ragged edge and a Groshong valved catheter should have its radioopaque tip intact
While maintaining gentle pressure at these two points cut the catheter below cuff (send tip to microbiology if required). The cuff is larger than the catheter and cannot be removed via the tunnel and skin exit site
Pull out the lower portion from original skin exit site (to prevent a dirty portion of the catheter (the external portion) being dragged through a clean surgical incision)
Insert one or two skin sutures at the cuff dissection point to close the skin
No sutures are usually necessary at the skin exit point as healing will have begun the day the device was inserted. Suturing does not speed up healing or reduce scarring
Apply sterile dry dressing to skin exit site and sutures. Cover <i>both</i> with an airtight dressing (Mennim et al, 1992)
The patient should remain lying down, under observation, for 30 minutes (Walden, 1997)
Air tight dressing to remain in situ for 48 hours
Sutures to remain in for 5–7 days (longer if the patient has slower healing such as those on steroid therapy). This ensures adequate wound healing

patient. Table 5 gives a summary of the symptoms, potential reasons, and nursing care of these complications.

REMOVAL PROCEDURE FOR DIFFERING CVCS

When removing a CVC the procedure to follow will depend on the type of CVC in situ. Short-term CVCs exit the skin where they enter the vein, tunnelled CVCs often have a cuff securing them in the tunnel, and PICCs, although relatively easy to remove, can often become stuck. Despite the different procedures used for removal there are a number of common parts of the procedures which will be outlined here.

Explanation of the procedure to the patient

This both decreases anxiety and increases compliance with positioning and breathing techniques.

Disconnection of infusions

This reduces the tug on the catheter aiding maintenance of sterility and also preventing fluids leaking as the catheter is withdrawn.

Strict aseptic technique

This prevents infection at the exit site. Asepsis includes handwashing, antimicrobial skin preparation, sterile equipment (including gloves), and sterile dressing over the exit site.

Positioning

The supine position increases the CVP to higher than that of air pressure. The Trendelenburg position (Figure 1) increases the CVP further and should be used in a patient who is dehydrated and will have a lower CVP than normal (see assessment). A CVP higher than air pressure will prevent air being aspirated into the venous system. If air is aspirated greater quantities can be tolerated in the supine (or Trendelenburg) position as air can collect in the right ventricular apex and away from the pulmonary valve (Mennim et al, 1992).

Breathing

When removing the catheter the patient should ideally perform the Valsalva manoeuvre (trying to breathe out with the glottis closed — similar to straining on the toilet). If

this is not possible respiration should be momentarily ceased or removal performed on expiration. The patient should not be told to take a deep breath in. This technique increases the CVP and reduces the risk of air aspiration (see air embolism).

Gentle traction

The catheter should be withdrawn in a slow constant motion (no resistance should be felt). Catheter fracture and embolization can occur if the CVC is removed against resistance (see catheter fracture).

Table 8. Procedure for removal of a peripherally inserted central catheter (PICC)

Set up trolley for aseptic technique
Explain the procedure to the patient
Disconnect or turn off infusions
Position the patient comfortably with arm outstretched. An outstretched arm aids easy removal as it straightens out the vein
Remove the old dressing
Wash hands and apply sterile gloves
Prepare the site
Cut sutures (if PICC was held in by sutures)
Apply gentle traction at the skin exit site regrasping the catheter near the skin every few centimetres. Regrasping the catheter allows for better control and a more even force along the length of catheter. This decreases the risk of the catheter breaking (Marx, 1995). NB. If the patient has signs of catheter-related sepsis the catheter may be more prone to breakage so extra care should be taken (Wall and Kierstead, 1995)
Do not put pressure on exit site or vein as the catheter is removed. Pressure on the exit site or vein during removal encourages the catheter to touch the vein wall and can cause venous spasm (see problems during PICC removal)
Do not remove the catheter quickly. A moderate removal rate will also reduce venous spasm
Apply gentle pressure at the exit site on removal
Inspect catheter for completeness. If the catheter is not intact then, as well as the advice given previously, the following should be implemented immediately: <ol style="list-style-type: none"> Apply pressure to the location of the catheter fragment A tourniquet should be applied above this The patient should be encouraged to stay still (this prevents the fragment migrating to the heart or pulmonary system) See section on inspecting catheter
Apply sterile dry dressing to exit site and cover with an airtight dressing
Airtight dressing to remain in situ for 24 hours. Although there appears to be no literature on air embolism following PICC removal this preventive measure will ensure that it does not occur

Table 9. Removal of peripherally inserted central catheters when venous spasm has occurred

Action	Rationale
Apply slight tension and retape	Slight tension at the point of venous spasm will, when the venous spasm has subsided, then allow for easy removal of the device
Apply a warm compress to entire arm for 20 minutes	Local heat encourages vasodilation
Remove compress, apply tourniquet under axilla (above estimated catheter tip)	Venous spasm will occur in the upper arm veins. Applying the tourniquet high will prevent further irritation of the vein and encourage venous dilation by filling
Apply gentle traction at the skin exit site	To prevent fracturing the catheter
If still stuck, try infusing warm saline via a cannula inserted lower down the arm in the same vein, apply glycerol trinitrate patch below vein, mental relaxation and distraction can help reduce fear which can produce venous spasm, drinking a warm beverage, wrist and hand exercises to encourage muscle movement	These are all methods to reduce venous spasm and encourage venodilation
If the catheter does not come out after another 30 minutes a chest/upper arm X-ray should be arranged	This will ensure the catheter is not coiled
If no coiling continue reducing the venous spasm with the above methods and try to remove in 24 hours	If no coiling of the catheter has occurred then the only reason for the PICC to be stuck is venous spasm
If the catheter still cannot be removed a surgical cutdown may be needed which will require a surgical referral (Wall and Kierstead, 1995)	The only other way to remove a PICC other than gentle traction is via a surgical cutdown performed by the surgeon

