
1 Access Sites of Percutaneous Procedures

In 1929, Werner Forssman performed the first human cardiac catheterisation by passing a urethral catheter from his left antecubital vein into the right side of his heart (10). Cardiac catheterisation has evolved since then and nowadays is used in a variety of procedures that vary from investigative tests such as angiograms to interventions such as coronary angioplasty and atrial septal defect repairs, thus reducing the need for cardiac surgery (11).

These can be referred to as percutaneous coronary procedures, as the heart is accessed by inserting a catheter through the skin into an artery and/or vein, and threading it up to the heart. Access to the arterial system may be via the femoral, brachial or radial artery (5).

ADVANTAGES OF PERCUTANEOUS ACCESS

The majority of percutaneous coronary investigations and interventions are performed under local anaesthetic, as patients may be asked to cough, hold their breath or move their position during the procedure. Using a local anaesthetic also has the advantage of avoiding the risks associated with general anaesthesia (11). The other advantages that percutaneous coronary procedures offer over cardiac surgery include:

- Patients are less anxious waiting for a percutaneous procedure than for a surgical procedure (8).
- A cardiopulmonary bypass machine, if required, and its inherent risks are avoided (8).
- The hospital stay is shorter. For example, patients undergoing percutaneous coronary intervention (PCI) normally stay in hospital for 12–24 hours, whereas patients undergoing a coronary artery bypass graft (CABG) require a stay of 3–7 days (8).
- Barring complications, the average cost of percutaneous coronary procedures is substantially lower than that of surgery (8).
- Patients are able to resume their normal life sooner after percutaneous procedures. For example, patients can usually return to work within 7–10 days after a PCI, whereas patients undergoing a CABG return to work within 6 weeks (8).

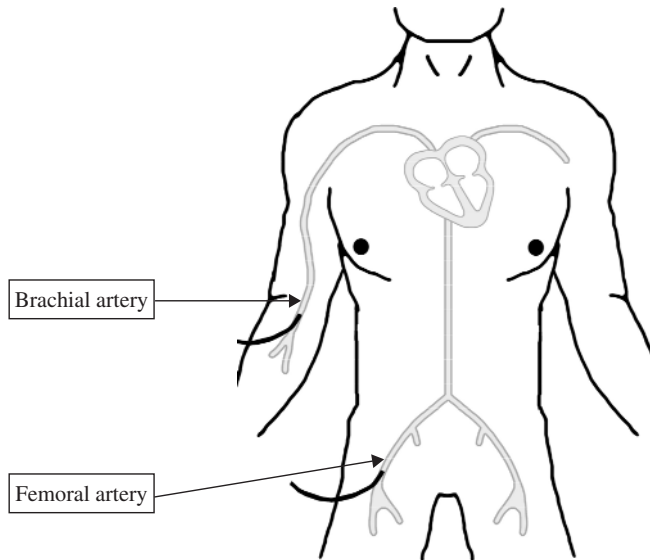


Figure 1.1. Introducing a catheter into the brachial or femoral artery.

- If a patient has a clotting disorder or has recently had thrombolysis, they can be treated in an emergency with PCI (1).

SELECTING THE ARTERIAL PUNCTURE

The access site is selected by the cardiologist prior to the procedure; however, the femoral artery is the preferred access site to the arterial system for the majority of percutaneous procedures (see Figure 1.1). Although the brachial and radial arteries may be preferred by some cardiologists, they are mainly used if the femoral artery is unavailable, due to peripheral vascular disease, for example, or if the patient is unable to lie flat on their back during the procedure, such as patients with severe heart failure, who would normally sleep with three or four pillows (9).

The brachial and radial arteries are smaller than the femoral artery and carry a higher risk of dissection and occlusion. Percutaneous puncture of the brachial artery is more likely to require surgical repair than percutaneous femoral puncture. In addition to this, brachial arteriotomy under direct vision can be technically challenging for the inexperienced operator and is time-consuming (9).

Percutaneous radial artery puncture appears safe, but it results in occlusion of the radial artery in around 5% of cases. Although, in such cases, the blood to the hand would be supplied by the ulnar artery, the occluded radial artery would not be available for a CABG surgery if the patient required one in the future (9).

FEMORAL ACCESS

The most common vascular access site is the femoral artery. It can also be referred to as the Judkin's approach (7). The selected femoral artery is shaved of groin hair in order to reduce infection risk and then the area is liberally cleaned with antiseptic solution (8). Then, a local anaesthetic such as lignocaine is slowly injected into the inguinal area of the groin, as a slow injection of the local anaesthetic is less painful for the patient and produces better tissue infiltration (2).

Once the femoral area is anaesthetised, the cardiologist punctures the femoral artery percutaneously by inserting a large cannula containing a removable obturator. The presence of blood flow once the obturator is removed confirms that this cannula is within the lumen of the artery. Once proper placement is established, a guidewire is introduced through the cannula into the artery to the level of the diaphragm. The cannula is then removed and replaced by a valved introducer sheath (known as a femoral sheath) (8). The patient may feel some pushing and tugging at this time. This introducer sheath provides haemostasis and support at the puncture site and reduces potential arterial trauma if multiple catheter exchanges are necessary (8).

