Point of Care Ultrasound in the Perioperative Setting

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The use of point of care ultrasound (POCUS) in the perioperative setting is rapidly increasing. Indications are expanding, and a growing body of literature supports its efficacy for improving patient management and outcomes.[1] The use of POCUS has become standard practice for vascular access, regional anaesthesia, cardiac, and chest assessment in the intensive care and anaesthesia environments, and in the emergency department. Training in POCUS is now mandatory for intensive care medicine and emergency medicine, and is supported in anaesthesia, but not yet mandated. POCUS encompasses a wide range of modalities and scope of practice – and as such, multiple professional societies and colleges have proposed guidelines and standards of training. [1] [2] [3] [4] [5] As machines become smaller, more portable, and less expensive, and the utility of POCUS is further demonstrated, use is expected to become nearly ubiquitous. This talk will focus on the current use of echocardiography and ultrasound by non-cardiac anaesthetists, in the perioperative setting.

Transoesophageal Echocardiography

Whilst transoesophageal echocardiography (TOE) skills are generally the domain of cardiologists and cardiac anaesthetists, the role of TOE in the perioperative setting for diagnosis of unexplained haemodynamic instability, and in the management of high risk and prolonged surgeries for co-morbid patients is well established. Non-cardiac anaesthetists may make use of TOE by referral to colleagues (e.g., a combined intra-operative approach with two anaesthetists), or with training and interpretation at the basic level. As with all modalities in POCUS, defined scope of practice and appropriate level of training and credentialing are essential.[6] Basic and advanced levels of TOE certification have been established in the United States by the National Board of Echocardiography (NBE), and in Canada by the Canadian Cardiovascular Society and Canadian Society of Echocardiography, whilst in Europe and the United Kingdom certification for TOE is at an advanced perioperative level. Guidelines for the performance of TOE are available from the American Society of Echocardiography (ASE), and The European Association of Cardiovascular Imaging (EACVI).[7] TOE is useful for both limited and comprehensive examination of the heart, great vessels, lungs and pleura.

Transthoracic Echocardiography and Focused Cardiac Ultrasound (FOCUS)

Transthoracic echocardiography (TTE) is used more frequently than TOE, and is less invasive, often more portable, and associated with less cleaning and sterilisation costs. TTE probes and machines can be used not only for cardiac ultrasound, but for imaging of the great vessels, the chest and airway, and abdominal structures. Suitably qualified and trained clinicians can perform TTE in the perioperative setting, and guidelines exist once again for training and qualification. [5] FOCUS refers to use of surface echocardiography and can encompass a broad range of studies and uses, from a comprehensive diagnostic echocardiogram ("formal TTE") to a Focus Assessed Transthoracic Echo (FATE) protocol echocardiogram, which examines five basic views, and is used to specifically rule in or rule out limited pathology or conditions. Diagnosis of gross LV and RV pathology (dilatation, severe systolic impairment), pericardial collections, severe valvular pathology (in particular severe aortic stenosis) can be made reliably using FOCUS. The interpretation of volume status and afterload has also been described using FOCUS, and whilst in patients with previously normal cardiac status and supporting physiologic variables this can be reliable, there are several caveats that are important to understand to avoid misdiagnosis or incorrect interpretation of echocardiographic findings. [8] [9] These will be discussed during the presentation.

Lung and Airway Ultrasound

Chest pathology such as pleural collections, pneumothorax, pulmonary oedema, lung atelectasis and airway pathology may be diagnosed (and the response to management such as drainage via catheters or needle aspiration, assessed) with POCUS. Ultrasound has been used to identify the trachea and cricothyroid membrane in patients with difficult anatomy (such as obesity), and to identify vascular abnormalities prior to front of neck access (planned or unplanned). Ultrasound has proven utility in these areas also, as a rapid and readily available, non-invasive and reliable method of assessment. [10] [1]

