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Should the femoral or brachial artery be used if radial artery cannulation is difficult?

Current best practice in placement of arterial lines is to attempt to cannulate the radial artery in the first instance. However, if the radial artery is difficult to cannulate there is no consensus among clinicians on how best to proceed. This article looks at the evidence for the different options.

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Introduction

Arterial lines are a commonplace intervention in anaesthesia and critical care medicine. Current best practice is to attempt to cannulate the radial artery in the first instance (Nuttall et al, 2016). However, if the radial artery is difficult to cannulate there is no consensus among clinicians on how best to proceed. Persisting with attempts at the radial artery vs opting for a different site requires the balancing of the risks of complications against the likelihood of success. The most commonly used sites after the radial artery (89%) are the femoral (7.1%) and the brachial (2.6%) arteries (Nuttall et al, 2016).

Use of ultrasound guidance

Previous injury to the target artery is a risk factor for vascular complications, so reducing the number of attempts is clinically important (Nuttall et al, 2016). The use of ultrasound to guide radial arterial line placement was assessed by a randomised control trial (Wilson et al, 2020). This study demonstrated that use of ultrasound significantly reduced the number of attempts for radial arterial cannulation: first attempt success rate was 96% in the ultrasound group and 49% in the landmark group, $P<0.001$ (Wilson et al, 2020).

Radial artery: second attempt

The radial artery is the first-choice site for most practitioners. It is easily accessible and has historically been thought to have the lowest overall complication rate (radial artery 3.4 per 10 000, femoral artery 9.0 per 10 000 and brachial artery 12.3 per 10 000), although this was not statistically significant (Nuttall et al, 2016).

Repeated attempts at radial artery cannulation increase the risk of insertion-related complications, such as aneurysms, false lumens and thrombosis. The cannulation success rate also decreases with subsequent attempts – repeated trauma to the artery causes vasospasm and haematoma formation.

Radial artery cannulation can also be difficult as a result of anatomical variants, atherosclerosis or hypotension. These issues are likely to occur on each side, making cannulation of the opposite radial artery equally challenging.

Femoral artery

The femoral artery is the second most commonly chosen site for arterial cannulation (Nuttall et al, 2016). In the authors' practice cannulation of the femoral artery is usually successful on the first attempt, even following a failed attempt at radial artery cannulation. The main concern around routine femoral artery cannulation relates to the risk of infection. A meta-analysis investigating catheter-related bloodstream infections found that femoral artery catheters have a 1.93 relative risk of infection compared to radial artery catheters (O'Horo et al, 2014). The study's authors recommended avoiding using the femoral artery whenever feasible. However, this infection risk can be mitigated by reducing the length of time the femoral cannula is in situ: changing an arterial cannula within 5 days of insertion

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greatly reduces the risk of infection (O'Horo et al, 2014; Nuttall et al, 2016). Infection risk can also be reduced by using chlorhexidine skin preparation, chlorhexidine-impregnated dressings and full aseptic precautions. While full aseptic precautions have not been shown to reduce catheter-related bloodstream infections in radial arterial lines, their use has been recommended for femoral arterial lines because of the increased risk of catheter-related bloodstream infection (O'Horo et al, 2014).

Brachial artery

The brachial artery is the third most commonly chosen site (Nuttall et al, 2016). Again, in the authors' clinical practice, following a failed radial artery cannulation attempt, cannulation of the brachial artery is often successful on the first attempt. The main concern around routine brachial artery cannulation relates to the risk of vascular complications: the brachial artery is an end artery and lacks a collateral supply. Studies attempting to compare the vascular complication rate of brachial and radial arterial lines suggest that this risk has historically been overestimated (Handlogten et al, 2014). The studies have been unable to demonstrate statistically significant differences in vascular complication rates between the radial and brachial sites (Handlogten et al, 2014). However, the authors advise caution; they only recommend brachial cannulation when the radial artery is not palpable and recommend minimising the time that the catheter is in situ (Lakhal and Robert-Edan, 2017).

Conclusions

The authors advocate the use of ultrasound for any attempt at arterial cannulation regardless of site. There is clear evidence that ultrasound use increases success rate.

If an experienced operator has failed to cannulate the radial arteries, subsequent radial artery attempts are likely to increase the risk of vascular complications (Nuttall et al, 2016). Having reviewed the evidence, the authors advocate that subsequent attempts should be ultrasound guided and that the femoral and brachial arteries are considered. For short-term indications (<5 days) femoral artery cannulation with full aseptic precautions could be selected. Here, ease of insertion and the collateral blood supply minimises the risk of vascular complications and the short duration of use mitigates the infective risk. The brachial artery is also an acceptable alternative site. Here, the infection risk is low and the concerns over increased vascular injury risk unproven and can be mitigated by close observation of the limb.

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