HAEMODYNAMIC MANAGEMENT

Navigating CVCs: An Informative Refresher

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CONTENTS

Article 1:
UNDERSTANDING CVCs: ROLES, ANATOMY, AND DEVICE SELECTION

Vascular access is the most common procedure that patients in tertiary care undergo and, with recent improvements and advances in technology, the choices of devices and insertion techniques have evolved. It is therefore important that education and training is available to assist practitioners in this field[1].

Central Venous Catheters (CVCs) are tools in modern healthcare, enabling the administration of medications, fluids, and nutrition, as well as facilitating haemodynamic monitoring. While central venous catheters have been used in clinical practice for decades, their role within vascular access is evolving rather than expanding. The use of acute CVCs is generally not increasing; in fact, some organisations now favour PICCs and midlines as safer alternatives for medium-term therapy. However, CVCs remain essential in critical care, haemodynamic monitoring, rapid resuscitation, and situations where peripheral or midline access is not suitable.

This article explores the responsibilities of healthcare professionals, the anatomical and physiological considerations for CVC placement, and the criteria for selecting the appropriate device.

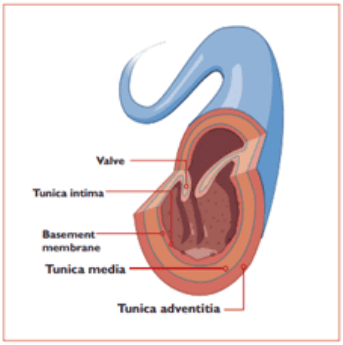
Evolving Roles of Nurses and Advanced Healthcare Practitioners (AHPs)

Over recent decades, the responsibilities of nurses and allied health professionals have expanded in response to healthcare system reforms, workforce shortages, and technological advancements. This shift has been driven in part by Working Time Regulation initiatives such as the European Working Time Directive[2] and Modernising Medical Careers[3].

In response to these changes in professional boundaries, Critical Care and ICU Nurses and AHPs now play a pivotal role in inserting CVCs under local competency, governance, and medical oversight, with no external training support. This is also due to additional factors including an ageing population, increased consumer expectations, technological advances, and growth in radiological procedures. Their involvement not only enhances service efficiency but also improves patient outcomes by ensuring timely and skilled catheter placement.

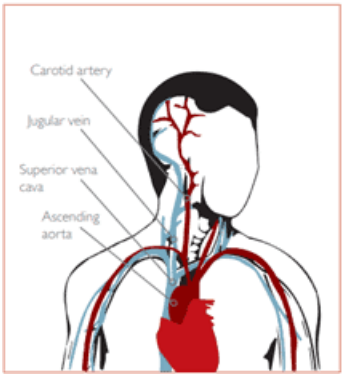
Legal and Ethical Responsibilities

With expanded roles come increased legal and ethical responsibilities. Nurses are accountable to the Nursing and Midwifery Council (NMC)[4], while AHPs are governed by the Health and Care Professions Council (HCPC)[5]. Both regulatory bodies emphasise the importance of maintaining up-to-date knowledge and skills, particularly when undertaking advanced procedures such as CVC insertion.



Venous Anatomy and Physiology

A thorough understanding of venous anatomy is essential for safe and effective CVC placement. Veins are composed of three layers: the tunica intima (inner), tunica media (middle), and tunica adventitia (outer). The integrity of the tunica intima is particularly important, as trauma can lead to thrombosis and other complications[6].



CVCs are typically placed in central veins such as the superior vena cava (SVC), inferior vena cava (IVC), or right atrium. Access is usually gained via peripheral veins like the internal jugular, subclavian, or femoral veins, using the Seldinger technique for correct placement. Correct tip placement, ideally in the lower third of the SVC or upper right atrium is crucial to minimise risks such as thrombosis, cardiac tamponade, and catheter malfunction[7,8,9]. Understanding this anatomy is critical in preventing complications such as malposition, venous injury, or arrhythmia during CVC placement.

Types of CVCs and Selection Criteria

CVCs vary in design, material, and functionality. Selection should always be tailored to the clinical indication, expected duration of therapy, and individual patient factors. Different catheter types offer distinct advantages in specific situations.

Common types of CVCs include:

Polyurethane catheters for short-term access.

Polyurethane provides a good balance of strength and flexibility making it suitable for acute settings such as critical illness, perioperative care, or short inpatient stays where high flow rates are required. They are generally preferred when rapid infusion, vasopressor administration, or frequent blood sampling is expected.

Antimicrobial catheters with silver ion technology.

These are selected when the patient has an increased risk of infection such as in intensive care units or oncology patients with prolonged neutropenia. Silver ion coatings help inhibit microbial colonisation at the insertion site and intra-luminally, lowering the incidence of catheter-related blood stream infections, and without risk of chlorhexidine allergy or anaphylaxis.

Antibiotic-impregnated catheters for high-risk patients[10].

These are typically used in high-risk patients, for example, those with repeated line infections, those requiring long dwell times, or when the consequences of infection would be severe. They may provide additional protection in environments with high catheter use or limited line replacement opportunities.

Rationale For Selecting Specific Catheter Features:

Number of lumens: Based on the need for multiple infusions.

Choosing the correct number of lumens at the start of treatment is essential.

Multi-lumen CVCs allow simultaneous delivery of incompatible medications, blood products, parenteral nutrition, and high-flow infusions.

Using a multi-lumen catheter from the outset reduces the need for adding extra lines later, which decreases cumulative insertion risks such as bleeding, infection, and mechanical complication.

Starting with a single-lumen catheter and later adding additional access points increases patient discomfort, requires more staff time, and exposes the patient to further procedural risk.

A three-lumen CVC is commonly selected in critical care because it provides sufficient versatility without compromising line diameter for high-flow infusions.

A five-lumen high-flow CVC is also a consideration to avoid the need for the use of multiple insertion sites (Want to read more? Visit our Article; Why Use 2 when One Will Do. www.campusvygon.com/uk/articles/central-venous-access-in-cardiac-surgery-why-use-two-when-one-will-do/)

Length: Determined by insertion site and patient anatomy[11].

The ideal length depends on the insertion site and patient anatomy.

- Shorter catheters are suitable for internal jugular or subclavian insertion where the path to the superior vena cava is short.
- Longer catheters may be required for femoral access or in taller patients to ensure the tip reaches the correct central position. Optimal tip placement reduces the risk of thrombosis, arrhythmia, and malposition.

Material and coating: To reduce infection risk and improve biocompatibility[12].

Material choice can influence complication rates.

Polyurethane offers durability and kink resistance.

Silicone is more flexible and biocompatible, often used for long-term devices but less ideal for high-pressure infusions.

Antimicrobial or hydrophobic surface coatings reduce bacterial adhesion and biofilm formation, which is particularly beneficial for patients requiring long-term CVC support.

Contraindications and operator considerations[13]

Contraindications such as coagulopathy, local infection at the intended insertion site, or thrombosis must be assessed prior to placement. The experience of the operator also strongly influences safety and success. Skilled placement minimises complications like arterial puncture, malposition, and pneumothorax, while also improving first-pass success rates and overall patient comfort.

Conclusion

The landscape of CVC use is evolving, with nurses and AHPs taking on increasingly complex roles in their placement and management. Understanding the legal framework, anatomical considerations, and device options is essential for delivering safe, effective care. With appropriate training and adherence to best practice guidelines, healthcare professionals can ensure optimal outcomes for patients requiring central venous access.

