Putting in central venous lines

Introduction

Central lines are inserted for the following reasons:

- Difficult peripheral access
- Haemodialysis and plasmapheresis
- Infusion of irritant drugs and total parenteral nutrition
- Measurement of central venous pressure
- Cardiac catheterization and transvenous cardiac pacing
- Pulmonary artery catheterization.

Overview of technique

Full asepsis and standard monitoring must always be used. If the patient is conscious then local infiltration is preferable.

The catheter over guide wire (Seldinger) technique is preferred as a result of its ease and lack of trauma to the tissues. Its application is as follows: a large (usually 16 gauge) needle attached to an empty syringe locates the vessel by free flow of venous blood on withdrawal of the plunger. A flexible guide wire with a J-shaped tip is threaded into the vein. The needle is removed, leaving the guide wire in situ. The tissues are dilated, and the line threaded over the guide wire, which is removed. The line is flushed and fixed to the skin.

The commonest veins to cannulate, in order of popularity, are:

1. The internal jugular vein
2. The femoral vein
3. The subclavian vein
4. The antecubital fossa
5. The external jugular vein.

Internal jugular vein

The internal jugular vein is the route of choice for measuring central venous pressure. The right side is preferable, as it tends to be bigger and straighter.

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Anatomy

It begins at the base of the skull at the jugular foramen and travels vertically within the carotid sheath. It joins the subclavian vein behind the sternal end of the clavicle (*Figures 1* and *2*).

A number of structures run close to the vein, including the carotid arteries, the vagus, glossopharyngeal and hypoglossal nerves, the sympathetic chain and, on the left side, the thoracic duct. A thorough understanding of the landmarks is therefore essential.

Technique

The patient lies supine and slightly head-down, distending the neck veins and minimizing air embolism. The head is turned away from the cannulation site. The internal jugular vein is balloted at the apex of the triangle formed by the two heads of sternocleidomastoid and the clavicle, at

Figure 1. Veins of the neck: lateral view.

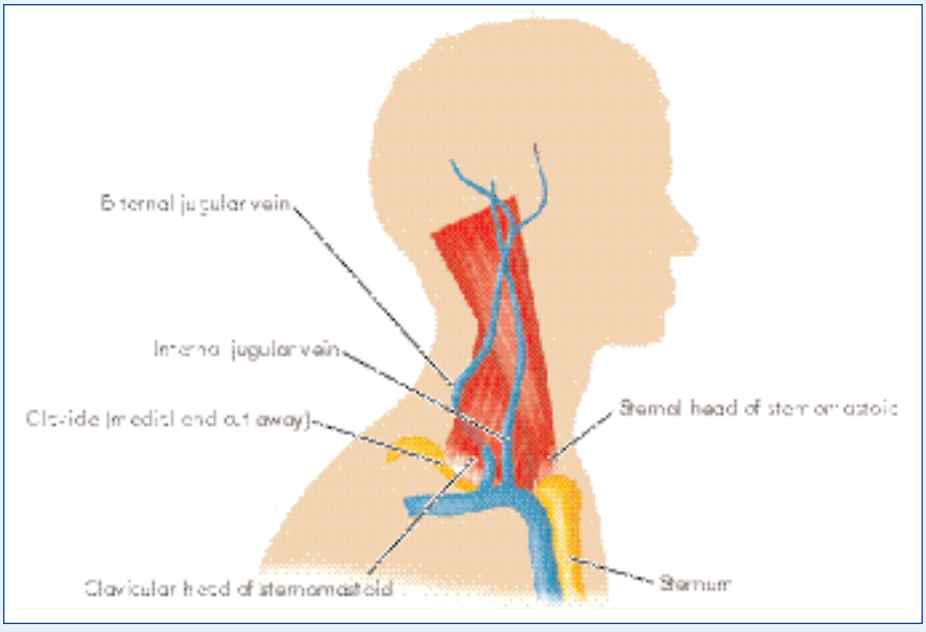
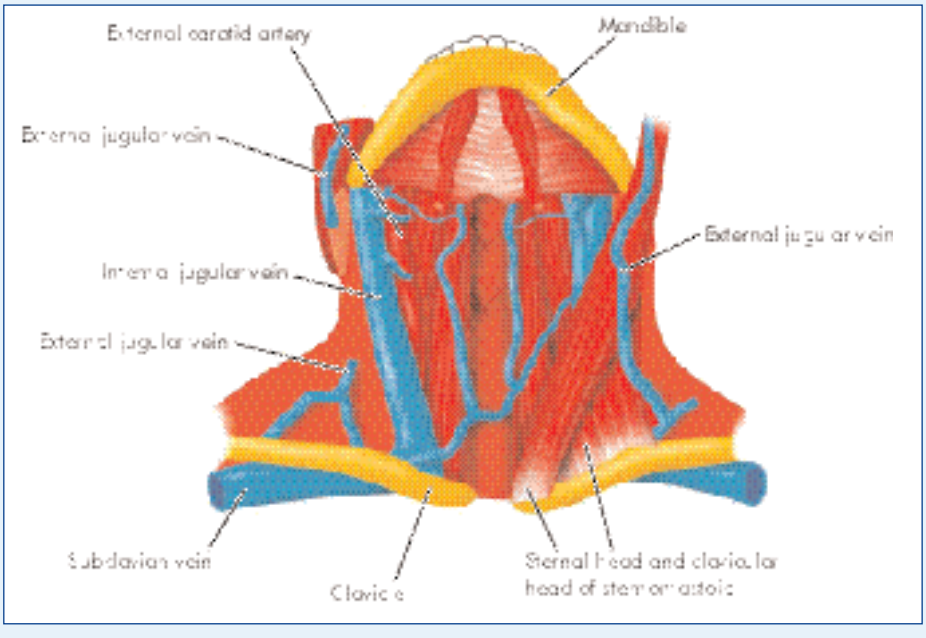


