

Commentary

Can you justify not using ultrasound guidance for central venous access?

Andrew R Bodenham

Department of Anaesthesia, Leeds General Infirmary, Leeds, LS1 3EX, UK

Corresponding author: A R Bodenham, Andy.Bodenham@leedsth.nhs.uk

Published: 22 November 2006

This article is online at <http://ccforum.com/content/10/6/175>

© 2006 BioMed Central Ltd

Critical Care 2006, **10**:175 (doi:10.1186/cc5079)

See related research by Karakitsos *et al.*, <http://ccforum.com/content/10/6/R162>

Abstract

Karakitsos and coworkers, in this journal, reported further compelling evidence on the value of ultrasound in guiding internal jugular vein catheterization. In a large, prospective, randomized study of 900 patients, comparisons were made between patients in whom the procedure was performed using landmark-based techniques and those assigned to ultrasound guidance. The key benefits from use of ultrasound included reduction in needle puncture time, increased overall success rate (100% versus 94%), reduction in carotid puncture (1% versus 11%), reduction in carotid haematoma (0.4% versus 8.4%), reduction in haemothorax (0% versus 1.7%), decreased pneumothorax (0% versus 2.4%) and reduction in catheter-related infection (10% versus 16%). The implications of these findings are discussed, and a compelling case for routine use of ultrasound to guide central venous access is made.

Karakitsos and coworkers [1], in this journal, reported further compelling evidence on the value of ultrasound in guiding internal jugular vein catheterization. Their work follows other series demonstrating similar results [2,3]. This study differs from previous studies for the following reasons. First, it is much larger (900 patients), prospective and randomized. Also, comparisons were made between patients in whom the procedure was performed using landmark-based techniques (following use of a small seeker needle) and those in whom ultrasound guidance was utilized. Operators in both groups had significant experience in both techniques.

Significant key benefits obtained with routine use of ultrasound were as follows: reduction in needle puncture time, increased overall success rate (100% versus 94%), dramatic reduction in the frequency of carotid puncture (1% versus 11%), reduction in carotid haematoma (0.4% versus 8.4%), reduction in haemothorax (0% versus 1.7%), decreased pneumothorax (0% versus 2.4%) and reduction in central venous catheter associated bloodstream infection (10% versus 16%).

The reported reductions in complications are in accordance with the findings of previous studies. Ultrasound was used to salvage and diagnose the problem in all failed procedures in the group in which the landmark-based technique was used. The overall failure rate and frequency of serious complications in the landmark-based technique once again refute comments from sceptics who claim that the very low frequency of complications in their hands means that they do not need to take steps to learn to use ultrasound and acquire appropriate equipment for their department. Can you realistically claim that you and your colleagues or trainees would perform better than this group of senior and experienced clinicians in a number of different international units?

The report by Karakitsos and coworkers [1] is the first to provide evidence that use of ultrasound may reduce the risk for catheter-related sepsis in such patients. The true reasons for this are not known, but it is tempting to speculate that it is related to reductions in the number of needle passes, in the risk for thrombosis from vein trauma, in the development of haematoma, and in the frequency of cannulating already partially thrombosed veins. There is a clear link in the literature between thrombosis and infection. Presuming that this link is true, then this is another very strong argument for use of ultrasound because catheter-related infection is accepted as carrying major risk for adverse outcome in critically ill patients, and is also extremely costly to treat and manage.

Karakitsos and coworkers did not attempt to calculate the effect that the net reduction in complications achieved with ultrasound would have on a population of intensive care patients. Although difficult to quantify, it is likely that the high frequency of carotid puncture, pulmonary complications and catheter-related sepsis will have significant effects on both morbidity and mortality in critically ill patients. It is recognised that inadvertent carotid puncture by either seeker needle or introducing needles carries finite risks for stroke and other

complications [4]. Such complications may well be missed in the critically ill or attributed to other causes. Equally, haemothorax and pneumothorax, although treatable in most cases, are likely to lead to increased duration of mechanical ventilation and may, on occasion, mean the difference between death and survival in sicker patients.

Successful use of ultrasound requires adequately trained operators who are skilled in its use [5]. Departments must invest money to purchase appropriate devices and training time for their staff. As the authors of these reports emphasize, it is not just a question of identifying a suitable vein; real-time guidance of the needle into the vein with avoidance of all collateral structures is also required. Techniques of needle visualization in this context are reviewed elsewhere [6].

