

In this article...

- The use of arterial lines in critical care
- The significance of normal, dampened and undampened arterial waveforms
- Correct arterial line care and complications

Essential critical care skills 3: arterial line care



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Key points

Arterial lines are used to monitor arterial blood pressure and obtain arterial blood gases and blood specimens

They should only be used in clinical areas where staff have the competency to care for them safely

Correct arterial line care is essential to reduce complications and ensure patient safety

All care should be documented as per local policy and any concerns must be reported to the nurse in charge of the patient

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Abstract An arterial line is a small catheter that is directly inserted into an artery. The procedure is associated with risks, so it is important that appropriate care is taken during and after insertion. This article is part three of the essential critical care skills series, and discusses the insertion of arterial lines, monitoring of an arterial waveform, and any associated risks or complications with this critical care procedure.

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Arterial lines are commonly used in patients who are critically ill to monitor arterial blood pressure continuously, and to obtain blood samples for arterial blood gases and blood specimen collection. The radial artery is the most common site for arterial line insertion, but other arteries may be used, including the ulnar, brachial, femoral or dorsalis pedis.

As arteries have a vital role in supplying oxygenated blood, it is important to make sure there is a collateral circulation to the area of the body that is supplied by the chosen artery. This is necessary in case an arterial thrombosis (blood clot) occurs, as adequate peripheral circulation to the limb by another artery is essential to avoid permanent limb damage.

Professional skills

It is important that the health professional who inserts the arterial line is competent in this skill. Arterial lines should only be used in clinical areas where staff have the competency to care for them safely; they are not appropriate for use on general wards (Garretson, 2005). Nurses should only take on care of an arterial line when

they have:

- Undergone training;
- Been assessed as competent to do so.

They should follow local policies and procedures and work in adherence with the Nursing and Midwifery Council's (2018) code of conduct.

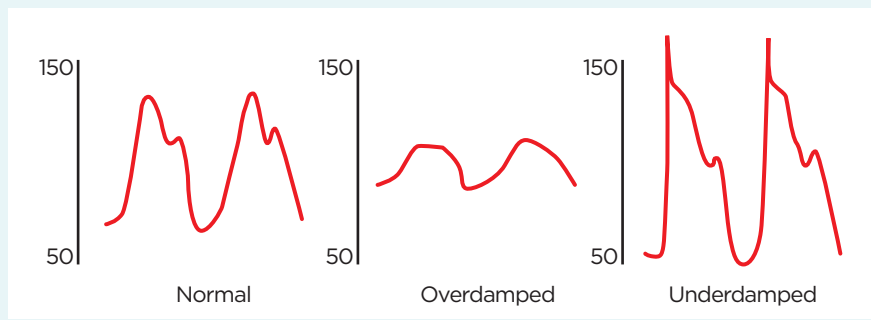
Setting up the transducer system

The Association of Anaesthetists of Great Britain and Ireland's (2014) guideline for arterial lines aims to reduce harm to patients from administration of the incorrect infusion fluid, and to identify steps that should be taken to reduce this risk.

Arterial lines should be clearly identifiable following local procedures, as this will reduce the risk to patients of accidental drug administration into the artery. Registered health professionals should check the infusion solution (usually 500ml of 0.9% sodium chloride) before connecting to a patient, and also at all patient handovers, such as transfer from the emergency department to critical care or shift handovers in the critical care unit (Leslie et al, 2013).

The infusate fluid and arterial line transducer set should be changed according to

Fig 1. Arterial waveforms



local policies and procedures. The infusate is contained in a pressure bag, which is inflated to 300mmHg; as this pressure is higher than the arterial systolic pressure, it prevents the backflow of blood from the cannula into the administration set.

The arterial administration set delivers a continuous slow flush of 3-4ml per hour; this keeps the line free from clots. It is important that this infusate solution is continuous – it should not be discontinued.

Monitoring using an arterial line

Arterial lines are used to monitor arterial blood pressure continuously, so it is essential to understand normal and abnormal arterial pressure waveforms; these are shown in Fig 1.