Figure 2. Veins of the neck: anterior view.



the level of the cricoid cartilage. A needle is inserted just lateral to the carotid pulsation at this level, aiming caudally toward the ipsilateral nipple until there is free flow of venous blood. Insert the guide wire as per the Seldinger technique. Request a chest X-ray to confirm position and exclude pneumothorax.

Tips

- The vein is superficial – the needle should seldom be more than 2 cm deep
- Continuous carotid palpation during needle insertion reduces the risk of arterial puncture
- Check that the blood flowing back is venous. If in doubt send a blood gas sample to check oxygenation.

Complications

- Pneumothorax or haemothorax – review chest X-ray post procedure. More likely with low insertion
- Air embolism – can be avoided by ensuring that the patient is head down
- Arrhythmias – occur if the guide wire is passed too far. Ensure electrocardiographic (ECG) monitoring during placement
- Carotid artery puncture or cannulation – is easy unless the carotid is palpated during needle insertion
- Cardiac perforation and tamponade are late complications
- Chylothorax – if left side is used.

The femoral vein

The femoral vein may be cannulated with low morbidity. The risk of infection is greater, however, and pressure measurement is not always practical. It is more appropriate in the supine patient as sitting up will kink the line. It is useful in patients with superior vena caval obstruction.

Anatomy

The femoral vein runs medially to the femoral artery in the femoral triangle. It ends at the inguinal ligament (*Figure 3*).