Clinicians must work within the scope of their professional registration. Doctors are accountable to the General Medical Council (GMC), nurses to the or the Nursing and Midwifery Council (NMC), and advanced healthcare practitioners to the Health and Care Professions Council (HCPC), and should be familiar with their relevant guidelines and developments. Specific competency levels required for CVC insertion are listed in the Anaesthetic and ICM Curricula (ROCA). Use of Vascular Access Devices can result in harm to patients and negative outcomes. Vygon (UK) Ltd accepts no liability for the content of this series or the consequences of any actions taken on the basis of the information provided.

Article 2:

PREPARING FOR CVC INSERTION: PATIENT ASSESSMENT, CONSENT, AND PAIN MANAGEMENT

Understanding the patient's condition before inserting a medical device is a vital step in ensuring safe and effective care. This involves a thorough assessment to determine suitability and identify any potential risks. Equally important is recognising the factors that could lead to complications during or after the procedure, allowing for proactive measures to be taken and improving overall outcomes.

Pre-Procedure Patient Evaluation

Before inserting a central venous catheter, obtaining a thorough patient history is essential. This will directly influence device selection, insertion, site choice, and overall safety. Understanding the patient's general health, comorbidities, full blood count, and vascular access history provides a clearer picture of potential risks and helps prevent complications.

A key part of this assessment is reviewing previous long-term or repeated vascular access. Prior lines may have altered the patient's venous anatomy, increased the risk of stenosis or thrombosis, or resulted in complications that should guide future decisions.

Before insertion, clinicians should gather information on:

- **Previous devices used** – Identifying whether the patient has had PICCs, CVCs, ports or dialysis catheters helps determine which vessels could already be compromised. This prevents repeated cannulation of a vein that may be narrowed or damaged, maintaining long-term vascular health.
- **Any complications associated with those devices** – A history of catheter-related bloodstream infection, thrombosis, occlusion or malposition alerts the clinician to potential risks during a new insertion. This may lead to choosing an antimicrobial or antibiotic-impregnated catheter, altering the insertion site, or involving a more experienced operator.
- **Previous insertion sites** – Knowing where previous catheters were placed helps avoid overusing one anatomical area. Recurrent use of the same vein increases the likelihood of stenosis or scarring. Documentation of successful or difficult sites guides a more informed choice and can reduce procedural time and patient discomfort.
- **Reason for removal** – If the prior catheter was removed because of infection, malfunction or intolerance, similar problems may occur again. This information steers decisions on catheter type, number of lumens, material and the need for antimicrobial protection.

Why This Matters

Each element of the patient's access history influences the immediate plan and protects their future venous access options. A well-informed approach reduces the risk of avoidable complications, supports better line longevity, and ensures that clinicians select the most suitable catheter for the patient's clinical needs.

Laboratory Assessment

Before device placement, a laboratory assessment is useful to identify any factors that may increase the risk of complications, for example, consider coagulation factors and treat appropriately before inserting a CVC.

Consent

Consent is a critical component of ethical practice. Written informed consent must be obtained for all invasive procedures, ensuring patients understand the risks, benefits, and alternatives[14].

Every adult must be presumed to have the mental capacity to consent or refuse treatment, unless they are unable to: take in or retain information, understand the information provided, or weigh up the information as part of the decision-making process. Nurses and midwives have three over-riding professional responsibilities with regard to obtaining consent (NMC, 2015): ensuring that the care of people is their first priority and they gain consent before beginning and treatment or care; that the process of establishing consent is rigorous, transparent and demonstrates a clear level of professional accountability; and that all discussions and decisions relating to consent are recorded.

Practitioners must also be aware of variations in consent laws across the UK and adhere to local and national guidelines. For example, in Scotland, The Adults with Incapacity Act 2000, provides ways to help safeguard the welfare and finances of people who lack capacity, protecting adults (people aged 16 or over) who lack capacity to take some or all decisions for themselves, including those with inability to communicate a decision, allowing a relative, friend or partner to make decisions on their behalf[15].

Pain Management

In addition to understanding the patient's history and gaining their informed consent, it is important to consider their comfort during the procedure.

Studies have shown that adequate patient assessment can lead to more effective pain control and fewer post-operative complications. The pain receptors of the skin and other tissues are all free nerve endings. There are pain receptors throughout the superficial layers of the skin as well as in some tissues (arterial walls and joint surfaces). The skin is therefore a very sensitive organ as at any single point on its surface there could be at least three different networks of nerve fibres running across it[16].

Pain signals can be fast and sharp or slow and chronic.

- **Fast and sharp** – Transmitted by either thermal or mechanical pain stimuli and transmitted in the peripheral nerves to the spinal cord by small type Aδ fibres.
- **Slow and chronic** – Transmitted mainly by chemical pain stimuli but can be caused by persistent mechanical or thermal stimuli. It is transmitted by C fibres[17].

To minimise any discomfort and pain during CVC insertion, there are two main techniques, using local anaesthesia and providing psychological support to the patient, which when used together, can help to effectively reduce the pain of CVC insertion. This discomfort is typically felt as a significant amount of pressure for example, when vessel dilators are used.

Local anaesthesia provides an effective, economical and rapid pain relief for this procedure direct to the site of cannulation and is administered immediately prior to the procedure. Lidocaine is the most commonly used injectable local anaesthetic and comes in different concentrations (.05%, 1% and 2%).

It is also important to consider the potential risks of administering local anaesthesia, which include; allergic reactions, anaphylaxis, inadvertent injection into the vascular system, and obliteration of the vein[18].

In addition, using diversion strategies, for example, breathing techniques throughout the insertion, can also be an effective method (when used in conjunction with anaesthesia), to help the patient relax as it can lessen the awareness of pain or discomfort. It is important therefore to ensure the patient receives necessary top ups of anaesthesia and adequate psychological support[19].

Additional Considerations

Some additional considerations when assessing the patient are:

- **Clinical status** - Most patients will be in a stable condition, but acute illness increases complication risk[19].
- **Allergies** - Systematic and topical allergies appear to be increasing. In relation to CVC insertion, this could be related to chlorhexidine. This is becoming an increasing issue with reports of anaphylaxis[20]. Patients may also display allergies to dressings, latex etc. Allergies can range from a skin rash through to full anaphylaxis. Appropriate medical advice should be sought if an allergy does occur and this should be reported, highlighted and documented.
- **General physical assessment** - Respiratory, cardiovascular, neurological, muscular–skeletal and vascular assessment as issues related to these systems can have an impact on the successful placement and function of a CVC.
- **Patient cooperation** - Confusion or lack of cooperation can complicate the procedure.

Conclusion

A thorough pre-procedure evaluation is essential for the safe and effective insertion of a central venous catheter. By carefully reviewing the patient's medical history, previous device use, and laboratory results, clinicians can anticipate and mitigate potential risks. Additional factors such as allergies, clinical stability, and patient cooperation must also be considered to ensure optimal outcomes. This comprehensive approach supports informed decision-making and enhances patient safety throughout the procedure.

Article 3:
INFECTION PREVENTION AND ASEPTIC TECHNIQUES

Infections related to central venous catheters remain a significant cause of healthcare-associated bacteraemia and septicaemia[21]. Infections from central venous catheters can come with a significant risk of morbidity and mortality. It is important therefore to understand the risks and how to mitigate them. To do this we must understand how bacteria can form in relation to CVCs.