Arterial pressure waveforms are obtained by attaching the arterial line to a transducer (Fig 2). A transducer is a device that converts one energy form to another – in this case, it converts pressure into an electrical signal. This signal is sent via a cable to a monitor, where it is displayed as a waveform. The arterial line waveform can be affected by anatomical, physiological and technical factors. Accuracy of arterial blood pressure monitoring relies on the patient exhibiting a normal arterial pressure waveform and the nurse recognising this. When monitoring blood pressure via an arterial line, the transducer needs to be placed at the level of the heart. This position is known as the phlebostatic axis and is located at the fourth intercostal space on the mid-axillary line.

Overdamped waves, which underestimate blood pressure, can be a result of air bubbles or clots in the pressure tubing, kinks in the catheter or tubing, low pressure in the pressure bag, or no fluid in the flush bag. Underdamped waves overestimate blood pressure and can be caused by an artefact, stiff non-compliant tubing, hypothermia, tachycardia or dysrhythmia.

A scale is used when the arterial pressure waveform is displayed on the

monitor. This scale can be altered depending on the patient's blood-pressure measurements. Normal waves can appear overdamped or underdamped if the arterial waveform is not scaled properly. Most monitors contain an auto-scale feature. It is important to check this if there are concerns about the arterial waveform, and adjust it as required. Blood pressure changes can mean the scale is no longer correct and should be readjusted.

Accurate monitoring of arterial blood pressure requires the transducer to be 'zeroed':

- At least once during each shift;
- When the accuracy of the reading is in doubt.

Zeroing is performed to counteract the influence of external pressures, such as atmospheric pressure, on the monitoring system. Zeroing the transducer ensures that only the arterial pressure will be measured so the arterial blood-pressure readings will be accurate. There are a number of steps required to perform this and it is

important to follow local guidelines to ensure patient safety and infection control.

When a patient is moved, care needs to be taken to make sure the transducer remains positioned correctly at the phlebostatic axis; it may need repositioning and it is important to consider whether the transducer should be re-zeroed.

The position of the arterial cannula in the artery can affect blood pressure; for example, a cannula in the radial artery may have been affected by the position of a patient's wrist. As such, it is important to make sure the waveform is normal (Fig 1) before making any alterations to the patient's treatment, such as increasing or decreasing medications that will alter their blood pressure.

If health professionals have any concerns about waveforms or zeroing, they must raise these with a more senior nurse or health professional.

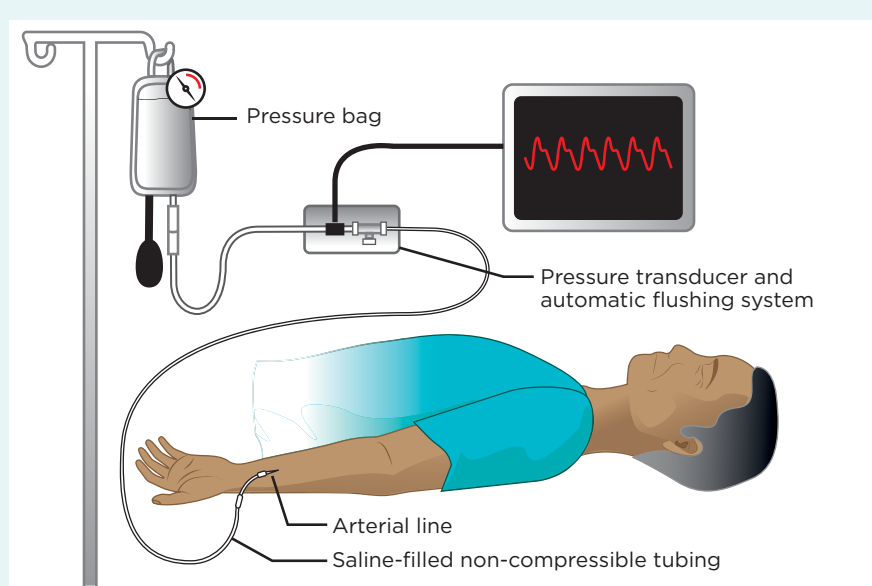
Arterial blood samples

Samples of arterial blood should:

- Only be taken when clinically indicated;
- Not be performed routinely.