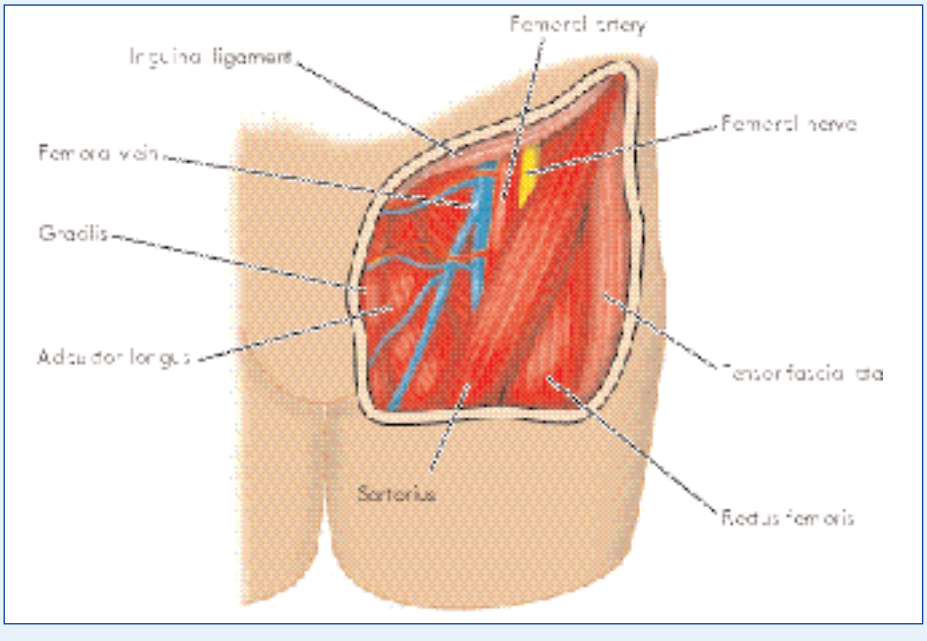
Technique

Abduct and externally rotate the patient's straightened leg slightly at the hip. Locate the femoral artery 2 cm caudal to the inguinal ligament, and introduce the needle 1 cm medial to the arterial pulsation, aiming at the patient's chin. Follow the Seldinger approach.

Complications

- Infection is most common at this site: it is not recommended for long-term use
- Damage to the femoral artery or nerve
- Arteriovenous fistula
- Bleeding can be torrential if the patient stands and the line is not closed fully
- Deep vein thrombosis is a late complication.

Figure 3. Femoral triangle.



The subclavian vein

The subclavian vein carries a higher risk of pneumothorax than the internal jugular, and so is best avoided unless performed with ultrasound guidance, or where other concerns (such as cervical spine injury) contraindicate other sites.

Anatomy

The subclavian is the continuation of the axillary vein and originates at the first rib. It passes anterior to the subclavian artery to join the internal jugular vein behind the sternoclavicular joint (*Figures 1* and *2*).

Technique

Position the patient as for internal jugular cannulation. Introduce the needle 1 cm caudal to the junction of the middle and medial thirds of the clavicle. Direct the needle medially, slightly cephalad, and posteriorly behind the clavicle toward the suprasternal notch. Follow the Seldinger approach, as above. Request a chest X-ray to confirm position and exclude pneumothorax.

Complications

- The risk of pneumothorax and haemothorax is far greater with this technique
- The subclavian artery may be inadvertently cannulated – it is not possible to apply pressure at this point.

The antecubital fossa

The antecubital fossa requires a long catheter, approximately 60 cm for adults. Rapid fluid infusion is difficult.

Anatomy

There are two intercommunicating main veins, the basilic and the cephalic (*Figure 4*). The veins are superficial to the bicipital aponeurosis, which covers the brachial artery and the radial and median nerves (*Figure 5*).

Technique

Apply a tourniquet to the upper arm. Estimate the length of catheter needed to reach the superior vena cava. Puncture the chosen vein with the needle and cannula and remove the needle. Insert the catheter through the cannula and advance it a short distance, then release the tourniquet.

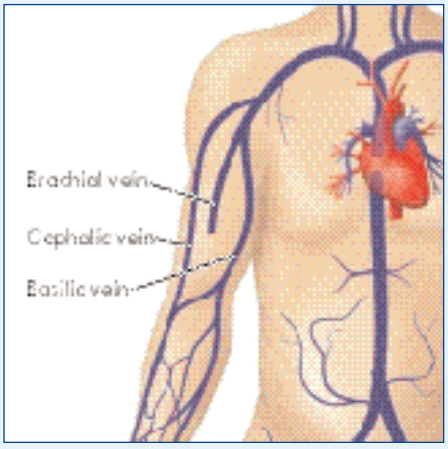


Figure 4. The veins of the arm.

Advance the catheter along the vein until it is estimated to be in the correct position. Confirm position by aspiration of venous blood and chest X-ray.

Complications

Owing to its peripheral insertion site, this technique has relatively low morbidity. Care must be taken to avoid over-deep insertion of the needle, however, which can lead to inadvertent cannulation of the brachial artery, and damage to the medial and radial nerves.

The external jugular vein

The external jugular vein is often visible in the supine patient. However, its course is seldom straight and it contains valves, which often makes it difficult to thread the guide wire, as it may travel via the subclavian into the axillary vein rather than the vena cava. This makes it a less preferable technique.