The femoral vein is accessed in a similar manner if it is required. Venous access is mainly used during electrophysiological studies (EPS) and radio-frequency ablation (RFA). Venous access for temporary pacing is no longer routine during PCI; however, it should be considered for high-risk patients, such as those with acute myocardial infarction (MI) or left bundle branch block needing right coronary artery PCI, or if a rotoblator or thrombus aspiration device is required (6).

REMOVING A FEMORAL SHEATH

There are several methods of obtaining haemostasis in the femoral puncture site post sheath removal. Closure devices, such as AngioSeal, VasoSeal, Duett and Perclose, allow the removal of the femoral sheath at the end of the procedure, no matter what the anticoagulation status is (9). However, the majority of centres still rely on the compression of the femoral artery using either manual or mechanical compression, or a combination (4). This means that the femoral sheath is usually removed 3–4 hours after the procedure if heparin has been used, such as during PCI (8). As femoral sheaths are usually removed on the ward by nursing staff, it is discussed in more detail in Chapter 2.

RADIAL ACCESS

The radial artery approach was developed as an alternative to the percutaneous transbrachial approach in an attempt to limit vascular complications. The inherent advantages of the transradial approach are that the hand has a dual arterial supply

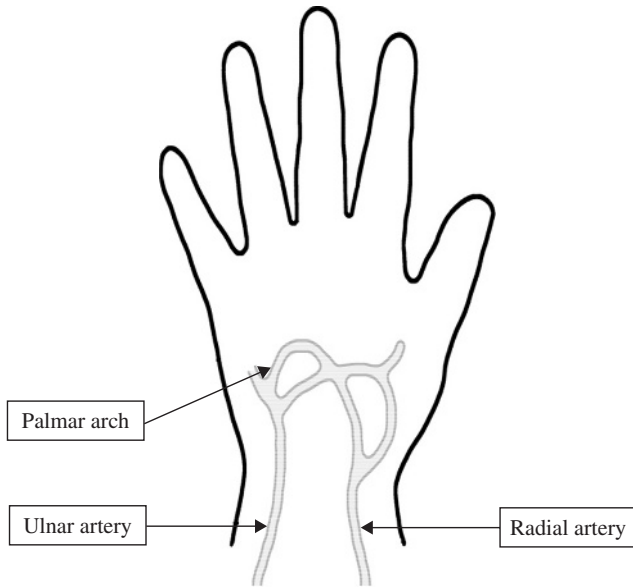


Figure 1.2. Radial artery anatomy and collateral circulation.

connected via the palmar arches and that there are no nerves or veins at the site of puncture (3). The location of the radial artery enables easy access in most people, and it is easier to control bleeding (see Figure 1.2). In addition, prolonged bed rest is unnecessary after the procedure (6).

Although using the radial approach is associated with fewer severe access site-related bleeding complications than the femoral approach, the sheath sizes are smaller. They are usually limited to size 6 or 7 French, and therefore would not be suitable for cases in which larger catheters are required, such as valvuloplasty or rotablation (7). Unfortunately, the radial artery has a propensity to develop spasm, which may make catheter movement difficult or impossible. This can be overcome by the use of vasodilators and long introducer sheaths when appropriate (6). In addition, radial access is only suitable for left-sided heart catheterisation; another approach would be required if the right side of the heart required catheterisation as well (3).

Prior to a radial procedure, the clinician must complete an Allen's test to assess the ulnar artery in the arm to be proceeded on. First, the radial and ulnar arteries are occluded simultaneously while the patient makes a fist. Then, when the hand is opened, it appears blanched. The ulnar artery is released and the hand colour should return within 8–10 seconds. Satisfactory ulnar flow can also be documented by pulse oximetry (6).

In order to insert the catheter into the radial artery, the selected arm is abducted at a 70° angle on an arm board, and the wrist hyperextended over a gauze roll. It is cleaned liberally with antiseptic. A topical anaesthetic is applied first, as

it reduces the amount of lignocaine needed for local infiltration over the radial pulse. Large amounts of lignocaine may obscure the pulse and make cannulation more difficult (6). A small incision is made and an 18-gauge needle is introduced at a 45° angle into the radial artery. A guidewire is inserted first and then a valved introducer sheath. Haemostasis is obtained at the end of the procedure after sheath removal using direct pressure. It is recommended that the arterial puncture site be allowed to bleed for several beats before maintaining direct pressure. The radial pulse should be monitored regularly for several hours after the procedure (3).

SHEATH REMOVAL AND POST-PROCEDURE CARE

Before the sheath is removed, 1 mg of verapamil is given through the sheath to minimise spasm of the radial artery (6).