The literature supporting the use of ultrasound for central venous access by the internal jugular veins is compelling, but there is far less information available to support its use for other routes of access. Nevertheless, the benefits of ultrasound are intuitive at the femoral [7], axillary/subclavian [8] and other peripheral sites [9]. Here deeper, smaller vessels with more complicated relations are present, including the brachial plexus, pleura and arteries. It can be questioned whether large comparative prospective trials of ultrasound versus landmark techniques should be carried out at every single site of vascular access in the body, just to confirm that ultrasound is of benefit. It is my belief that there is enough evidence now from this and the other cited reports to support routine use of ultrasound in all situations in which vessels are not immediately visible or easily palpable from the skin surface. Ultrasound guidance for arterial access has not been studied extensively to date but similar benefits ensue [10-12].

Sceptics of this technology, which now has a much stronger evidence base than many other of the interventions we routinely use in critical care, should urgently appraise their practice. I am regularly invited as an expert witness in the UK to comment on fatal and nonfatal complications of central venous access. In the past, it was possible to defend clinicians who did not use ultrasound on the basis that it was not yet routine or of proven benefit, but I believe that this position will become increasingly untenable in the future.

Other considerations such as patient discomfort with multiple needle passes are also significant. You should ask yourself, what would you prefer, if faced by the prospect of central venous access, often under local anaesthesia alone? Would you prefer a landmark-based technique with the cited risks following multiple needle passes, or the near 100% success rate with minimal passes and a near zero procedural complication rate with the use of ultrasound. The low overall cost of ultrasound devices compared with many other interventions [13,14] now mean that you and your patient can no longer afford complacency in this area.

Competing interests

ARB has received lecture fees from ultrasound companies for teaching ultrasound guided interventions.

References

1. Karakitsos D, Labropoulos N, De Groot E, Patrianakos AP, Kouraklis G, Poularas J, Samonis G, Tsoutsos DA, Konstadoulakis MM, Andreas Karabinis A: **Real-time ultrasound guided catheterization of the internal jugular vein: a prospective comparison to the landmark technique in critical care patients [ISRCTN61258470]**. *Crit Care* 2006, **10**:R162.
2. Hind D, Calvert N, McWilliams R, Davidson A, Paisley S, Beverley C, Thomas S: **Ultrasonic locating devices for central venous cannulation: meta-analysis**. *BMJ* 2003, **327**:361.
3. National Institute for Clinical Excellence: *Guidance on the Use of Ultrasound Locating Devices for Central Venous Catheters (NICE technology appraisal, No. 49)*. London, UK: NICE; 2002.
4. Reuber M, Dunkley LA, Turton EP, Bell MD, Bamford JM: **Stroke after internal jugular venous cannulation**. *Acta Neurol Scand* 2002, **105**:235-239.
5. Bodenham A: **Editorial II: ultrasound imaging by anaesthetists: training and accreditation issues**. *Br J Anaesth* 2006, **96**:414-417.
6. Chapman GA, Johnson D, Bodenham AR: **Visualisation of needle position using ultrasonography**. *Anaesthesia* 2006, **61**: 148-158.
7. Hughes P, Scott C, Bodenham A: **Ultrasonography of the femoral veins, implications for vascular access**. *Anaesthesia* 2000, **55**:1199-1202.
8. Sharma A, Bodenham AR, Mallick A: **Ultrasound-guided infra-clavicular axillary vein cannulation for central venous access**. *Br J Anaesth* 2004, **93**:188-192.
9. Sandhu NS, Sidhu DS: **Mid arm approach to basilic and cephalic vein using ultrasound guidance**. *Br J Anaesthesia* 2004, **93**:292-294.
10. Dudeck O, Teichgraber U, Podrabsky P, Lopez Haenninen E, Soerensen R, Ricke J: **A randomized trial assessing the value of ultrasound-guided puncture of the femoral artery for interventional investigations**. *Int J Cardiovasc Imaging* 2004, **20**: 363-368.
11. Schwemmer U, Arzet HA, Trautner H, Rauch S, Roewer N, Greim CA: **Ultrasound-guided arterial cannulation in infants improves success rate**. *Eur J Anaesthesiol* 2006, **23**:476-480.
12. Levin PD, Sheinin O, Gozal Y: **Use of ultrasound guidance in the insertion of radial artery catheters**. *Crit Care Med* 2003, **31**:481-484.
13. Scott DHT: **It's NICE to see in the dark**. *Br J Anaesthesia* 2003, **90**:269-272.
14. Calvert N, Hind D, McWilliams RG, Thomas SM, Beverley C, Davidson A: **The effectiveness and cost effectiveness of ultrasound locating devices for central venous access: a systematic review and economic evaluation**. *Health Technol Assess* 2003, **7**:1-84.