Anatomy

The external jugular vein passes from the angle of the mandible perpendicularly down the neck, deep to the midpoint of the clavicle at the posterior border of sternocleidomastoid, where it joins the subclavian vein (*Figures 1* and *2*).

Technique

Place the patient as for internal jugular cannulation. Introduce the needle well above the clavicle and advance it over the vein at about 20° to the frontal plane. When a free flow of blood appears, follow the Seldinger approach. The valves may make introduction of the guide wire difficult.

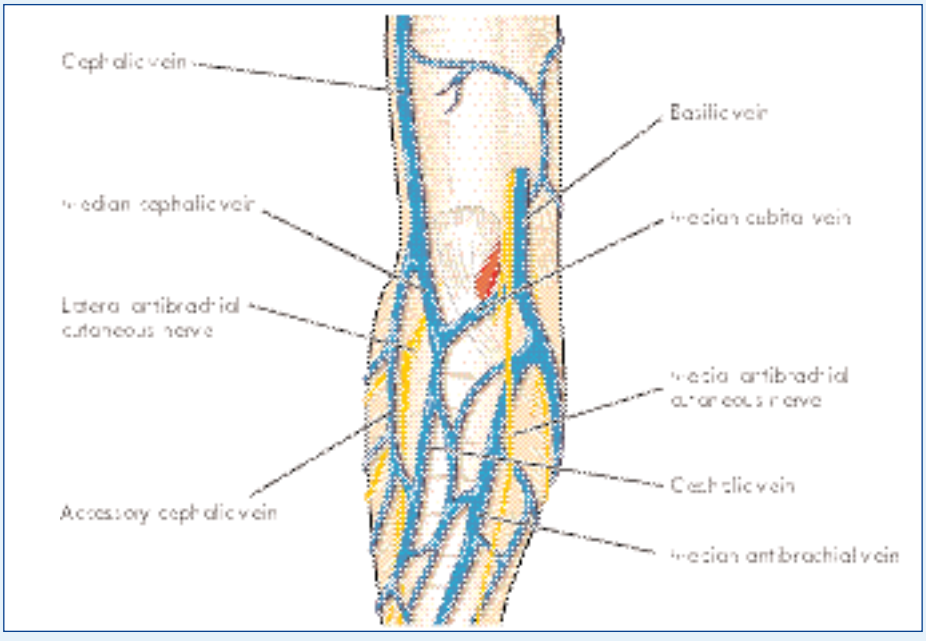


Figure 5. The antecubital fossa.

Some practical aspects of central lines

Line-related infection is a common cause of morbidity and mortality. A foreign body in the central vasculature may cause local infection, distant infective emboli or systemic sepsis.

Risk factors

- Site – see above
- Extremes of age
- Immunodeficiency and severe illness
- Poor asepsis on line insertion or poor line nursing.

Reducing line infection

- Daily inspection of site and regular changing of dressings
- Antimicrobial catheters are available which have antiseptic agents bonded to their surface to resist colonization
- Prompt re-siting of lines if there is evidence of infection
- Review need for central access daily.

Ultrasound guidance for placing central lines

The National Institute for Clinical Excellence has issued guidance on the use of ultrasound-locating devices. This reduces insertion-related morbidity, but there are practical and financial considerations. The technique should always be considered, but its use depends on the context and urgency of insertion, and the operator's experience. The landmark technique should still be taught and practised, to prevent de-skilling of trainees. **BJHM**

Figures 1–5 *have been adapted from AnaesthesiaUK website (www.frca.co.uk), with kind permission.*
Conflict of interest: none.

Further reading

Collin GR (1999) Decreasing catheter colonization through the use of an antiseptic-impregnated catheter: a continuous quality improvement project. *Chest* **115(6):** 1632–40

Ouriel K (2003) Preventing complications of central venous catheterization. *N Engl J Med* **348:** 2684–6

Rosen M, Latto IP, Shang Ng W (1981) *Handbook of Percutaneous Central Venous Catheterisation.* WB Saunders Company Ltd, London

KEY POINTS

- Monitoring and full asepsis should always be used when inserting central lines.
- A full knowledge of the relevant anatomy reduces morbidity.
- Ultrasound guidance should be used if available and appropriate, but should not be taught at the expense of landmark techniques.