Classification of Infections

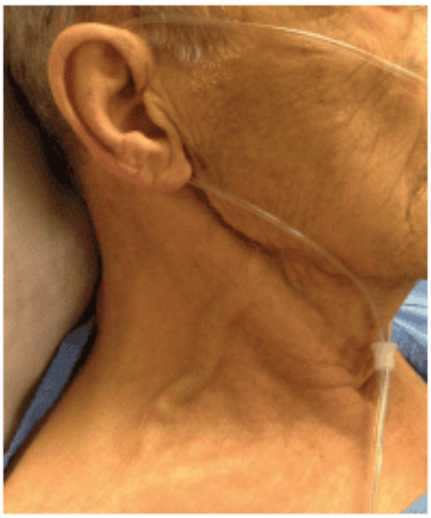
Vascular access catheter infections in relation to CVCs can be broken down into two types; local infection and systemic infections[22]. With both of these types of infections, there are multiple risk factors to consider, these are:

- Age
- Genetics
- Immunosuppression
- Immunocompromised
- Loss of skin integrity
- Multiple invasive procedures
- Antibiotic therapy
- Presence of distant infection
- Poor nutrition.

Microorganisms

Microorganisms are everywhere and can come from human skin or the general environment. As humans we liberate microorganisms through acts such as coughing. Skins scales are always being eliminated during desquamation, and these can be carried through the air while bed making etc[23].

The skin is the main source of bacteria responsible for IV associated infections and therefore requires meticulous preparation. It is important to note, when preparing a patient for CVC insertion, it is difficult to remove all microorganisms from the skin with friction, one of which, resident flora (S.aureus and S. epidermidis), is a major cause of IV infections. Different parts of the skin contain different amounts of and types of flora and this is often determined by the moisture factor.



While resident flora plays an important role in the prevention of colonisation of the skin by other potentially pathogenic organisms through the physical advantage of previous occupancy, competing for essential nutrients, and producing inhibitory substances such as fatty acids which discourage other species of organisms from evading. It can spread into previously sterile parts of the body, for example, when the body is breached by an IV device. It can also be disturbed after administration of antibiotics which can then lead to an overgrowth of potentially pathogenic resident microorganisms[24].

Colonisation of Microorganisms

The microorganisms most commonly associated with CVC infection are coagulase-negative staphylococci, S. aureus, different species of aerobic gram-negative bacilli, and C. albicans. These bacteria can colonise a CVC in multiple ways causing catheter related bloodstream infections and phlebitis, which have serious complications.

These can arise from numerous routes, including;

- **Extraluminal colonisation** – Bacteria which originates from the skin migrates along the outside surface of the CVC. It usually occurs during insertion of shortly after. Typically, this arises due to inadequate skin disinfection for insertion and during dressing management.
- **Haematogenous seeding of the catheter tip** – Bacteria which is already present in the bloodstream attach to the catheter tip causing a secondary infection. This bacterium usually comes from a pre-existing infection.
- **Intraluminal colonisation of the hub and lumen of the CVC** – Bacteria enter and grow inside the CVCs lumen or hub where the IV lines connect after insertion. This is due to poor aseptic technique during device insertion, during care, and whilst maintaining device access, for example contaminated hands, improper handling, or non-sterile equipment.
- **Poor device securement** – Causing catheter movement and friction, see Article 7: on page 21. Inadequate device site selection (areas of flexion), or from moisture, heat and hair at insertion site.

Other risk factors include:

- Type of catheter used
- Method and site of insertion
- Purpose of use
- Level of aseptic technique.

Preventing colonisation involves strict aseptic technique, regular site care, and early removal of unnecessary catheters.

Routes of Infections

Extraluminal

This refers to the migration and entry of bacteria down the insertion site on the external surface of the catheter. The bacteria can originate from the air, or the skin of the patient or healthcare worker, also from dressings etc.

Intraluminal

This refers to entry through the infusion system, usually via fluids or additives. The catheter hub is also a source, and this can occur during manipulation.

Haematogenous spread

This is the migration of organisms from a distant site of infection e.g. bowel or lungs, wound or stoma etc. This means the catheter is colonised from a remote unrelated site.

Contaminated infusates

This refers to the intravenous fluids or medications that have been tainted by harmful microorganisms such as bacteria or fungi. They pose a serious risk of infection, including bloodstream infections and sepsis, especially in vulnerable patients.

Infection Prevention and Aseptic Techniques

It is important to ensure proper infection prevention techniques are employed, including hand hygiene, and aseptic non-touch techniques and surgical scrub. Most transient microorganisms found on the skin can be removed by washing with soap and water, whilst resident microorganisms will be reduced by washing with an antiseptic detergent[25]. Despite scrupulous cleaning, the skin can never be rendered sterile, the aim of these techniques is to make sure the skin is socially clean.

Hand Hygiene

An effective handwashing technique involves three stages: preparation, washing and rinsing, and drying.

For preparation, wet hands under tepid running water before applying liquid soap or an antimicrobial preparation. The hand wash solution must come into contact with all of the surfaces of the hand. The hands must be rubbed together vigorously for a minimum of 10 to 15 seconds, paying particular attention to the tips of the fingers, the thumbs and the areas between the fingers. Rinse hands thoroughly before drying with good quality paper towels.

When decontaminating hands using an alcohol hand rub, ensure that hands are free from dirt and organic material. The hand rub solution must come into contact with all surfaces of the hand. The hands must be rubbed together vigorously, paying particular attention to the tips of the fingers, the thumbs and the areas between the fingers, until the solution has evaporated and the hands are dry.

Apply an emollient hand cream regularly to protect skin from the drying effects of regular hand decontamination. If a particular soap, antimicrobial hand wash or alcohol product causes skin irritation, consult an occupational health team[26].

Aseptic Non-Touch Technique (ANTT®) and Surgical Scrub

ANTT® is a method to prevent contamination of wounds and other sites by ensuring that only sterile items come into contact with the insertion site. The environment for the procedure should also be as clean as possible[27]. It must be used for all medium to long term vascular access device insertions, for site care and for accessing the system. There are two main types of ANTT®: Standard ANTT® and Surgical ANTT®.

Surgical ANTT® should be used for all vascular access device placements and includes the use of gown, gloves and sterile surgical drapes[21].

Sterile ANTT® is suitable for drug administration, phlebotomy and cannulation[28].

Cutaneous Antisepsis

Skin preparation is of great importance in reducing the risk of site infection. The choice of solution for skin cleansing is also important and it is imperative to meticulously cleanse the venous insertion site prior to catheter insertion.

The choice of an effective antiseptic solution to disinfect the insertion site before catheter placement and during subsequent care is one of the most important measures[29].

The most recent EPIC 3 guidance[21] and CDC guidelines[30] suggest that chlorhexidine solution greater than .05% in 70% alcohol is adequate for cutaneous preparation.

Conclusion

Preventing these infections requires a comprehensive approach that includes meticulous aseptic technique, effective hand hygiene, appropriate skin antisepsis, and adherence to ANTT® principles. Understanding the routes of microbial entry and the role of both resident and transient flora is essential in reducing the risk of colonisation and subsequent infection. By addressing both procedural and patient-related risk factors, healthcare professionals can significantly improve patient outcomes and reduce catheter-related complications.

Article 4:
FOUNDATIONS OF ULTRASOUND PHYSICS AND APPLICATIONS

The safe and effective insertion of a central venous catheter (CVC) requires a solid understanding of both the theoretical and practical aspects of the procedure. This includes a foundational knowledge of ultrasound physics and the ability to apply ultrasound guidance accurately during catheter placement. Clinicians must also demonstrate the competence and confidence to perform the insertion itself, while ensuring appropriate post-procedure care and thorough documentation. Together, these elements support high standards of patient safety and clinical practice.