Blood sampling via an arterial line should only be performed after training, supervised practice and successful competency assessment, as per local policy. Using a correct sampling technique is fundamental to making sure the blood sample is not contaminated with the infusate, which may affect all blood results, including arterial blood gases, clotting studies and electrolytes (AAGBI, 2014). To eliminate this, the nurse or health professional must withdraw and discard a volume of three times the dead

Fig 2. Arterial line connection



space of the arterial line (Leslie et al, 2013). Care must be taken to ensure:

- All caps in the arterial line system are closed and connected;
- Lines are flushed thoroughly after sampling;
- When flushing lines, it is not forced, as there may be a thrombus that, if dislodged, may lead to ischemia.

This ensures patient safety before and after the procedure. Making sure the pressure bag is maintained at 300mmHg will mean there is a counter-pressure to prevent thrombus formation.

Obtaining the blood sample is the initial stage; the sample must then be processed in line with local policies and procedures. When the results are available, they must be analysed by a health professional who is competent to do so and can make clinical decisions about the care of a patient who is critically ill. Any concerns about obtaining arterial blood samples or any of the blood results must be reported to the nurse in charge of the patient.

Arterial line care

Correct arterial line care is vital to reduce complications and ensure patient safety (Blackburn and Walton, 2016; Leslie et al, 2013). Arterial lines must be secured in line with local policy and covered with a clear dressing, with the date of dressing change clearly documented (Loveday et al, 2014).

Dressings should be changed in line with local policy or when there are signs of bleeding, infection or diaphoresis (profuse sweating). The rate of infection associated with arterial cannulas is relatively low (Blackburn and Walton, 2016), but nurses must be vigilant; if signs of infection are observed, this must be reported to a senior nurse and/or medical practitioner.

When changing the dressing, all local infection prevention and control techniques

– such as aseptic non-touch technique – should be followed. The skin should be wiped away from the insertion site and allowed to air dry (Loveday et al, 2014).

Arterial line care should be documented as per local policy, but would include;

- A clean, intact dressing;
- Documenting the date of dressing changes;
- Observing the insertion site for phlebitis.

If there are any concerns about the care of the arterial line, this must be reported to the nurse in charge.

“Correct arterial line care is vital to reduce complications and ensure patient safety”

Removal of arterial lines

When they are no longer needed, arterial lines should be removed according to local procedures. It is important before removing a line that health professionals are aware of the patient's coagulation status (international normalised ratio test, partial thromboplastin time and platelets) and, if there are any abnormalities, that the decision to remove the line is discussed with a senior member of the healthcare team. This is vital, as there may be a risk of bleeding.

The line should be removed adhering to all local infection prevention and control techniques, and the correct procedure must be followed. Only staff who have demonstrated competence in the skill should remove arterial lines.

Once the arterial cannula is removed, direct pressure must be applied to the insertion site until haemostasis (formation of a clot to limit bleeding from the insertion site) is fully achieved; this may take up to 15 minutes, depending on the position of the arterial line and the patient's coagulation status. If there are any concerns about line removal, it is essential to ask the nurse in charge of the patient for help.

Complications

A number of complications are associated with arterial lines, including:

- Thrombus formation in the cannula;
- Distal ischaemia to the cannula;
- Haemorrhage from the monitoring system;
- Infection;
- Air embolism;
- Use of wrong infusate fluid;
- Inadvertent injection of drugs into the cannula.

Drugs that are wrongly injected into an arterial line will result in that drug being directed to the limbs and body extremities. This leads to the injected particles lodging in blood capillaries and affecting circulation, which can result in a lack of blood flow, eventually causing the tissue to die. If not identified early, vascular complications can cause permanent harm to patients and may result in limb amputations (Blackburn and Walton, 2016).

Patients with radial arterial cannulas must be closely observed to monitor thumb and hand perfusion. Arterial cannulation can cause distal ischemia to the arterial cannula if a patient's blood supply is compromised. The nurse must be vigilant in observing for changes in skin temperature and colour, and for patients complaining of limb pain.

Monitoring is important to make sure there is no haemorrhage from the arterial pressure monitoring system or from the insertion site.

Conclusion

When caring for patients who are critically ill and have arterial lines, appropriate nursing care and vigilance will help to ensure patient safety and also to limit complications. Nurses should follow all local policies and procedures, and adhere to the Nursing and Midwifery Council's (2018) code when caring for such patients. **NT**

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Further reading

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