**Radial arterial lines**

**Introduction**
Intra-arterial cannulae in the radial artery are used for invasive arterial blood pressure (IABP) measurement and for collection of blood for analysis. The radial artery is the preferred site for insertion because of low complication rates. Arterial lines are the gold standard for accurate blood pressure measurement. They may be used in intensive care and high dependency units and in anaesthetized patients undergoing surgical procedures. An understanding of basic principles enables arterial lines to be used safely in these settings.

**Indications**
The indications for a radial arterial line are:
1. Continuous, beat-to-beat blood pressure measurement. Examples include patients on the intensive care unit (ICU) requiring inotropic support, or patients with severe cardiovascular disease undergoing surgery.
2. Frequent arterial blood gas analysis in patients with respiratory failure, or severe acid/base disturbance.

**Choice of arterial site**
The radial artery has low complication rates compared with other sites. It is a superficial artery which aids insertion, and also makes it compressible for haemostasis. The ulnar, brachial, axillary, dorsalis pedis, posterior tibial, femoral arteries are alternatives.

**Preparation**
Allen's test is recommended by many textbooks before the insertion of a radial arterial line. This is used to determine collateral perfusion between the ulnar and radial arteries to the hand: poor collateral perfusion is said to be present in 12% of people. If ulnar perfusion is poor and a cannula occludes the radial artery, blood flow to the hand may be reduced. The test is performed by asking the patient to clench their hand. The ulnar and radial arteries are occluded with digital pressure. The hand is unclenched and pressure over the ulnar artery is released. If there is good collateral perfusion, the palm should flush in less than 6 seconds. In practice the usefulness of this test is questionable.

**Equipment**
- **Arterial cannulae.** Made from polytetrafluoroethylene (‘Teflon’) to minimize the risk of clot formation (Figure 1) they are short, with parallel sides to minimize the effect on blood flow distally. A 20G (pink) cannula is used in adult patients, a 22G (blue) for paediatrics, and a 24G (yellow) for neonates and small babies. Larger gauge cannulae increase the risk of thrombosis, smaller cannulae cause damping of the signal. The cannula is connected to an arterial giving set.

- **Arterial giving set.** Specialized plastic tubing, short and stiff to reduce resonance (see below), connected to a 500 ml bag of saline.

- **500 ml bag of saline.** This is pressurized to 300 mmHg using a pressure bag, i.e. a pressure higher than arterial systolic pressure to prevent backflow from the cannula into the giving set. The arterial giving set and pressurized saline incorporate a continuous slow flushing system of 3–4 ml per hour to keep the line free from clots. The arterial giving set and pressurized saline incorporate a continuous slow flushing system of 3–4 ml per hour to keep the line free from clots. The arterial giving set and pressurized saline incorporate a continuous slow flushing system of 3–4 ml per hour to keep the line free from clots. The arterial giving set and pressurized saline incorporate a continuous slow flushing system of 3–4 ml per hour to keep the line free from clots. The arterial giving set and pressurized saline incorporate a continuous slow flushing system of 3–4 ml per hour to keep the line free from clots. The arterial giving set and pressurized saline incorporate a continuous slow flushing system of 3–4 ml per hour to keep the line free from clots. The arterial giving set and pressurized saline incorporate a continuous slow flushing system of 3–4 ml per hour to keep the line free from clots. The arterial giving set and pressurized saline incorporate a continuous slow flushing system of 3–4 ml per hour to keep the line free from clots. The arterial giving set and pressurized saline incorporate a continuous slow flushing system of 3–4 ml per hour to keep the line free from clots. The arterial giving set and pressurized saline incorporate a continuous slow flushing system of 3–4 ml per hour to keep the line free from clots. The arterial giving set and pressurized saline incorporate a continuous slow flushing system of 3–4 ml per hour to keep the line free from clots. The arterial giving set and pressurized saline incorporate a continuous slow flushing system of 3–4 ml per hour to keep the line free from clots. The arterial giving set and pressurized saline incorporate a continuous slow flushing system of 3–4 ml per hour to keep the line free from clots.
Practical Procedures

**Arterial pressure waveform**

Once inserted, an arterial waveform trace should be displayed at all times. This confirms that the invasive arterial BP (AQ Please define in full) monitoring is set up correctly, and minimizes problems as a result of, for example damped arterial waveform (see below).

**Peripheral and central arterial waveforms**

Waveforms from a peripheral artery such as the radial artery differ from those of an aortic trace (Figure 4). A peripheral trace has a higher peak systolic pressure, a wider pulse pressure and a more prominent dicrotic notch, i.e. the systolic pressure in the dorsalis pedis artery is higher than in the radial artery, which is higher than in the aorta. This is because peripheral arteries are smaller and less compliant than central arteries and therefore less distensible.

Additional information from arterial waveform

In addition to BP measurement, the shape of the waveform gives further useful information:

1. Myocardial contractility. Indicated by the rate of change of pressure by unit time (dP/dt max) i.e. the slope of the arterial upstroke.

2. Hypovolaemia. Suggested by a narrow waveform, a low dicrotic notch and a peak pressure which varies with IPPV (AQ Please define in full) breaths if the patient is ventilated, or with deep inspirations in the spontaneously breathing patient (also called an ‘arterial swing’).

**Damping and resonance**

Damping and resonance may distort the arterial pressure waveform (Figure 5), and lead to inaccurate recording of systolic and diastolic pressures. Myotonic arterial pressure (MAP) is usually still recorded accurately.

Any restriction in transmission of the arterial pressure to the diaphragm of the transducer results in a damped arterial waveform (Figure 5). The waveform is smoothed out without sharp changes displayed. Damping is caused by the dissipa-

**Complications**

Haemorrhage may occur if there are leaks in the system. Connections must be tight-

**Disposed with care.**

**Radial arterial lines are associated with low complication rates.**

**Comparison with non-invasive BP**

Arterial lines measure systolic BP approximately 5 mmHg higher and the diastolic BP approximately 8 mmHg lower compared to non-invasive BP (NIBP) measure-

**Advantages of invasive blood pressure measurement**

- Continuous blood pressure recording.
- Accurate blood pressure recording even when patients are profoundly hypoten-

**Disadvantages of invasive blood pressure measurement**

- Potential complications as listed above.
- Skilled technique.
- Expensive compared with NIBP.

**KEY POINTS**

- Radial arterial lines are associated with low complication rates.
- Sensi...

- They provide a means of accurate and continuou...

- They provide a means of repeated arterial blood gas analysis.
- They should only be used by trained staff in high dependency / ICU (AQ Please define in full) environments.

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**Avoidance of peripheral arterial catheters used for haemodynamic monitoring in emergency and intensive care.** Medicine Critical Care 158–204