An Introduction to Ultrasound

An early meta-analysis concluded that ultrasound guidance significantly reduced placement failures[31]. In addition, the analysis showed a decrease in complications. Alternative meta-analysis provided evidence which supported the use of two-dimensional ultrasonography for central venous catheter placement[32]. More recently, similar results demonstrated both an increased first puncture rate in addition to an increased successful catheter insertion[33, 34].

From these few studies it could be suggested that the evidence to use ultrasound guidance is compelling. However, we have to be aware that, when introducing new technologies, there is always a learning curve and during this time complication rates can increase[35].

Ultrasound training is now recommended as part of CVC placement training[36, 37]. In addition to simulation training a good knowledge of the physics of ultrasound and how this relates to image production and interpretation is deemed necessary[38].

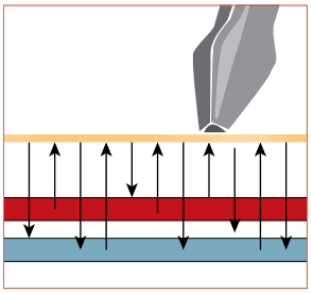
The National Institute for Clinical Excellence (NICE) further reiterates this by stating, "The use of two-dimensional (2-D) imaging ultrasound guidance should be considered in most clinical circumstances where CVC insertion is necessary either electively or in an emergency situation"[39].

As the use of ultrasound guidance to place central venous catheters requires a competent and experienced operator[40], training for all nurse specialists is paramount.

Current guidelines state: "It is recommended that all those involved in placing CVCs using two-dimensional (2-D) imaging ultrasound guidance, should undertake appropriate training to achieve competence"[41].

Basic Ultrasound Physics

Ultrasound is sound energy in the form of waves that have a frequency above the range of human hearing. The human ear can detect up to approximately 20,000 cycles per second (20,000Hz), at this point sonic range ends and the ultrasonic range begins.



Ultrasound is used to locate objects by similar means echolocation used by bats, whales and dolphins as well as sonar used by submarines.

In ultrasound medical imaging, the following occurs:

- High frequency sound waves from the machine are transmitted through a medium into the body via a transducer
- As the sound waves travel into the body, they hit structures (boundaries) such as fluid, soft tissue or bone
- Some of the sound waves are reflected back to the transducer while some travel on further until they reach another boundary and at this point, they are reflected back
- Reflected waves are picked up by the probe and relayed back to the machine
- By using the speed of sound in tissues, the machine is able to calculate the distance from the probe to the tissue or organ (boundaries) and the time of each echo's return
- The two-dimensional image displayed on the machine reflects the distance and intensities of the echoes
- All of the above occur simultaneously in real time scanning.

Transducer (Probe)

The probe transmits and receives the ultrasound beam on contact with the patient's skin. It takes a thin slice of the object being imaged. Rotate or angle to change views. It is important to note that the length of the transducer face is only 1mm thick. The length of the beam is dependent upon the selected depth. The markings on the transducer provide a guide to the orientation.

When performing an ultrasound guided puncture, the needle must remain in the ultrasound beam to ensure it is visible on the screen at all times.

Orientation

Most ultrasound machines have markers to allow correct orientation. This may be in the form of a groove on the side of the transducer. This groove teams up with an orientation maker on the ultrasound screen. If orientation is incorrect, this can lead to confusion as when the probe is moved to the left, the image will move to the right. Therefore, correct orientation is important.

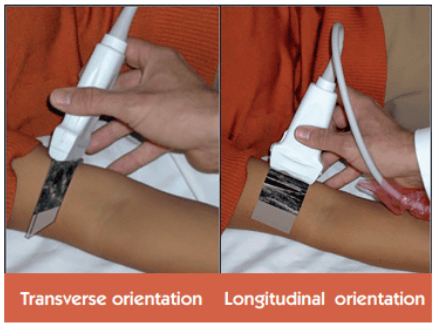
Another simple way to ensure correct orientation is to touch the side of the transducer with your finger. On the screen a flicker will appear which indicates the orientation of the transducer.

Transverse

In transverse orientation the vessel will appear round. If a puncture is performed in the centre of the probe, this will lead to a puncture in the centre of the vessel.

Longitudinal

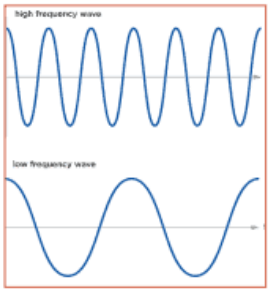
A longitudinal orientation will display the vessel as a line. Puncturing at this angle will allow the guidewire to be followed some way along the vessel.



Transverse orientation Longitudinal orientation

Frequency

It is important to use the highest frequency transducer that will reach the depth required. In vascular access the vessel depth is usually relatively superficial, so a high frequency probe will result in less depth, whereas a low frequency probe will result in more depth.



Blood Vessel Characteristics on Ultrasound

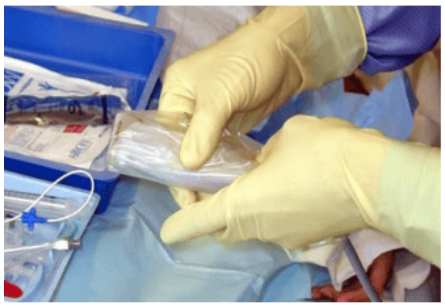
As well as allowing visualisation of the vessels, ultrasound can confirm patency of the vessel. A thrombosed vessel will not compress. In addition, the vessel will appear white instead of black on the screen.

	Vein	Artery
Appearance	Black	Black
Movement	None	Pulsating
Compressibility	Yes	No
Size	Usually larger than an artery	Usually smaller/rounder than a vein

Gain

This control improves the vision on the screen. It is similar to a brightness control and should be used to enhance the appearance prior to puncture. This control can be near gain, which will change the appearance at the top of the screen. Far gain will adjust the appearance at the bottom of the screen and, finally, there will be the option of changing the overall gain of the whole screen.

Probe Preparation



One of the most important pre-scanning aspects is the preparation of the probe. Ultrasound requires a couplant to allow waves to transmit. Ultrasound gel needs to be placed within the ultrasound probe sheath cover as well as to the skin surface to ensure optimal visualisation. Air within the sheath cover will lead to a poor view, which may reduce puncture success rate. This procedure may require two people, one who is scrubbed whilst the other would not be. It is important to ensure air free coupling between all surfaces.

Some Common Mistakes When First Using Ultrasound

- Watching your hands instead of the screen
- Holding the ultrasound probe incorrectly
- Collapsing the vein with probe pressure
- Puncturing at the wrong angle.

Conclusion

Ultrasound guided puncture can be a hugely beneficial skill which enhances both the safety and accuracy of vascular access procedures, including CVC insertion. Following best practices can significantly improve outcomes and puncture success rates and reduce complications discussed in earlier articles, such as obliteration of the vessel. Using the advice set out above, outlining key steps and considerations for practitioners to develop confidence and competence in using ultrasound for guided puncture.

Article 5:

CENTRAL VENOUS LINES: INSERTION TECHNIQUES AND PAIN MANAGEMENT

Insertion of central venous lines is becoming more commonly undertaken by specialist nurse-led units[42,43]. To reduce complications, it is imperative these are only placed by experienced, trained and competent operators[36,44]. Most guidelines now advise that, in all cases of CVC insertion, the use of ultrasound is beneficial, decreasing the risk of complications on insertion[45], decreasing the number of needle punctures, complications, and subsequently increasing insertion success rates[44].

