Practical procedures in cardiology

Philip A MacCarthy

Abstract

Contemporary cardiology is highly invasive, often adopting early interventional treatment strategies for prognostic advantage. Proactively managed patients are often unstable and require early invasive monitoring and treatment. It is therefore more important than ever that the emergency physician responsible for the initial phase of patient stabilization is highly competent in the practical bedside procedures which are necessary in the critical care setting. This article summarizes four common procedures: central venous access, temporary cardiac pacing, pericardiocentesis and the use of the intra-aortic balloon pump. Basic principals and indications are outlined, but the emphasis is on the practical and procedural detail. Many common themes (such as aseptic technique) run through all four procedures and complications can be similar. An appreciation of potential complications can improve operator competence and allow their early identification and management.

Keywords Central venous access; central line; temporary pacing; pericardiocentesis; intra-aortic balloon pump/counterpulsation

Doctors undertaking potentially dangerous procedures have a duty to be both well informed about the indications and potential complications of the procedure, and competent in the practical aspects. Invasive monitoring and therapeutic procedures are increasingly used in cardiology, and decisions to undertake them at the appropriate time can have fundamental consequences on patient outcome.[1] This contribution outlines the indications, practical aspects and potential complications of four of the more common procedures:

- central venous access
- temporary cardiac pacing
- pericardiocentesis
- intra-aortic balloon counterpulsation.

Philip MacCarthy ***PhD MRCP*** *is a Consultant Cardiologist at King's College Hospital, London, UK. He qualified from Bristol University Medical School, and trained in general medicine and cardiology in Oxford and Cardiff, and in interventional cardiology at King's and in Aalst, Belgium. His research interests include applied coronary physiology, left ventricular hypertrophy and endothelial function.*
Conflicts of interest: none.

What's new?

- The basic principles that underlie the safe and competent approach to these procedures have not changed in recent years. However, advancing technology has allowed ever-more sophisticated equipment, including smaller (often hydrophilic) venous sheaths, lower profile and smaller devices (e.g. 8F intra-aortic balloon pumps) and more effective means to achieve haemostasis. Smaller, portable echocardiography equipment also provides the means to monitor procedures (such as pericardiocentesis) whilst they are done on the ward or in the catheter laboratory
- Fibreoptical technology has improved pressure monitoring from intra-aortic balloon pumps and gives the procedural advantage of immediate pressure monitoring on insertion

Central venous access

Indications

Drug administration – certain agents (e.g. amiodarone, dobutamine, stronger potassium solutions) cause phlebitis when given into peripheral veins.

Monitoring of central venous pressure (CVP) – subclavian/jugular lines can be used. It should be noted that monitoring of CVP is of limited value in patients with cardiogenic haemodynamic instability; simple clinical assessment of the jugular venous pulse (JVP) gives the same information, and right ventricular filling pressure (i.e. the CVP) is often less relevant when optimizing haemodynamics than left ventricular (LV) filling pressure (pulmonary capillary wedge pressure, as measured with a Swan–Ganz catheter).

Venous access – central venous access may be used when peripheral access is poor.

Venous conduit for temporary pacing – sometimes, central access is obtained in case temporary pacing is needed quickly at a later stage.

Practical approach

The procedure should be performed on a ward appropriate for invasive monitoring/therapy, with adequate space around the bed. Strict asepsis should be maintained and a trolley should be prepared with a surgical pack containing syringes, needles, sterile drapes, 2% lignocaine, 3/0 silk suture, gauze swabs and a scalpel (Figure 1). Guide-wires can be difficult to manage and may stray onto non-sterile surfaces, so sterile drapes should be used generously and the operator should wear a gown. The patient should be positioned correctly; head-down tilt fills the veins maximally and decreases the risk of air embolism, though venous pressure is often high in those with cardiogenic haemodynamic instability and patients may find it difficult to lie flat. About 5 ml of lignocaine should be infiltrated in the skin and along the proposed passage of the needle/cannula.

Passage of the line into a vein is achieved in one of three ways.

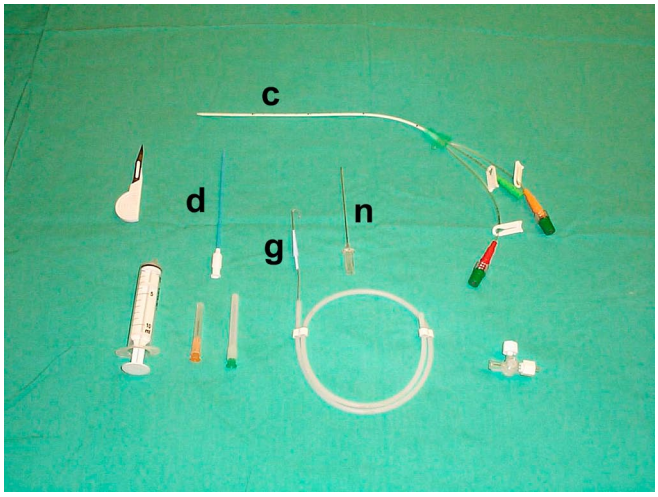

Figure 1 A standard commercially available central line pack including a triple-lumen cannula (c), a dilator (d), a finding needle (n) and a j-tipped guide-wire (g).

