

How to insert a central line

Introduction

The ability to insert a 'central line' (a catheter into a large central vein) is an essential skill for many physicians. This is a risk-prone procedure and is now subject to National Institute for Health and Clinical Excellence guidance (National Institute for Clinical Excellence, 2002).

Central venous catheters are inserted for a variety of indications (Table 1). Around 200 000 central venous catheters are

inserted annually in the NHS, with failure rates estimated to be as high as 35%.

Central venous catheters can be situated in six sites (the internal jugular, subclavian and femoral veins) (Figures 1 and 2) depending on the indications, risk of complications and expertise of the doctor. It should be remembered that most central veins are often deep and have to be located without the aid of direct vision. This is associated with damage to nearby structures, especially in the hands of an inexperienced operator.

Successful catheterization by either the internal jugular or the subclavian route therefore relies on a thorough understanding of the anatomy of the neck and use of two-dimensional ultrasound. The internal jugular vein is located at the apex of the triangle formed by the heads of the sternocleidomastoid muscle and the clavicle. The subclavian vein crosses under the clavicle medial to the mid-clavicular point.

Ultrasound (two-dimensional) guidance is recommended for placing a central venous catheter in the internal jugular vein in both the elective and emergency situation (Figure 3). It allows precise location of the target vein, and identification of anatomical variation and thrombosis within the vein. Audio-guided Doppler ultrasound is not recommended.

Patients should be assessed for contraindications, both absolute and relative. These include an uncooperative patient, uncorrected bleeding diathesis, skin infection over the puncture site, thrombosis, a pneumothorax or haemothorax on the contra-

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Figure 2. Sites of central venous line insertion.

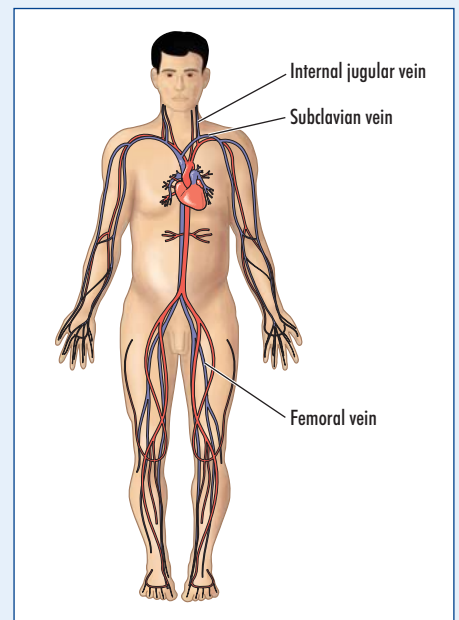


Figure 3. Ultrasound views of central venous catheter showing right common carotid artery (RCCA) and compressed right internal jugular vein (RIJV).

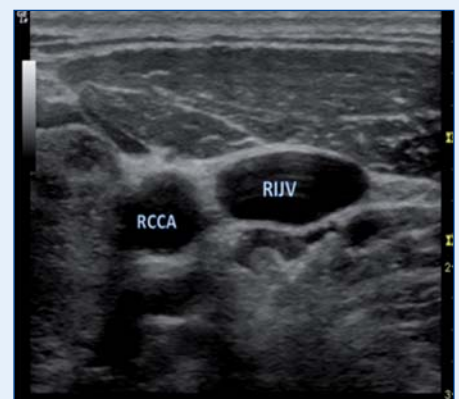
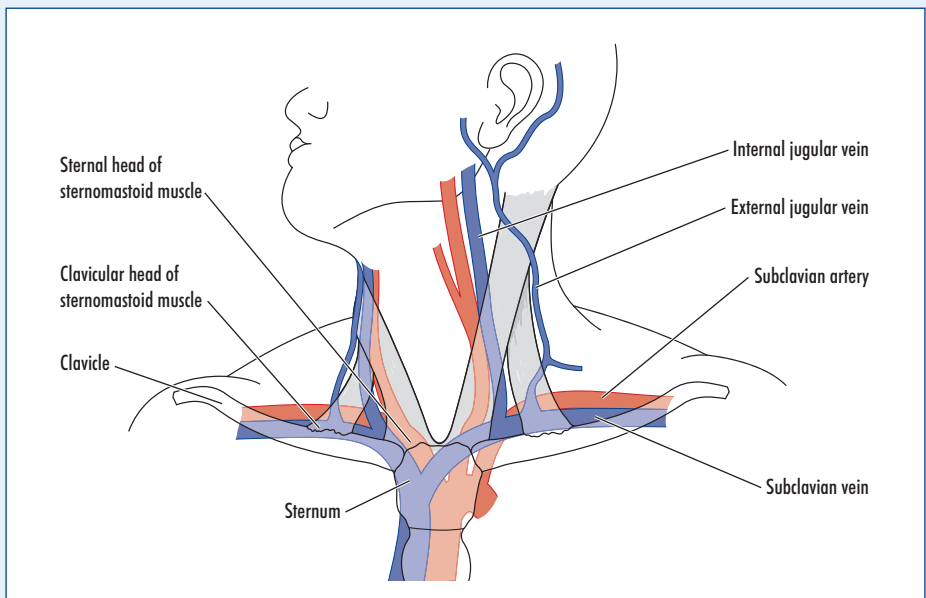