CVC Insertion Technique – Seldinger Technique

There are several different methods of central venous line placement. In all cases, the vein of choice is directly punctured and the skin entry site dilated to allow easy insertion of the device. To ensure the procedure is as pain free as possible adequate anaesthesia is necessary. Using a Seldinger Technique, CVC insertion can be performed with ultrasound guidance, which comes strongly recommended, or with a landmark technique[41, 44, 45].

CVC Insertion

Equipment Required

- Clean dressing trolley
- Sterile dressing pack
- Sterile gown
- Sterile gloves
- Sterile drapes
- 2% chlorhexidine with 70% Isopropyl Alcohol (Chloraprep to cleanse the skin)
- CVC kit - Choose a CVC with the least number of lumen required and which is an appropriate length
- Securing device (SecurAcath®)
- Semi-permeable clear dressing
- 10mL luer-lock syringe
- 10mLs ampoule of 0.9% Sodium Chloride
- Sharps container
- Disposal bag
- Documentation
- Local anaesthetic

Central Line Insertion

Trolley setting and scrubbing up

The trolley will be cleaned with alcohol and set using a surgical ANTT®. Hands will be washed using a surgical scrub technique and in accordance with the infection control manual. Wear a scrub suit, theatre gown and sterile gloves, hat and mask[46]. Consider the use of standard CVC insertion packs.

Patient positioning

The patient should lay flat on a bed, trolley or theatre table. The head should be tilted down about 15-30° in Trendelenburg position. This will allow good vein filling and help prevent air embolism. Arm boards should be used where available. No patient should be left unattended on the table or trolley.

Monitoring

All patients should have blood pressure, pulse, oxygen saturations and ECG recorded during the procedure. If awake, inform the patient that this is routine.

Cleaning and draping

The target vein should be identified prior to cleaning and draping the area. The patient's neck and upper chest are cleaned using chlorhexidine 2% in 70% alcohol for 30 seconds. This must be left to dry fully to ensure effectiveness. A fenestrated drape is placed over the patient allowing access to the access site. The patient should be completely draped to help prevent infection during insertion[41].

Locating target vein

The three central veins most commonly used for catheter insertion are the femoral vein, the internal jugular vein, and the subclavian vein.

Ultrasound guided puncture

Ultrasound guidance should be considered for all CVC insertions[46]. The veins can be easily identified and assessed. Visualise the target vein on the right-hand side and checked for size and patency. If the vein is too small, or appears thrombosed, the left side should be checked. Using light pressure with the probe on the skin, observe how the vein is readily compressed whilst the artery remains patent.

Landmark technique

If ultrasound is not being used, determine the vein into which the catheter will be inserted using external landmarks.

Internal jugular vein

For access via the IJ the most popular method is the "median" approach. The key landmark is the apex of the triangle formed by the sternal and clavicular heads of the sternocleidomastoid muscle. When the patient's head is turned away from the insertion site, this triangle becomes relatively easily identified. The needle is inserted at the apex at an approximately 30-degree angle with the skin and is directed toward the ipsilateral nipple.

Subclavian vein

The subclavian veins lie just beneath the clavicles but cannulation of this vein is associated with complications. The most commonly used approach to the subclavian is the so-called infraclavicular approach. The insertion site is the junction of the distal and middle thirds of the clavicle. This site should be approximately 1cm from the lateral border of the clavicular head of the sternocleidomastoid. The needle is inserted into the skin and the tip is directed toward the sternal notch. The needle is then guided beneath the clavicle while still directed toward the notch.

Femoral vein

To identify the correct site for femoral insertion, identify the arterial pulse 1 to 2cm distal to the inguinal ligament. A towel roll placed beneath the ipsilateral buttock can improve exposure. The correct site for insertion is 1 to 2cm medial to the femoral arterial pulse. The needle is directed along the course of the vein and at a 45-degree angle to the skin.

Administer adequate local anaesthetic

Local anaesthetic dosage should be tailored to the patient's response and the site of the administration, using the lowest effective concentration. Administer the anaesthetic via slow subcutaneous injection at a 45° angle to the dermis, allowing 60–90 seconds for the initial effect. Continue injecting through areas already affected by the anaesthetic. Always aspirate between each injection to check the needle is extra vascular. Local anaesthetic is administered via a needle to the patient; this needle is then changed for deeper infiltration.

Identifying and targeting vein using ultrasound

Cover the ultrasound probe with a sterile sheath filled with gel, smoothing out any wrinkles or bubbles over the acoustic window with a gloved finger. Apply sterile gel to the sheath. Stand behind the patient's head and position the probe transversely on the neck, maintaining light, steady contact to avoid vein collapse. Scan the vein until it is seen at its maximum diameter and/or at its greatest separation from the carotid artery and then centre it on the screen. In conscious, cooperative patients, a Valsalva manoeuvre can enlarge the internal jugular vein and ease puncture. This is explained to the patient as holding their breath while straining a stool.

Centre of probe = Centre of screen = Centre of the vein.

Puncturing the vein

Draw up about 4ml of saline into a 10ml syringe and attach a 19g needle. Insert the needle tip in the incision, just beneath the skin, then angle the needle shaft upward. If using ultrasound, focus on the screen and watch for the needle's tip (a bright white mark). Draw on the syringe plunger and, with constant aspiration, advance the needle with a short, controlled movement. Be careful not to plunge too deeply, or quickly as the anterior aspect of the vein lies barely a centimetre under the skin.

As the needle advances, the anterior vein wall will deform and invaginate springing back as it's punctured, while blood is aspirated into the syringe. Note that advancing too slowly risks a double-wall puncture as the vein walls may compress together before puncture takes place, resulting in needing to withdraw the needle into the lumen of the vein (seen as an upward tenting of the posterior wall). Once in the vein, support the syringe/needle with your dominant hand, then with your non-dominant hand set down the probe, and return it to remove the syringe and insert the guidewire.

Inserting the guidewire

The J tip of the wire should be straightened using the scud. Gently bring the needle down towards the head, and whilst holding the needle steady gently insert the wire. If there is any resistance do not force wire instead remove the wire and check, you are still in the vein by reattaching the syringe and aspirating. Changing the angle of the needle may also help. This is an appropriate moment to use screening if available. The wire should be inserted into the SVC. Keep an eye on the ECG monitor at this time, as it will show ectopic beats if you have advanced the wire too far. The needle should now be removed taking care not to dislodge the wire.

Inserting the dilator

Advance the dilator over the guidewire, always maintaining a firm grip on the wire to prevent displacement. Line yourself up so that the dilator can be pushed over the wire with ease. If resistance is felt stop and reassess. Monitor the ECG closely as inadvertent wire advancement may trigger ectopic beats. If the dilator is difficult to advance, consider using serial dilators or make a small incision in the skin at the entry site. Once the tract is adequately dilated, remove the dilator and feed the catheter over the guidewire. When the catheter is correctly positioned withdraw the guidewire.

Checking catheter patency

Using a 10 or 20ml syringe filled with saline, aspirate the line to check that there is blood return. There should be no resistance on flushing. Always use a push pause, positive pressure flush technique[47]. Heparin can be used depending on local policy. Place a needle-free device at the end of each lumen[44].

Catheter stabilisation

Follow your Trust's policy on whether to suture the CVC in place, or use a subcutaneous anchor securement system – see Article 7: on page 21

Dressing

Make sure the patient has no allergies to dressings. Apply a gauze dressing to the venous access site if there is oozing present and apply a breathable dressing. Note that the sites may ooze slightly following insertion of the catheter.

