Pro: Ultrasound and Central Venous Access—It Is Time to Enforce a Standard of Care

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Central venous cannulation is routinely performed for cardiac operations. The right internal jugular vein (IJV) is the site most frequently chosen because it can be cannulated reliably, provides a direct conduit to the right atrium, and is relatively safe. Techniques that have been described for percutaneous IJV cannulation include needle guidance based on surface anatomy or direct ultrasound imaging of the vessel.

Central venous cannulation of the IJV is safe, but has a finite risk of failure and complications (1). Failure to successfully cannulate the IJV occurs in the range of 2% to 9%. Failure rates may be greater in patients who have had multiple prior vascular access procedures, in patients with difficult anatomy, or if the procedure has to be performed in suboptimal conditions. Failure to successfully cannulate the IJV on an initial attempt may also increase risk of pneumothorax because of multiple needle passes or the increased difficulty encountered in performing the procedure may increase the subsequent risk of catheter associated bloodstream infection. The most common complication of IJV cannulation is carotid artery puncture with an incidence ranging from 3% to 10%. Although carotid artery puncture seldom causes a serious adverse event, vascular injuries accounted for the majority of complications leading to claims in the American Society of Anesthesiologists (ASA) Closed Claims Project. In the analysis of central line complications after 1990 from the ASA Closed Claims Project, 16/26 cases (61%), including 7 fatalities, were the consequence of vascular injury, often from accidental cannulation of the artery instead of the vein with an introducer sheath or large bore catheter (2).

Based on the available evidence in the medical literature, 2-dimensional ultrasound guidance was significantly better than guidance based on anatomic landmarks for successfully IJV cannulation. An analysis of randomized controlled trials found that 2-D ultrasound guided IJV cannulation was superior based on the following outcome measures: a) number of failed catheter placements, b) number of catheter placement complications, c) risk of failure on the first catheter placement attempt, d) number of attempts required to achieve successful catheterization, and e) rate of success after failure by the alternative method (3-4). The consistent demonstration of the advantages of 2-D ultrasound for facilitating central venous cannulation has lead to guidelines that recommend the routine use of ultrasound guidance for central venous cannulation. The National Institute of Clinical Excellence (NICE) issued guidelines recommending that ultrasound guidance be used for all elective and considered for all emergency central venous cannulations in the National Health Service (England and Wales) (4). In the United States, the Agency for Health Care Research and Quality identified use of real-time ultrasound guidance for central venous cannulation as one of the items in its list of best practices to improve patient safety (5).
The advantages of ultrasound guided venous cannulation include precise direct imaging of both IJV and carotid artery vessel location and size; identification of aberrant anatomical relationships between the artery and vein; visualization of needle puncture of the vessel; and confirmation of guidewire and catheter placement within the vessel. The advantages of ultrasound imaging are particularly useful in patients with ambiguous external landmarks because of obesity, previous neck surgery or neck radiation; patients who have had previous central vein access procedures; patients at risk of deep vein thrombosis; or patients at risk for bleeding complications. Aberrant anatomic relationships between the IJV and carotid artery were observed in as many as 3% of adult patients studied by ultrasound with head rotation 30° from midline (6).

Arguments against the routine use of ultrasound guidance for central venous cannulation are difficult to support. In a cost analysis, it was estimated that routine use of ultrasound could result in savings as a consequence of physician time, equipment needed for each successful cannulation, and treatment costs for avoidance of 90 complications for every 1000 procedures performed (5). The results of the randomized and non-randomized trials comparing ultrasound to anatomic landmark techniques for central venous cannulation suggest that the successful use of ultrasound guidance requires very little training and can be rapidly adopted by experienced physicians across a variety of specialties. Available studies also suggest that any technique that employs the use of ultrasound such as “X marks the spot technique”, “one-handed technique”, “three-handed technique”, or the use of needle guides were all associated with improved success compared to guidance based on anatomic landmarks (7).

In conclusion, the existing evidence, from randomized controlled trials to expert opinion, support unequivocally the routine use of ultrasound imaging for central venous cannulation and the evidence is most compelling for cannulation of the IJV in particular. Any busy clinical practice with a high volume of cases that require central venous cannulation seeking to improve efficiency and patient safety should consider acquiring the necessary equipment and training their practitioners on the routine use of ultrasound imaging to facilitate central venous cannulation.

References