Table 1. Indications for insertion of central venous pressure lines
A fluid resuscitation aid: for central venous pressure and central venous gas measurements
When peripheral venous access is difficult
When vasoactive, inotropic or hypertonic agents are required that should not be administered peripherally (e.g. adrenaline, noradrenaline or total parental nutrition)
For haemodialysis, plasmapheresis, temporary cardiac pacing or chemotherapy

Figure 1. Anatomy of the neck in relation to internal jugular vein catheterization.



lateral side, or the presence of only one functioning lung. Factors that might increase the difficulty of catheter insertion, such as a history of failed catheterization attempts or the need for catheterization at a site of previous surgery, skeletal deformity or scarring should also be considered. When difficult catheterization is anticipated, patient safety dictates that the procedure be performed or supervised by an experienced physician.

Equipment

Venous catheters (Figure 4) are now available that differ in length, internal diameter, number of access ports, material and methods of fixation. Adult catheters for subclavian or internal jugular lines are commonly 20 cm in length although if right-sided neck veins are cannulated, shorter 15 cm catheters should be used to prevent catheter entry into the right atrium.

Figure 4. Equipment for insertion of a central line.
 1. Quadruple lumen central venous catheter.
 2. Sutures. 3. Three way taps. 4. Galipot. 5. Catheter binders. 6. Scalpel. 7. Guidewire. 8. Introducing cannula. 9 and 10. Syringes.



Technique of insertion

The patient is consented then commonly positioned in the Trendelenberg position (feet up, head down to distend the vessels) for internal jugular vein or subclavian vein central venous catheter insertion. For placement of a central venous catheter in the femoral vein the supine position is adopted. Landmarks are identified and ultrasound is then used to identify the desired vein and adjacent arteries.

Full sterile technique (sterile gown and gloves, mask, cap with ultrasound probe in sterile sheath) must be used. The area should be cleaned in a sterile fashion using an appropriate disinfectant, followed by sterile draping. In an awake patient, local anaesthetic should be used to anaesthetize the venipuncture area as well as the suture area. The artery is usually medial to the vein, smaller and pulsatile and, unlike the vein, is not compressible. The needle is advanced under ultrasound while applying negative pressure to the syringe until a flash of blood is visualized. The Seldinger technique (where a guidewire runs through the needle which is then withdrawn to leave the guidewire only) is then used to insert the catheter after which a chest radiograph is required to confirm the position and exclude a pneumothorax.

Managing the patient with a central venous catheter

Patients should be monitored for signs of complications (Tables 2 and 3). Central lines with drug or fluids being infused should be clearly labelled. Lines should be regularly flushed and a 500 ml bag of 0.9% saline connected to the line should be maintained at a pressure of 300 mmHg. All connections must be secure to prevent

leak, introduction of infection and air emboli. Furthermore the insertion site should be frequently and carefully assessed for signs of infection. The length of the indwelling catheter should be recorded and regularly monitored. Central venous pressure lines should be removed when clinically indicated, and with the patient in the head down position if the neck has been used as the site of insertion.

Conclusions

The ability to insert a central venous catheter is a useful skill to have. It is important to know the anatomy, indications and technique as well as to be able to recognize and manage any potential complications. **BJHM**

Conflict of interest: none.

National Institute for Clinical Excellence (2002) *Guidance on the use of ultrasound locating devices for placing central venous catheters.* National Institute for Clinical Excellence, London (www.nice.org.uk/nicemedia/pdf/Ultrasound_49_GUIDANCE.pdf accessed 3 August 2009)

Table 3. Complications of central venous catheter insertion

Malposition of the catheter
Air emboli
Haematoma
Catheter embolism
Arterial puncture
Thrombosis
Pneumothorax
Haemothorax
Haemorrhage
Cardiac tamponade
Sepsis
Cardiac arrhythmias

KEY POINTS

- Central venous catheter insertion is a common procedure performed by a range of specialities.
- Ultrasound guidance is recommended.
- Central venous catheters facilitate administration of drugs and assessment of volume status.
- Insertion of a central venous catheter has numerous potential complications.

Table 2. Comparison of central venous catheter insertion sites

	Internal jugular	Subclavian	Femoral
Compressibility of vessels in bleeding	++	+	+++
Ease of access during active resuscitation	+	++	+++
Ease of use with ultrasound-guided techniques	+++	+	+++
Patient comfort and maintenance of dressing	++	+++	+
Arterial puncture	++	++	+++
Thrombosis and haematoma	++	+	+++
Haemothorax and pneumothorax	+	++	-
Infection risk	++	+	+++