Subclavian central venous cannulation: should ultrasound guidance be used in routine practice?

Subclavian venous cannulation has traditionally been performed with a landmark technique. However, it has been suggested that the use of ultrasound guidance makes it easier and safer. This article discusses the case for and against the use of ultrasound to facilitate subclavian venous cannulation in adults.

Reasons for using ultrasound

There is considerable evidence that ultrasound-guided subclavian venous cannulation is safer than the landmark technique. A Cochrane review (Brass et al, 2015) found that the use of ultrasound reduces arterial puncture and haematoma formation. Fragou et al (2011) found that real-time ultrasound guidance in the hands of experienced operators decreased all mechanical complications (arterial puncture and haematoma formation, pneumothorax, haemothorax, brachial plexus injury, phrenic nerve injury and cardiac tamponade) compared to the landmark technique. The value of ultrasound is probably greater once physicians become proficient in its use.

Patients at high risk of cannulation failure benefit most from the use of ultrasound (Troianos et al, 2011). Thus it may have a valuable role in intensive care as critically ill patients are more likely to fall into this challenging group.

A handful of studies have demonstrated that ultrasound is associated with a better success rate than the landmark technique for subclavian venous cannulation. One randomized controlled trial reported a 100% success rate with ultrasound compared to 87.5% with the landmark technique (Fragou et al, 2011). A meta-analysis of nine randomized controlled trials (Brass et al, 2015) showed no difference in success rate between the two techniques, but in a sub-group analysis, when only real-time long axis imaging was used, ultrasound was superior. Thus the way in which imaging is performed can influence its effectiveness. The ideal way is in real time, enabling dynamic views of the needle during advancement, and using the long axis orientation, allowing the entire needle to always be seen thus reducing the risk of inadvertently puncturing structures surrounding the subclavian vein (Troianos et al, 2011).

Ultrasound-guided subclavian venous cannulation offers additional advantages: it can be used to identify those with atypical anatomy, and subclavian vessel patency can be evaluated before cannulation. Its use also enables misplacement of the guidewire to be identified, allowing the catheter to be repositioned correctly (Fragou et al, 2011).

Reasons not to use ultrasound

Ultrasound-guided subclavian venous cannulation can be a challenging technique; the subclavian vein can be difficult to visualize given the acoustic shadow created by the overlying clavicle. Ultrasound-guided subclavian venous cannulation with real-time, long axis imaging has been rated 8/10 on a difficulty scale (Fragou et al, 2011). The benefits of ultrasound are unlikely to be evident until a certain level of skill has been attained, which may be why the meta-analysis by Brass et al (2015), which grouped trials with operators of varying experience into one systematic review, found only marginal gains with ultrasound.

In the UK guide to ultrasound training (Denny et al, 2011), ultrasound-guided subclavian venous cannulation is listed as a level 2 skill. Achieving level 2 competence usually requires further experience beyond that obtained during normal training. The merits of making this a core skill are questionable, given the cost and time constraints, and the uncertainty as to whether it is better than the landmark technique when performed by an inexperienced clinician.

A number of important queries regarding ultrasound-guided subclavian venous cannulation remain unanswered. How effective is it in the hands of novice operators? Are the benefits only seen in patients at high risk of cannulation failure? What are the outcomes (e.g. success rate, rate of complications) in the emergency setting? Does cost/benefit analysis support its widespread use?

Conclusions

Ultrasound-guided subclavian venous cannulation outperforms the landmark technique in terms of safety and the success rate in difficult subclavian venous cannulation (e.g. patients who have had radiation therapy, multiple prior catheterizations, have a high body mass index and old clavicle fractures). The benefit of ultrasound will increase as more clinicians become proficient in its use. Although both methods are clinically relevant, the ultrasound-guided approach is superior in patients who are challenging to cannulate. **BJHM**

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Brass P, Hellmich M, Kolodziej L et al (2015) Ultrasound guidance versus anatomical landmarks for subclavian or femoral vein catheterization. *Cochrane Database Syst Rev* **1**: CD011447 (doi: 10.1002/14651858.CD011447)

Denny NM, Fox K, Gillbe C et al (2011) Ultrasound in Anaesthesia & Intensive Care: a guide to training. www.rcoa.ac.uk/system/files/PUB-Ultrasound_Anaes_IC2011.pdf (accessed 26 June 2015)

Fragou M, Gravvanis A, Dimitriou V et al (2011) Real-time ultrasound-guided subclavian vein cannulation versus the landmark method in critical care patients: a prospective randomized study. *Crit Care Med* **39**(7): 1607–12 (doi: 10.1097/CCM.0b013e318218a1ae)

Troianos CA, Hartman GS, Glas KE, et al (2011) Guidelines for performing ultrasound guided vascular cannulation: recommendations of the American Society of Echocardiography and the Society of Cardiovascular Anesthesiologists. *J Am Soc Echocardiogr* **24**(12): 1291–318 (doi: 10.1016/j.echo.2011.09.021)

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