Confirmation of tip position

For CVCs inserted in the upper body, the patient will require a chest X-ray to confirm the position of the line. The tip of the line should be in the lower third of the SVC, or right atrium. Be aware that catheter position can change with patient position.

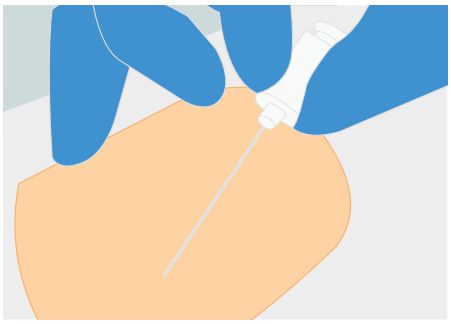
Conclusion

The successful insertion of a central venous catheter relies on a combination of technical proficiency, adherence to evidence-based protocols, and a patient-centred approach. Key procedural elements, including the administration of local anaesthesia, ultrasound-guided vein identification, and the meticulous execution of the Seldinger technique, are essential for minimising risks and ensuring catheter patency. Post-insertion practices such as securement, dressing application, and confirmation of catheter tip placement further contribute to patient safety and procedural success. In summary, CVC insertion demands a high standard of clinical practice, continuous monitoring, and thorough documentation to uphold the quality of care and reduce the incidence of complications.

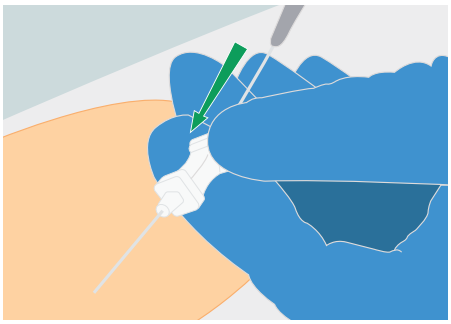
Procedure for CVC Insertion

1. Clean the insertion site, according to hospital policy

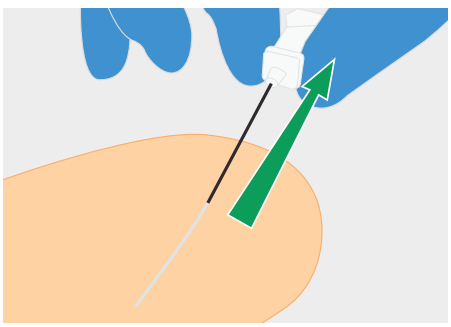
2. While using the ultrasound probe, puncture the vein with the needle



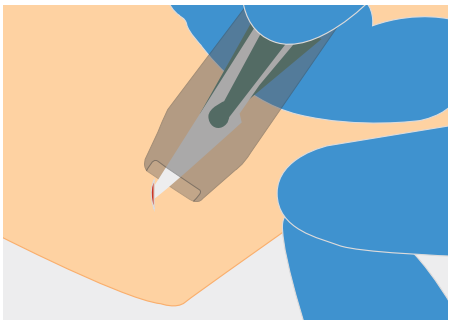
3. Once flashback is visualised, insert the guidewire



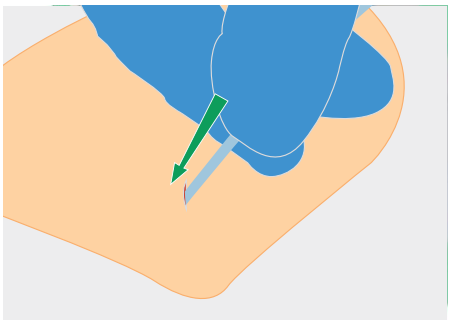
4. Remove the needle



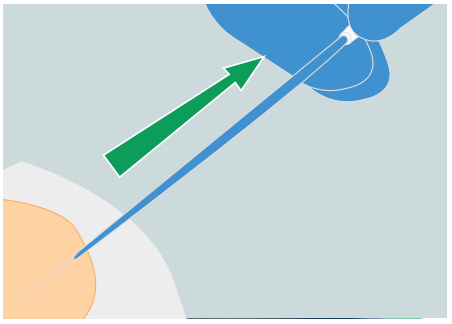
5. Make a small incision with the scalpel



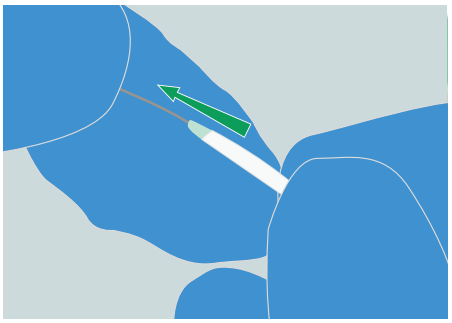
6. Insert the dilator



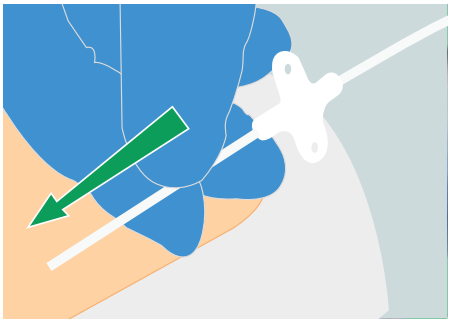
7. Remove the dilator carefully



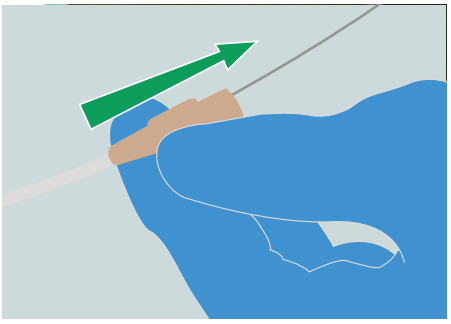
8. Insert the catheter over the guidewire



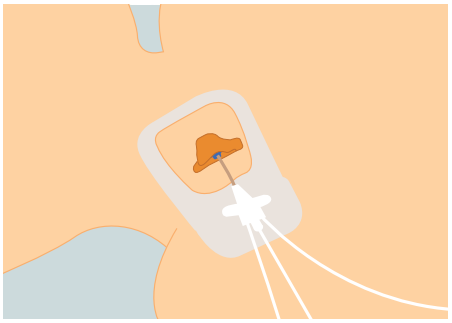
9. Insert the catheter to the hub



10. Remove the guidewire



11. Secure the catheter using sutures or an alternative securement device, such as a subcutaneous anchor securement system, following local hospital policy.



Article 6:
NAVIGATING COMPLICATIONS IN CENTRAL VENOUS ACCESS

Central venous catheter (CVC) insertion carries a risk of complications which clinicians must be prepared to manage. This article outlines common complications, their causes, methods of prevention, and appropriate clinical responses to ensure safe and effective practice.

Complications can be divided into three categories: acute, semi-acute and delayed. These can include acute or technical complications directly related to the procedure, these are:

- Infection (discussed in Article 3: on page 8)
- Arterial puncture (discussed in Article 5: on page 14)
- Arterial cannulation
- Air embolism
- Nerve damage
- Malposition and failure to place catheter.

These complications can occur despite training and experience, making them a recognised risk when inserting these catheters[48]. Additionally, quality of care issues, such as repeated insertion attempts, can cause significant patient anxiety and discomfort. It is essential that practitioners are aware of potential complications and understand how to prevent and manage them effectively[49].

Inadvertent Arterial Puncture

The differing anatomy of veins and arteries is vital to help identify them. An artery will appear rounder than a vein and when compressed an artery will pulsate, which will be seen on ultrasound.

