Ultrasound applications for regional anaesthetists – thinking outside the box

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Deposition of local anaesthetic in the proximity of nerves, plexi, within fascial planes, in the paravertebral, epidural or subarachnoid space, is the ever expanding core activity of a regional anaesthetist. Advantages of using ultrasound in this clinical setting include detection of anatomic variants, reduction of volume of local anaesthetic needed with the implication of a lower potential for systemic toxicity, faster onset, real-time assessment of needle advancement avoiding key structures such as blood vessels or pleura, and observation of local anaesthetic spread patterns, all of which are key elements of block success and safety [1]. In addition, we have developed approaches aimed at reducing or quantifying side effects, such as sparing the phrenic nerve when performing an interscalene block [2,3] or assessing the degree of the resulting diaphragm paralysis [4].

From the preoperative to the postoperative period, there appear to be many more opportunities for ultrasound users to improve patient assessment and management in the ultimate hope of improved perioperative outcomes.

Recent guidelines on *vascular access* recommend the use of ultrasound guidance for all routes of access where the vessel cannot be directly seen or palpated [5]. Routine use of ultrasound had been previously documented for internal jugular central venous catheterisation (unless in emergency or other unusual situations), and early in other procedures (arterial and peripheral venous), if difficult. Clearly, ultrasound makes many steps safer includ-

ing: evaluation of puncture site, eliminating seeker needles, needle guidance, verification of guidewire/catheters in a vessel, information on central catheter tip position and recognition of complications [5].

As an emerging application, ultrasound has been shown to aid *airway evaluation and management* with obvious potential benefits for both clinician and patient. Ultrasound can identify vocal cord dysfunction and pathology before induction of anaesthesia thus highlighting potential difficulties. It may be utilized to determine airway size and predict the appropriate diameter of single- and double-lumen endotracheal tubes as well as tracheostomy tubes [6]. It appears to reliably differentiate between tracheal, oesophageal, and bronchial intubation. Taken a step forward, ultrasonography of the neck can accurately locate the cricothyroid membrane for emergency airway access and identify tracheal rings for ultrasound-guided tracheostomy. Upper airway point-of-care ultrasound has thus the potential to become the first-line non-invasive adjunct assessment tool in airway management [6].

Much has been published in recent years on the utility of ultrasound for *evaluation of gastric content*. Inhalation of gastric content during induction, maintenance or emergence from anaesthesia has devastating consequences leading to significant morbidity and mortality. Therefore, evaluation of gastric contents is most helpful in order to inform an assessment of aspiration risk and thus guide anaesthetic management at the bedside. It is possible to qualitatively evaluate and determine the nature of gastric content: empty, clear fluid, or thick fluid/solid. In addition, mathematical models have correlated antral cross-sectional areas with volumes of gastric content. A semi-quantitative three-point grading system based solely on qualitative evaluation of the clear-fluid-containing gastric antrum scanned in both the supine and right lateral decubitus positions, has been proposed as a simple screening tool to differentiate low- from high-

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volume states [7]. This assessment modality appears useful not only in emergency situations but also in elective settings where patients either do not follow the fasting instructions [8] or present with full stomach despite the recommended duration of fasting [9].

Postoperative bladder distension and associated urinary retention leading to pain, restlessness and confusion particularly in the elderly population, is commonly underestimated. Bladder ultrasound is a simple, reliable method to *detect residual urine and measure its volume*. The decision to catheterise or not can be guided with bladder ultrasound thus diminishing the risk of urinary tract infection [10].

Acknowledging the widespread use of the '*Focussed Assessment with Sonography for Trauma*' (FAST) exam by our emergency and intensive care medicine colleagues, its utility for evaluating intra-abdominal fluid extravasation in the perioperative setting has been recently pointed out [11]. Correlating the presence of intra-abdominal fluid extravasation with greater postoperative pain in patients who have undergone hip arthroscopy, is intriguing to say the least [12].

Focused Cardiac Ultrasound' (FoCUS) is a well-established assessment tool for patients in critical conditions. A comprehensive review summarises opportunities for the regional anaesthetist specifically, to improve patient assessment and implicitly perioperative management [13]. Preoperatively, FoCUS can be used to assess patients for volume status and significant valvular disease prior to neuraxial anaesthesia; intraoperatively, it can help differentiate among complications related to regional anaesthesia, including high spinal or local anesthetic toxicity resulting in hemodynamic instability or cardiac arrest, as well as aid the diagnosis and management of life-threatening complications such as pulmonary embolism or derangements in volume status [13].

Similarly, *lung ultrasonography* (LUS) is widely used worldwide in emergency rooms and critical care units to evaluate patients with respiratory distress. Compelling evidence has emerged in support of lung point-of-care ultrasonography as a rapid and superior tool to traditional imaging modalities such as chest radiography and fluoroscopy [14]. As nerve blocks put patients at potential risk of complications such as pneumothorax, it is important to understand how to use lung ultrasonography to evaluate for this condition. In addition, it is highly desirable to differentiate between other potential causes of respiratory distress, such as interstitial syndrome and pleural effusions [14].

In order for the afore mentioned applications and others to make their way into the regional anaesthetist's armamentarium, there is an urgent need to emphasise the

clinical utility of each, to develop a curriculum and begin training existing and future anaesthetists in perioperative ultrasound. In a recent position paper, a multidisciplinary task force reviewed the expanding scope of perioperative ultrasound and called to action for it to be made an essential component of the anaesthesia curriculum and to be embraced by anaesthetists [15]. Although not devoid of individual challenges, conquering the task should come naturally to the regional anaesthetist already familiar with principles of procedural ultrasound, making the outlook achievable in the foreseeable future.

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