Although haemostasis can be achieved by applying direct manual pressure over the puncture site, there are several radial haemostat devices available on the market, and their guidelines should be followed. The following is a description of one such device. A plastic bracelet with a pressure pad is placed around the wrist. Gauze is wrapped around the plastic strip to prevent skin injury when the bracelet is tightened. Another folded piece of gauze is placed under the pressure pad over the sheath insertion site. While the operator presses the pad over the puncture site, the sheath is withdrawn gently and the bracelet is tightened. The pad is pressed down and locked over the puncture by tightening of the bracelet bracket. The bracelet should be tight enough to ensure haemostasis but not occlude flow to the hand. The patient is checked 1–2 hours later, and the bracelet is loosened. The patient can be discharged 2 hours later and the bracelet removed at home. The patient should be given instructions about puncture site compression with the fingers if later bleeding occurs (6).

BRACHIAL ACCESS

There are two methods of obtaining brachial access, but they should be reserved for patients in whom the radial artery cannot be used (6).

PERCUTANEOUS BRACHIAL ARTERY PUNCTURE

Percutaneous arterial puncture is a safe and effective alternative to brachial artery cut-down, and is normally favoured over the brachial artery cut-down. Although it is similar to femoral arterial puncture, there are several important differences:

1. The brachial artery is smaller (3–5 mm in diameter) than the femoral artery.
2. Because of relatively loose subcutaneous tissues, the course of the brachial artery may change considerably.
3. Spasm can occur easily, with considerable decrease in pulse amplitude, making the puncture more difficult.

4. The artery is more mobile than the femoral artery.
5. The median nerve lies very close to the artery. Accidental touching of the median nerve causes a peculiar electrical shock sensation in the hand.
6. Care should be taken to puncture the artery on the first attempt. Because of the smaller space in the arm, uncontrolled haematoma formation here can readily cause compression syndrome with ischaemia of the forearm and hand (6).

The brachial artery can accommodate up to size 8 French sheath in large men. However, in most patients, especially smaller men and women, smaller sheaths (less than or equal to 6 French) are preferred (6). The brachial and radial pulses should be checked prior to attempting a brachial puncture. They should be strong and equal in both arms. The patency of the ulnar artery should be checked by the Allen's test (6).

The arterial sheath is removed at the end of the procedure and haemostasis is achieved by applying 15–20 minutes of manual pressure until the bleeding has stopped. The arm circumference at the site of the puncture should be measured to facilitate the detection of haematoma formation. The patient should be instructed to keep the arm in a relaxed position for 4–6 hours. Although the patient is allowed to sit up in bed, ambulation should be restricted until these 4–6 hours are completed, to ensure haemostasis (6).

BRACHIAL CUT-DOWN/SONES PROCEDURE

The brachial cut-down procedure is also known as the Sones procedure. This procedure is rarely performed nowadays, as radial access or brachial puncture is favoured over it. Unlike the other procedures, this is not a percutaneous procedure. Once the brachial area is anaesthetised, the brachial artery is accessed by making an incision close to the crease in the elbow. The selected artery is brought to the surface and is used to insert the appropriate catheters for the procedure. Once the procedure is completed, the artery is sutured to prevent bleeding, and then the incision is sutured. If non-absorbable sutures are used on the incision, they will need to be removed in 7–10 days. The wound should be covered with a firm dressing (2).

There is no need for the patient to be kept flat or motionless following a brachial cut-down procedure. They may sit up, eat and mobilise to the bathroom. If the patient has a strong radial pulse, they can be discharged home after 4–6 hours' observation (2).

REFERENCES

1. Al-Obaidi, M., Noble, M. and Siva, A. (2004) *Crash Course Cardiology*, 2nd edn, London, Mosby.
2. Baim, D. S. (2006) *Grossman's Cardiac Catheterisation: Angiography and Intervention*, 7th edn, Philadelphia, Lippincott Williams & Wilkins.

3. Braunweld, E., Zipes, D. and Libby, P. (2001) *Heart Disease: A Textbook of Cardiovascular Medicine*, Vol. 1, 6th edn, London, W.B. Saunders Co.
4. Galli, G. (2005) 'Ask the experts: Re removing arterial and venous sheaths after PCI', *Critical Care Nurse*, available online at www.findarticles.com.
5. Julian, D. G., Cowan, J. C. and McLenachan, J. M. (2005) *Cardiology*, 8th edn, London, Elsevier Saunders.
6. Kern, M. (2003) *The Cardiac Catheterisation Handbook*, 4th edn, London, Mosby.
7. Montalsecot, G., Andersen, H., Antoniuc, D., Betriu, A., de Boer, M., Grip, L., *et al.* (2004) 'Recommendations on percutaneous coronary intervention for the reperfusion of acute ST elevation myocardial infarction', *Heart*, 90, available online at <http://heart.bmjournals.com/cgi/content/full/90/6/e37>.
8. Morton, P. G., Fontaine, D. K., Hudak, C. M. and Gallo, B. M. (2005) *Critical Care Nursing: A Holistic Approach*, 8th edn, Philadelphia, Lippincott Williams & Wilkins.
9. Norell, M. and Perrins, J. (2003) *Essential Interventional Cardiology*, Philadelphia, PA, W.B. Saunders Co.
10. Rosendorff, C. (2005) *Essential Cardiology: Principles and Practice*, 2nd edn, Totowa, New Jersey, Humana Press.
11. Swanton, R. H. (2003) *Pocket Consultant Cardiology*, 5th edn, Oxford, Blackwell Publishing.