Modified Seldinger technique is the most common method of central venous access, and is safe and effective. After lignocaine infiltration, the vein is punctured with a 'finding needle'. Gentle aspiration is maintained on the syringe such that intraluminal location is confirmed with an easy 'flashback' of venous blood. When the vein has been located, the key to success is to keep the needle still with one hand while the guide-wire is fed through the needle with the other. Passage of the guide-wire should be easy; if any resistance is met, excess force should not be used. The soft, j-shaped tip of the wire prevents damage to or perforation of the vein.

Fluoroscopy can be used to confirm the position of the wire in the superior vena cava/right atrium. The needle is then removed over the wire and a small nick is made in the skin at the site of entry of the wire to facilitate passage of the dilator. When the dilator has been removed, the central line cannula can be advanced over the wire into the vein, ensuring that the guide-wire can be held at its distal end before the cannula is advanced through the skin. It is often easier to advance these cannulae by holding them near the skin and pushing firmly, with the knowledge that no harm can be done because the cannula enters the vein over the correctly positioned guide-wire. After securing the line with sutures, its position is confirmed radiographically.

Catheter-through-cannula is the most appropriate technique for inserting a 'long line' from an arm vein (usually from the antecubital fossa) into the subclavian vein/superior vena cava. A catheter (usually available in a pre-coiled drum) is fed through a wide-bore cannula into the vein. A common problem is difficulty negotiating the veins in the shoulder as they enter the axillary/subclavian vein.

Catheter-over-needle – inserting a catheter over a needle into a central vein is potentially dangerous because it necessitates blind puncture of a central vein with the relatively large bore of the needle/catheter combination, and advancement of the catheter is not protected by the presence of a guide-wire. However, with an experienced operator it can be a useful technique in, for example, cardiac arrest, when venous access cannot be obtained by safer means.

Access sites: the three most commonly used sites of central venous access are the internal jugular vein, the subclavian vein (Figure 2) and the femoral vein.

Internal jugular approach – the internal jugular vein runs behind the sternal head of the sternomastoid, just lateral to the carotid artery. The patient should be positioned at a 20° head-down tilt; the right side is preferred because it avoids injury to the thoracic duct. The carotid artery should be located and protected with the fingers of the left hand during location of the vein. The needle should enter the skin at the apex of the 'muscle-free triangle' formed by the sternal and clavicular heads of the sternomastoid. The needle should be held at an angle of about 30° to the skin and advanced towards the ipsilateral nipple. The internal jugular vein is not a deep structure and it is seldom necessary (and potentially dangerous) to advance the needle to its hub. The vein can usually be easily found with a standard 21G needle.

Subclavian approach – the subclavian vein runs between the first rib and the medial third of the clavicle. It is closely related to the subclavian artery, which lies posterosuperiorly, and the pleura, which lies immediately inferiorly, medial to the first rib. Puncture of this vein is more hazardous than other approaches. The skin should be entered at a point 1 cm below and 1 cm lateral to the junction of the medial and middle thirds of the clavicle. There is a palpable 'hollow' just lateral to this point below the clavicle that is a consistent and useful anatomical landmark. The right side of the patient is preferred, and the needle should be advanced towards the lower border of the clavicle in the direction of the suprasternal notch. It is useful to keep the middle finger of the left hand on the suprasternal notch. When the needle touches the bone of the clavicle (ensure adequate local anaesthesia – periosteum can be sensitive), it can be 'walked' down the clavicle before being advanced immediately underneath the bone, to

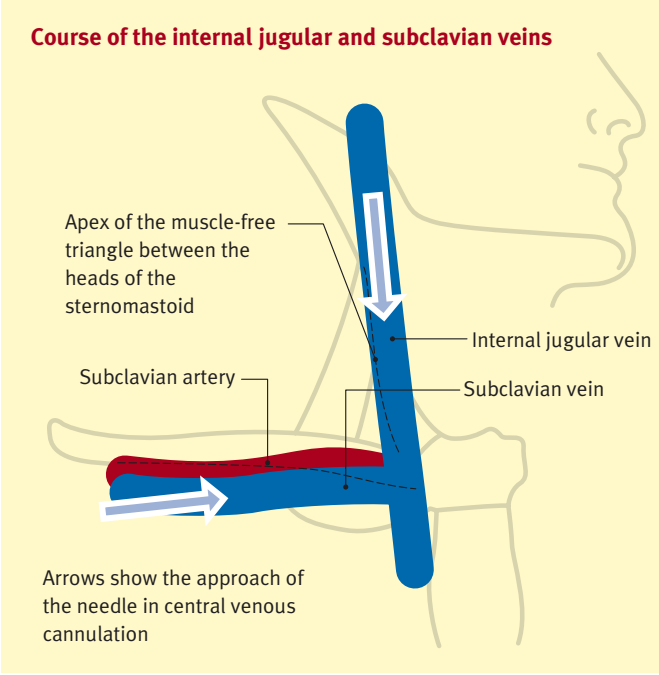

Figure 2 Correct position of temporary pacing wire on the chest radiograph.