Gentle pressure to the exit site

This prevents bleeding and air aspiration. As long as clotting is normal pressure should be applied for 5 minutes to stop bleeding, although air aspiration needs to be prevented for 24 hours. Both vein exit site (and tunnel) should be occluded as it is difficult with veins such as the subclavian (commonly used with tunnelled, cuffed CVCs) to locate them beneath the clavicle. The vein may not then be occluded and air could enter via the tunnel made by the catheter.

Catheter inspection

The catheter should be complete with no ragged edges. If it is not intact:

- Get medical assistance immediately
- Request urgent portable chest X-ray (to detect remnants of catheter)
- Monitor for signs of respiratory or cardiac distress (tip may migrate to the heart and pulmonary system)
- Act upon changes to ensure patient safety.

Dressing

Maintaining asepsis of the site is continued with the application of a sterile dressing (Mennim et al, 1992). An airtight dressing should be applied directly afterwards. The first time a patient sits

up or takes a deep breath the CVP will be increased to above air pressure. The airtight dressing will prevent air being sucked in while the vein and the exit site seal. There have been reports of air embolism occurring hours after removal when a non-airtight dressing has been applied (Phifer et al, 1991). These emboli are associated with the patient having taken a deep breath in (McCarthy et al, 1995).

Maintain lying position for 30 minutes

Changes in CVP as the patient sits up can restart bleeding from the vein. During this time any neurological deficits, swelling, or other symptoms can also be detected and acted upon (Walden, 1997).

REMOVAL OF SHORT-TERM CVCs

Table 6 illustrates the suggested, research-based, procedure for the removal of short-term CVCs.

REMOVAL OF TUNNELLED, CUFFED CVC (OFTEN KNOWN AS HICKMAN LINE)

A tunnelled CVC will often have a cuff surrounding the catheter within the tunnel. The

aim of this cuff is to adhere to the tissues and prevent accidental removal of the catheter. It can take from a few days to 3 weeks to become secure. Before removal the practitioner should be aware of what type of CVC has been inserted.

Some practitioners advocate that gentle traction should be exerted on the catheter until the cuff detaches from the soft tissues, thus permitting device removal (Fan, 1998). However, even the author of this statement admits that this can cause catheter fracture and the catheter should be carefully inspected to ensure that it is intact. This procedure for removal of tunnelled CVCs is not used in all hospitals. If the catheter fractures there is a great risk of both air embolism and blood loss (depending on the position and hydration of the patient) as the catheter will be open to the air. Also, if the catheter fractures distal to the cuff there is a risk of catheter embolization into the heart.

In the author's opinion, this is not a risk worth taking. The safest, and indeed most comfortable, means of removal for the patient is to dissect the cuff away from the tissues. This procedure is explained in *Table 7*.

REMOVAL OF PICCS

Removal of PICCs (often known as long lines), unlike the other CVCs, is described in the literature but with particular regard to complicated PICC removal (Marx, 1995; Wall and Kierstead, 1995). It is, however, a procedure that can be done very safely on the ward (following practice and supervision) as long as a few basic principles are followed. *Table 8* gives the suggested removal procedure.

THE PROBLEM PICC REMOVAL

Venous spasm

Mechanical vein irritation can occur after the removal of the PICC has begun resulting in contraction of the muscular fibres and venous spasm. This spasm can be so intense that it prevents the movement of the catheter, thus preventing removal in 1% of cases (Wall and Kierstead, 1995). Venous spasm usually occurs with those PICCs inserted for a shorter time frame (less than 15 days), although other reasons for difficulty in PICC removal after longer insertions have been suggested as phlebitis and thrombophlebitis, valve inflam-

mation, infection, thrombus formation, and vasoconstriction (Wall and Kierstead, 1995). Removal following venous spasm is considered in *Table 9*.

Painful PICC removal

Phlebitis can make a PICC removal painful as the vein is already irritated (Marx, 1995). Before removing a PICC where phlebitis is evident a warm compress should be applied to the arm for 30 minutes. This will cause vasodilation and reduce the further irritation of the vein during removal.

CONCLUSION

As can be seen from this article there are many potential complications associated with CVC removal. However, these complications, with a mortality rate of 57% (Kim et al, 1998), are often preventable. Serious thought should be given as to who performs this task and what training and supervision is needed. Practitioners should follow the simple procedures outlined to ensure that safe, research-based, high quality care is given whenever a CVC is removed. **BJN**

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KEY POINTS

- There are many complications associated with removal of a central venous catheter (CVC).
- When complications occur there is an overall mortality rate of 57% (Kim et al, 1998).
- Many complications of CVC removal are preventable.