Assessing adequacy of collateral foot circulation: A simple bedside test prior to lower extremity arterial cannulation

Sir,

Arterial cannulation for invasive blood pressure monitoring and sequential arterial blood gas analysis is routinely used in the Operating Theatres (OTs) and Intensive Care Units (ICUs). Known complications of this procedure include temporary vascular occlusion, thrombosis, ischemia, hematoma formation, and local catheter-related infection and sepsis. Usually the radial artery of the hand is frequently employed owing to its close proximity to the skin, collateral circulation with the ulnar artery and low rate of complication. Before performing radial artery cannulation or blood sampling, palmar arches should be evaluated by Modified Allen’s Test (MAT) which is a simple bedside test to assess adequate collateral circulation and the patency of hand collateral arteries (radial and ulnar). Quite often, lower extremity arterial cannulation is performed (failed radial artery cannulation, injured/burned upper limb, surgical procedures involving arms or where upper part of the body is not easily accessible) employing the dorsalis pedis or posterior tibial artery. A variation of MAT known as Lower Extremity Allen’s Test (LEAT) has been previously described, which utilizes a hand held doppler probe. However, Doppler probes may not be universally available. Thus, there exists paucity of simple bedside tests which can be performed prior to arterial cannulation of lower extremities which can evaluate the adequacy of arterial collateral flow.

We propose a simple amendment of MAT which can be performed at the bedside test to assess distal lower extremity collateral circulation by supplementing sequential arterial compression and release with pulse oximetry.

With the patient lying supine, the pulse oximeter is attached to any of the toe for recording of baseline oxygen saturation and waveform [Figure 1a]. Both dorsalis pedis artery and posterior tibial artery are identified superficially by the pulsations and simultaneously compressed till pulse oximetry waveform flattens [Figure 1b]. Pressure on the posterior tibial artery is then released. Return of waveform
indicates adequate posterior tibial artery flow to maintain perfusion of distal foot [Figure 1c] provided the dorsalis pedis is cannulated. Non-return of waveform after release of posterior tibial artery is indicative of inadequate patency of posterior tibial artery. If it occurs, pressure on dorsalis pedis artery is released. Return of waveform indicates dorsalis pedis artery dependent distal foot perfusion.

The entire procedure is repeated, beginning from simultaneous compression of both dorsalis pedis artery and posterior tibial artery till waveform flattens. Pressure on the dorsalis pedis artery is then released. Return of waveform indicates adequate dorsalis pedis artery flow to maintain perfusion of distal foot [Figure 1c] provided the posterior tibial artery is cannulated. Non-return of waveform after release of dorsalis pedis artery is indicative of inadequate patency of dorsalis pedis artery. In that case, pressure on posterior tibialis artery is released. Return of waveform is indicative of posterior tibialis artery dependent distal foot perfusion [Figure 1d].

Amplitude of the waveform may vary depending on which toe the probe, local temperature and probe proximity with the arterial source.

Vascular complications following dorsalis pedis artery cannulation are quite uncommon, because the three major arteries feeding the foot have multiple inter arterial connections, which protect the foot from limb ischemia.[3] Despite it, few reports of distal limb ischemia after dorsalis pedis artery cannulation have been reported previously.[4]

Although recommended tests for evaluation of lower extremity circulation include directional Doppler flow studies, transcutaneous oxygen tension, and angiography (gold standard), they may not be ubiquitously available in the OT or ICU settings. This limits their extensive application. The described modification is safe, easy to perform and cost effective. Pulse oximeter being universally available in the OTs’ and ICUs’ can be used in the pre-procedural period to assess the collateral perfusion of the foot. If any uncertainty is revealed after the performance of this test, alternative sites for arterial cannulation should be considered. Compared to MAT for the upper limb which relies on subjective visual assessment of the palmer colour, the addition of an objective component like pulse oximetry adds to the reliability and unambiguity of the information obtained.

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Conflicts of interest
There are no conflicts of interest.

References
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Sir,

Central venous catheterization (CVC) is a routine technique used in the pediatric health care setup for various purposes. One of the rare complications of this procedure is the intravascular loss of a guidewire, which may lead to various life-threatening consequences. We present a case of a retained guidewire that was introduced through the femoral vein. Point of care ultrasonography was used during its retrieval.

A 6-month-old male child was referred to the emergency room from another hospital with a retained guidewire in the right femoral vein for 5 days. He was being treated for pneumonia and right femoral venous cannulation was attempted during management. Although he was carrying a radiological film showing the guidewire, apparently no attempt was made to retrieve it as they were waiting for the child to recover from his illness. Then he was referred to our center.

A fresh X-ray revealed a straight wire extending from the right groin to the right supraclavicular region [Figure 1a]. Interestingly, the tip of the guidewire was straight and not curved.

The child was afebrile and all routine investigations were within normal limits. Keeping in view the position of the wire and the possible complications, it was decided to remove it under general anesthesia. After the institution of routine monitoring in the form of ECG, pulse oximeter and noninvasive arterial pressure, anesthesia was induced with fentanyl and propofol. A supraglottic airway was introduced following the administration of atracurium. Anesthesia was maintained with 2% sevoflurane and 50% oxygen in the air along with intermittent positive pressure ventilation.

It was decided to use point of care ultrasonography (M Turbo, Fujifilm SonoSite, Inc, Bothell, WA, USA) to locate the guidewire during retrieval to avoid further radiation exposure to the child. The guidewire tip was accurately visualized in the internal jugular vein and was retrieved surgically [Figure 1b]. On inspection, it was 23 cm in length and appeared to be a guidewire used for arterial cannulation. Neither of the ends was flexible or curved unlike the central venous catheter (CVC) guidewires available. The short length contributed to the intravascular loss of guidewire.

Neuromuscular blockade was reversed with neostigmine and atropine and the child made an uneventful recovery.

Intravascular loss of guidewire, although extremely rare, is a completely preventable complication. A retained guidewire results in costly investigations and procedures for its retrieval that are potentially harmful to the patient and may also lead to medicolegal issues.

Various modalities such as radiographs, CT scans, ultrasonography, echocardiography, and angiography have been used for the detection of the lost guidewires. Our patient also had repeated radiation exposure and had to undergo surgery under general anesthesia that was completely avoidable. A lost guidewire may remain asymptomatic and incidentally found on a routine X-ray done sometime later. The longest gap