Inadvertent arterial puncture involving a small needle (22G or 25G) is often without significant consequences[50].

However, the same injury with a large-bore catheter, can have serious consequences if not recognised, including haemotoma[50].

Identification

If an artery is punctured accidentally, it will be identifiable by bright red pulsating / spurting arterial blood. Blood can also fill the syringe on puncture.

Management

If this occurs, the needle should be removed and pressure applied for at least ten minutes to prevent haematoma formation. Pressure may need to be applied for up to 20 minutes.

Prevention

As previously mentioned, the use of ultrasound has been shown to greatly reduce the incidence of complications including inadvertent arterial puncture, as you can identify the artery with ultrasound.

Symptoms

Bright red, pulsating blood on removal of wire and dilator.

Action

- If the arterial puncture is by a needle – remove and apply pressure for at least 10 minutes, even up to 20 minutes where required[50].
- If a central line is inserted into an artery and is a large-bore CVC (7Fr or larger)[50]:
  - Leave the CVC in situ
  - Then, depending on the site of the injury, seek endovascular or surgical repair.

Air Embolism

Air can enter the venous system during or following the vascular access insertion procedure, with increased risk when using dilators which may rapidly draw air in large amounts into central circulations. This risk increases when the patient is hypovolemic, vulnerable, critically ill or breathless and gasping for air. While small volumes of air are often reabsorbed, larger volumes (3–8 ml/kg) can result in acute right ventricular dysfunction and pulmonary injury, leading to cardiogenic shock and circulatory arrest. Air entry at rates of 75–105 mL/sec is usually fatal, and symptoms may appear with 20 mL[51, 52].

Symptoms

Symptoms occur rapidly, and you will normally hear the air entering the system as a sucking sound. The patient will experience some or all of these signs and symptoms:

- Dyspnea
- Chest pain
- Tachycardia
- Hypotension
- Confusion
- Anxiety
- Lowered level of consciousness
- Neurological deficits
- Circulatory shock or sudden death.

Prevention

Valsalva Manoeuvre

This increases the pressure in the thoracic cavity. Attempting to breathe out against a closed epiglottis increases pressure in the thoracic cavity and hinders the return of venous blood into the heart. Ensure your patient is adequately hydrated where possible, as if the patient is hypovolemic this can generate an increased 'sucking' force. Use a closed CVC system and ensure vigilance during manipulation. Consider the use of luer lock connectors. Remember that air embolism can also occur following CVC catheter removal, therefore, ensure the use of an occlusive dressing following removal[51].

Management

If this occurs:

1. Do not sit patient up
2. Lie patient in the left lateral Trendelenburg position
3. Administer 100% oxygen
4. Consider intubation if respiratory distress evident
5. Terminate procedure unless access is needed urgently
6. Ensure help is sought early
7. Continuous monitoring and documentation.

Pneumothorax and Haemothorax

This in one of the most common complications of CVC insertion and is more likely to occur in emergency situations or when the device is being inserted by an inexperienced operator[53].

Symptoms

- Chest pain
- Hypotension/hypertension
- Respiratory effort (unilateral)
- Tracheal deviation.

Action

1. Chest X-ray
2. Administer 100% oxygen via trauma mask
3. Maintain, or establish, venous access Monitor (SaO2, BP, Pulse, Respirations)
4. Depending on patient condition – contact your emergency response team
5. Call Cardiothoracic surgeons.

Cardiac Tamponade

This is usually a result of damage to cardiac wall during dilator insertion. Cardiac tamponade can also occur if a catheter tip is left abutting the wall of a vessel.

Signs and symptoms

- Falling blood pressure
- Tachycardia or bradycardia
- Cold/clammy
- Feeling of dizziness
- Nausea
- Temporary loss of consciousness
- Chest pain radiating to back, shoulders and abdomen
- Anxiety
- Dyspnea/cyanosis.

Action

1. Contact the emergency response team
2. Monitor (SaO2, BP, Pulse, Respirations)
3. Oxygen 100% via trauma mask
4. Maintain or obtain venous access
5. Administer fluids
6. Arrange for a chest X-ray
7. Arrange for an ECG/Echocardiogram

Prevention of cardiac tamponade

Never force a dilator, there should be no resistance. Keep the wire moving during dilator introduction. The wire should continue to move freely.

Catheter Misplacement During Insertion

The tip of the catheter should ideally rest in the superior vena cava or upper right atrium[48, 54, 55]. Without fluoroscopy there are many methods for estimating the ideal catheter length before device insertion. Fluoroscopy screening should be used whenever available as this is the gold standard method of ensuring a device is in the correct position. It is also important to remember that the tip position should be confirmed and documented as being in the correct position prior to use.

Complications in relation to tip positioning

An incorrectly positioned catheter tip can potentially increase the risk of complications such as thrombosis or in extreme cases cardiac tamponade[48]. More commonly an incorrectly placed tip disrupts the drug infusion flow rate and can lead to Persistent Withdrawal Occlusion (PWO) which is the ability to freely deliver medication but an inability to aspirate from the catheter. PWO can also be a feature of a catheter abutting a vein wall[56].

Conclusion

In summary, while central venous catheter insertion is a routine and often life-saving procedure, it is not without risk. The range of complications, from arterial puncture and air embolism to cardiac tamponade and catheter misplacement, highlights the need for meticulous technique and clinical vigilance. Preventative strategies, such as ultrasound guidance and adherence to best practice, are essential but not infallible. Ultimately, recognising and managing complications promptly is critical to safeguarding patient outcomes and maintaining high standards of care.

Article 7:
POST-INSERTION CARE, MAINTENANCE, AND SAFE REMOVAL

Following device insertion, it is critical that the device is managed correctly to prevent post insertion complications. According to Loveday et al (2014)[57] and Moreau et al. (2013)[58] Healthcare workers caring for patients with intravascular catheters should be trained and assessed as competent in using and consistently adhering to practices for the prevention of catheter-related bloodstream infection. In this final article, we explore best practices for maintaining and removing CVCs.

Is the CVC Still Required?

The first step to CVC care and maintenance is to assess whether it is still required, or if it is causing harm to the patient by being in situ. It is important to follow your organisations Care Bundles and local guidelines, where available.

If the CVC is still required, and not causing harm to the patient in anyway, the next step is to ensure the area around the CVC is secure and a suitable barrier from bacteria and other sources of infection.

Aseptic Non-Touch Technique (ANTT®)

We discussed in the previous article the meaning and practice of Aseptic non-touch technique (ANTT®), but this mention serves as an important reminder to maintain the asepsis of procedure key parts[59] and always work with ANTT® techniques, referring to your organisations policy on these techniques for dressing and flushing vascular access devices.

Dressing Regimens and Procedures

An appropriate dressing for catheter sites is one that supports secure fixation, allows easy visual monitoring of the area, and maintains a protective barrier. It should also allow the skin to breathe while shielding the site from external moisture and contaminants.

Although the following section reflects widely accepted best-practice principles for CVC care, dressing products, change intervals, and site-care procedures differ across organisations. Local Trust policy must always take precedence.

- Use aseptic non-touch technique when accessing the CVC.
- Dressing should be:
  - Transparent to allow visual inspection of the site
  - Self-adhesive to provide stability and reduce the risk of vein intima trauma, phlebitis, and contamination.
  - Semi-permeable, protecting the site from bacteria and liquids while allowing the skin to breathe[60].
- Inspect dressings at each shift change to ensure integrity and cleanliness.
- Change dressings in accordance with your local Trust policy, typically dressings are changed every 7 days, 3 days, or 72 hours, or sooner if no longer intact, or if moisture collects under the dressing.
- If the patient has profuse perspiration, or the insertion site is bleeding or oozing, a sterile gauze dressing can be used. This will require daily inspection and replacement if it becomes damp, loose, or soiled[59].
- Replace gauze dressings with transparent dressings as soon as possible[59].

