Canadian Journal of Rural Medicine | Journal canadien de la médecine rurale

Spring 1997 Contents • Printemps 1997 Table des matières

The occasional arterial line

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Can J Rural Med vol 2 (2):77

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Arterial cannulation can be easier than venipuncture. It is safe and it greatly expands the therapeutic and monitoring capabilities of doctors caring for acutely ill patients. It is ideal for monitoring blood pressure continuously and accurately in unstable patients even during transport, when other methods, as rural doctors know, are dangerously inaccurate or impossible to perform. Arterial lines are also the kindest and most useful technique when multiple blood sampling is required, either for blood gas determination or for venous measurements when the patient has poor veins or simply cannot tolerate repeated needling.

Although this technique is not used widely outside urban intensive care units, it is safe and simple, and its rapid effectiveness is tailor-made for some situations in rural hospitals when transporting or caring for moderately or severely ill patients. A minimum of nursing training (less than 1 week per nurse for a group of 3 nurses, the other nurses being certified "in house," as we did in our hospital), a modest equipment investment (about $10 000 for a transport monitor with hemodynamic capabilities and $200 for transducers and catheters) and rural doctors showing their usual initiative are all that is needed. One half-day with a cardiac anesthetist in a tertiary centre is more than enough basic training for a rural doctor, although further subtleties and applications could be picked up during a week in an urban intensive care unit. These could then be taught to others.

Materials

Equipment needs are as follows:

- a 500-mL bag of normal saline with 1000 units of heparin mixed in

- a pressure bag (a blood pressure cuff will do in a pinch)
- disposable pressure tubing with a transducer
- a cardiac monitor with a pressure cassette
- an arterial cannulation catheter and needle (a standard 20-gauge intravenous catheter and needle will also do)
- 2% lidocaine without adrenaline in a 27-gauge tuberculin syringe
- povidone-iodine prep and gel
- tape or 5-0 nylon suture, or both.

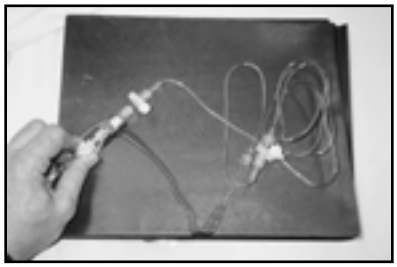
Procedure

Step 1



Insert the pressure tubing with the transducer into the heparanized saline bag. Place the saline bag into the pressure bag, then inflate to a pressure higher than the patient's systolic pressure, usually around 300 mm Hg. All pressure bags have a lock to ensure that the bag does not deflate suddenly. If using a blood pressure cuff, place a clamp around its tubing to ensure the same effect.

Step 2



Flush the tubing of the pressure/transducer line and remove all air in the system by pulling or squeezing the flush valve, found either on the transducer or on the tubing. This valve, when not opened, still allows 2 to 3 mL/h of infusate to drip into the artery, ensuring catheter patency.

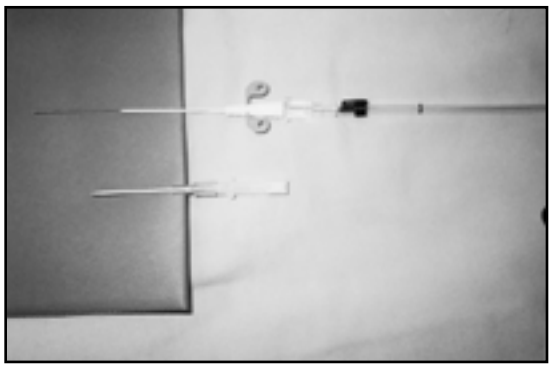
Perform the Allen test to ensure that the patient has good ulnar artery hand circulation before you catheterize the radial artery at the wrist. This simple test is described in all standard texts. Some doctors simply occlude the radial artery at the wrist and watch for a drop in the SaO2 or pulse wave-form using an SaO2 monitor clipped onto a finger of the patient's hand. Other arteries that can be used for catherization include the femoral (more risks of infection and distal embolization), the brachial (the sole supplier of blood to the forearm and therefore potentially a greater risk) and the dorsalis pedis (difficult to catheterize). Even the temporal artery can be used.

Step 3



Place the wrist in dorsiflexion to straighten the artery. It is a good idea to place a roll of gauze under the wrist and tape the hand to maintain dorsiflexion. Prep the area with povidone-iodine, infiltrate liberally with the lidocaine, and puncture the artery with the catheter-needle assembly at about a 30° angle.

Step 4



When arterial blood flows back, advance the catheter into the artery and remove the needle. This step is exactly the same as starting an intravenous line, and indeed a standard 20-gauge intravenous catheter-needle can be used. To make everything even easier, companies make an arterial catheter-needle assembly that has a guidewire which is first advanced into the artery after initial arterial puncture. The catheter can then be slid over the wire, ensuring foolproof catheterization. When the needle is removed from a properly placed catheter, blood will spurt out

from the catheter. This can be minimized by pressing firmly with your thumb distal to the catheter site.

Step 5



Connect the pressure tubing to the catheter.

Step 6



Tape or suture the catheter in place after dabbing the skin puncture with povidone-iodine gel. Ensure that the line is open from the pressurized saline bag to the catheter. Replace all the white caps (vented) with solid, non-vented yellow ones. Change the dressing and apply new disinfectant every day. Keep the catheter in place as short a time as possible, preferably less than 3 days.

Place the transducer on a pole at about the level of the patient's mid-axillary line. Connect the cable from the pressure cassette of the monitor to the wires from the transducer and turn on the monitor. A good arterial tracing should be seen (Fig.1A). Abnormal wave forms (Figs. 1B and 1C) imply either air in the system or kinking of the catheter.

Calibrate the system by following the manufacturer's instructions.

Complications appear to be independent of operators. Multiple punctures, prolonged catheterization and low cardiac output all increase the rate of complications. Twenty-gauge radial

artery catheters in place for 3 days or less have an 11% thrombosis rate. Recanalization of the artery usually takes place. Embolization, either distally or centrally (with long flushes), is rare. Infection remains the most common and severe problem and underlines the importance of good asepsis. Despite these complications very little permanent impairment results from radial artery cannulation.[1]

This simple technique will make a big difference in managing certain cases in rural hospitals. Our own nurses were extremely proud of their new capabilities. Our doctors are comfortable with the technique and our patients, we believe, receive better care.

Reference

1. Taylor RW, Civetta JM, Kirby RR, editors. Techniques and procedures in critical care. Philadelphia: JB Lippincott; 1990. p. 225-231. [This book provides a good overview of technique and complications with an excellent bibliography.]

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