Other Areas

Point of care ultrasound is used for other diverse tasks. Optic nerve ultrasound allows diagnostic information relating to intracranial pressure, whilst ultrasound is also used to detect intraocular foreign bodies, retinal detachment, vitreous haemorrhage, and retrobulbar haemorrhage. [1] Vascular uses are well beyond the scope of this paper, however are well documented and include assessment of vessels, confirmation of anatomy, and use for guidance during placement of catheters or intravascular procedures. Use during regional anaesthesia is of proven benefit, lowering the number of needle passes required, improving block onset time, and avoiding vascular injury, and is now a standard of care. [11] POCUS for abdominal diagnosis and management is increasingly described, and can be used to examine indwelling urinary catheters placement and efficacy, abdominal collections and fluid, gastric volume and aspiration risk, and the vena cavae and other vessels for information on volume status, and right heart function. [1] [12] [13]

Summary

The use of POCUS is increasing, due to the wide variety of clinical applications and the proven efficacy, as well as the relatively short and steep learning curve for novice practitioners to become competent in basic and limited assessments. Using ultrasound is a standard of care in several areas of anaesthetic practice currently, and this is likely to expand (along with training requirements) in the future.

References

1. Mahmood F, Matyal R, Skubas N, et al. Perioperative Ultrasound Training in Anesthesiology: A Call to Action. *Anesth Analg.* 2016;122(6):1794-1804.
2. Haskins SC, Tanaka CY, Boublik J, Wu CL, Sloth E. Focused Cardiac Ultrasound for the Regional Anesthesiologist and Pain Specialist. *Reg Anesth Pain Med.* 2017;42(5):632-644.
3. Via G, Hussain A, Wells M, et al. International evidence-based recommendations for focused cardiac ultrasound. *J Am Soc Echocardiogr.* 2014;27(7):683 e681-683 e633.
4. Jensen MB, Sloth E, Larsen KM, Schmidt MB. Transthoracic echocardiography for cardiopulmonary monitoring in intensive care. *Eur J Anaesthesiol.* 2004;21(9):700-707.
5. Spencer KT, Kimura BJ, Korcarz CE, Pellikka PA, Rahko PS, Siegel RJ. Focused cardiac ultrasound: recommendations from the American Society of Echocardiography. *J Am Soc Echocardiogr.* 2013;26(6):567-581.
6. Cahalan MK, Abel M, Goldman M, et al. American Society of Echocardiography and Society of Cardiovascular Anesthesiologists task force guidelines for training in perioperative echocardiography. *Anesth Analg.* 2002;94(6):1384-1388.
7. Hahn RT, Abraham T, Adams MS, et al. Guidelines for performing a comprehensive transesophageal echocardiographic examination: recommendations from the American Society of Echocardiography and the Society of Cardiovascular Anesthesiologists. *J Am Soc Echocardiogr.* 2013;26(9):921-964.

8. Frederiksen CA, Juhl-Olsen P, Andersen NH, Sloth E. Assessment of cardiac pathology by point-of-care ultrasonography performed by a novice examiner is comparable to the gold standard. *Scand J Trauma Resusc Emerg Med.* 2013;21:87.
9. Canty DJ, Royse CF, Kilpatrick D, Bowman L, Royse AG. The impact of focused transthoracic echocardiography in the pre-operative clinic. *Anaesthesia.* 2012;67(6):618-625.
10. Piette E, Daoust R, Denault A. Basic concepts in the use of thoracic and lung ultrasound. *Curr Opin Anaesthesiol.* 2013;26(1):20-30.
11. Neal JM, Brull R, Chan VW, et al. The ASRA evidence-based medicine assessment of ultrasound-guided regional anesthesia and pain medicine: Executive summary. *Reg Anesth Pain Med.* 2010;35(2 Suppl):S1-9.
12. Dahine J, Giard A, Chagnon DO, Denault A. Ultrasound findings in critical care patients: the "liver sign" and other abnormal abdominal air patterns. *Crit Ultrasound J.* 2016;8(1):2.
13. Denault AY, Beaubien-Souligny W, Elmi-Sarabi M, et al. Clinical Significance of Portal Hypertension Diagnosed With Bedside Ultrasound After Cardiac Surgery. *Anesth Analg.* 2017;124(4):1109-1115.