Maintaining Catheter Patency

Vascular access catheter occlusions are a common problem. However, it is important that the function of a CVC is maintained to prevent disruption in patient treatment.

Mechanical Occlusion

Occlusions can be mechanical. These types of occlusions are caused by inadequate function of some part of the administration set-up, the dressing or the catheter that interrupts the flow. Some of these occlusions are easily identified, such as kinks or closed clamps. Others are less obvious and can be caused by the internal positioning of the CVC[62]. Mechanical occlusions can be ruled out by checking the following:

- IV tubing – is it clamped or kinked?
- Are all connections tight with no air leaks?
- Is the catheter kinked, twisted or misplaced?
- Does the changing of patient position improve the situation?

If these strategies do not allow the aspiration or delivery of medication the patient should be referred for further investigation of their device.

Blood Occlusion

Blood occlusions occur when a clot completely occludes the lumen of the CVC. Blood occlusions can occur suddenly or over time. Failure to correctly flush a device is a common cause of catheter occlusion.

Persistent Withdrawal Occlusion

The body reacts to any irritant in the vascular system by depositing fibrin around the irritant. In vascular access devices the body sees the catheter as a foreign object and deposits fibrin and thrombus around it[61]. The first sign of a fibrin sheath is the inability to withdraw blood from the catheter. The vacuum created by negative pressure of withdrawal pulls back a flap, which is formed by the fibrin sheath, against the catheter opening and this prevents blood from entering the lumen. Fluids however can be delivered freely.

The catheter must be aspirated to ensure blood return prior to the delivery of medications or solutions[62]. However, according to the RCN (2010), there is no requirement to routinely withdraw blood and discard it prior to flushing (except prior to blood sampling although the first sample can be used for blood cultures)[63].

CVC Clearance / Flushing

While the following flushing guidance reflects widely accepted best-practice principles for maintaining CVC patency, specific flush volumes, solutions, and procedures vary between hospitals. Clinicians must always follow their local Trust protocols

- Flushing of CVCs is important for maintaining catheter patency (Loveday et al, 2014)[57]
- Catheters should be flushed with 0.9% normal saline
- Devices should be flushed prior to and following each infusion (INS, 2015)[62]
- A turbulent flush should be used by using a 'push / pause', stop / start positive pressure technique
- This will help to remove debris from the internal catheter wall
- CVC are designed to withstand venous infusion pressures but typically infusion pressures should never exceed 25-40 pounds per square inch (PSI). Therefore, syringes used for flushing of central venous access devices should be no smaller than 10mLs. Smaller syringe sizes will generate excessive pressures and could lead to catheter fraction (Hadaway, 2006)[64]
- Heparin should be used as per manufacturer and local guidelines and policies.

Other Considerations

Some additional considerations to ensure the longevity for the maintenance and care of a CVC include:

- The use of sutureless securement devices could be utilised[65], such as subcutaneous anchor securement systems.
- Needleless connectors should be changed as per manufacturer recommendations[60].
- Use a designated catheter lumen to administer lipid- containing parenteral nutrition or other lipid-based solutions
- Documentation should be maintained[60].
- Hands must be decontaminated, with an alcohol-based hand rub or by washing with liquid soap and water if soiled or potentially contaminated with blood or body fluids, before and after any contact with the intravascular catheter or insertion site[57].
- Use ANTT® for the insertion and care of an intravascular access device and when administering intravenous medication[57].

Removing a CVC Safely

CVCs should be removed as soon as they are no longer required or if they are causing the patient harm[57]. They should only be removed by competent practitioners. The patient should be prepared for the removal procedure, in the same way as when preparing for inserting the CVC in article 1 and 2.

Removal Procedure

Being aware of the risks of removal is just as important as the risks of insertion, and most of these risks carry over to this procedure.

During CVC removal the middle layer of the vein, Tunica Media, is stimulated. This can lead to venospasm, which will result in difficulty in removing the catheter, making the catheter feel as if it is 'stuck'. To reduce spasm, it is worth pausing the procedure for a short time and retrying. If it continues, it is important to contact an Interventional Radiologist for advice and assistance.

It is well documented that air embolism can occur post device removal and, therefore, it is imperative that a bioclusive dressing is applied and the patient is given instructions on how to recognise this critical complication, and what steps they should take if they suspect it.

Once the practitioner understands and mitigates all the risks, as before, they may start the removal of the CVC, to do this, they must[66, 67]:

Patient Preparation

- Check patient identity.
- Explain procedure to patient.
- Gain informed consent.

Patient Positioning

- Ensure patient comfort.
- Ensure adequate lighting and ventilation.
- The patient should be placed in the Trendelenburg position.
- This means that the exit site is below the heart and thus the risk of air embolism will be reduced.
- Instruct the patient to take a deep breath and hold it.
- Remove the CVC.

Prepare Trolley

- Wash hands or if hands visibly clean use alcoholic hand rub.
- Clean and set trolley.
- Remove old dressing.
- Decontaminate hands with alcohol rub and put on clean gloves.
- Sutures or securement device should be removed and disposed of.

Clean Site

- Clean site using chlorhexidine 2% in 70% alcohol.

Removal Process

- Remove catheter – there should be no resistance.
- Firm digital pressure should be applied for at least five minutes.
- An occlusive dressing should then be applied.

Following Procedure

- Routine culture of tips is no longer considered necessary.
- Document the procedure.

Conclusion

Proper care and timely removal of central venous catheters (CVCs) are vital to preventing complications and ensuring ongoing patient safety. Regular assessment of catheter necessity, adherence to aseptic techniques, and effective flushing and dressing practices help prolong the catheter's lifespan. When removal is required, it must be performed by competent professionals, with close attention to patient preparation and post-procedure care. By following these best practices, healthcare teams can confidently deliver safer, more effective vascular access and management, improving patient outcomes and reducing infection risks along the way.

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OUR COMMITMENT TO THE ENVIRONMENT

2021 was a landmark year as Vygon UK achieved carbon neutrality in accordance with the guidance set out in PAS 2060, with certification renewed in 2022 as year-on year emission reductions were achieved and the residual emissions were offset with the purchase of high-quality Verified Carbon Standard (VCS) emission reduction projects. Vygon are in the process of expanding its emissions reporting to include Scope 3 emissions, this will involve a baseline year reset and result in reporting higher emissions than in previous years and therefore, unable to purchase carbon credits. Following the baseline year and emission targets reset, our focus will be to regain Carbon Neutral status.

We are delighted to announce that Vygon UK has successfully undergone the NHS Evergreen Sustainable Supplier Assessment, attaining level 2 status. This is key to supporting us to understand how we align to the NHS's long term sustainability priorities and the pathway to progress.

We're proud to be a Planet Mark Certified Business, marking a vital first step on our journey to net zero. We annually measured our carbon emissions with Planet Mark, as we cannot manage what we do not measure. Vygon UK are committed to a 5% annual reduction in Scope 1 and 2 emissions. We look forward to sharing our progress through Planet Mark's Net Zero Certification Programme.

These accomplishments underscore our unwavering dedication to sustainable practices and reinforces our role as a responsible contributor to the healthcare system.

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