Perioperative Ultrasound: The Future Is Now

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In this issue of Anesthesia & Analgesia, a multispecialty working group headed by Mahmood et al.1 reports on “Perioperative Ultrasound (US) Training in Anesthesiology: A Call to Action.” We congratulate the authors on a comprehensive review of the current state of perioperative US applications and training in our increasingly complex clinical practice environment. Although proponents of this theme have been advocating action over the past decade,2–5 this “white paper” cogently summarizes the components of this theme have been advocating action over the past decade,2–5 this “white paper” cogently summarizes the value of perioperative US as a diagnostic and monitoring tool and its value in procedural guidance. In addition, the article identifies the current status of US education within anesthesiology and anesthesia subspecialty training programs, both domestically and internationally. The authors review several protocols for a broad-based perioperative US curriculum and urge thought leaders from the American Board of Anesthesiology (ABA), American Society of Anesthesiology (ASA), and anesthesiology subspecialty societies to define standards for residency training and implement pathways to achieve competency.

Although the authors note that certain critical concepts of perioperative US are already contained within the Anesthesiology Milestone Project,6 the ASA’s Perioperative Surgical Home model, and the ABA’s content outlines for written and oral examinations, the fact remains that trainees are not uniformly exposed to perioperative US in a structured teaching format across the United States. Obstacles to full implementation include the fact that certain fellowship programs (e.g., adult cardiothoracic anesthesiology, critical care medicine, and regional anesthesia/acute pain) have “siloed” subspecialty training and certification pathways, have championed unique US protocols, or promoted levels of expertise exceeding those considered practical by the general practicing anesthesiologist. In addition, many residency programs may not have the necessary infrastructure to develop a residency-wide curriculum.

As pointed out by the working group, a rapidly expanding body of evidence exists, suggesting clinical benefits for a variety of perioperative US applications, superiority of information obtainable from US compared with other point-of-care monitoring and diagnostic modalities (even in the hands of novice adopters), and feasibility of programmatic US-based residency training across multiple specialties.2–4

However, the shortcomings of broad-scale adoption of perioperative US are substantial and must be considered. How specific should a perioperative US curriculum be to enhance care and improve outcomes in the hands of general anesthesiologists? How do we train clinicians to recognize when to call a specialist? Will placing new technology into the hands of the noncertified anesthesiologist actually prevent necessary diagnostic examinations from being ordered or even inappropriately replace “gold standard” examinations when indicated because of false-negative results? What are the acceptable limits of agreement with certified subspecialists or, indeed, our nonanesthesiologist colleagues (cardiologists, radiologists, pulmonologists, etc.) for specific applications? The latter issue has been recognized by other specialties as a potential problem. Using computerized tomography as an example, Arhami Dolatabadi et al.10 compared interpretations of 544 head computerized tomography scans by emergency medicine physicians versus radiologists (as the gold standard). Attending emergency physicians and senior residents had combined error rates (false positives and false negatives) of 17% and 16%, respectively. In the realm of US, whereas focused cardiac US in the hands of emergency physicians has been shown to improve diagnostic speed and accuracy in the identification of aortic dissection, Pare et al.11 demonstrated a sensitivity and specificity of only 78.6% and 92.9%, respectively, for identification of aortic aneurysms.12 Just what are the acceptable margins of error we can tolerate in critical decision making with perioperative US? These will need to be determined.

If we as a specialty decide that incorporating perioperative US training is central to transforming the anesthesia resident of today into the perioperative physician of the future, there are several hurdles to clear. We have already set precedents of differential levels of certification for certain applications of perioperative US. As an example, the scope of practice of the newly developed Basic Perioperative Transesophageal Echocardiography certification pathway is limited to imaging that does not influence the surgical plan as one of its central tenants compared with Advanced Perioperative Transesophageal Echocardiography certification.13 What should define the scope of practice of anesthesiologists employing basic transthoracic echocardiography?
protocols such as those contained within popular protocols such as FoCUS or FORESIGHT. Although competency is implied for placement and interpretation of waveforms from a pulmonary arterial catheter, previous studies have well demonstrated that many clinicians’ aptitudes are in reality far from perfect. Should we assume that competence will be inferred from completion of training via incorporation of perioperative US into core residency training and ABA certification, or will it be necessary to establish a specific competency examination (or modules) to determine minimal standards for providers? Should we model a separate pathway to certification based on submission of actual clinical images as currently required by the American College of Chest Physicians, assuming images can be adequately deidentified? Is a training requirement (didactics with hands-on training) and an examination adequate, as has been established by the American Society of Regional Anesthesia and the ASA with respect to the continuing medical education–accredited US-Guided Regional Anesthesia and Clinical Training Portfolio? And realizing that there are limits imposed by inadequate fidelity of imaging available between vendors and different types of US probes, should there be basic equipment standards required?

These issues are further complicated by variability in credentialing practices relevant to diagnostic and therapeutic applications of US testing, monitoring, and US-guided procedures. Third-party payers have moved toward more stringent reimbursement criteria for indications of US and elements of reporting and may restrict payment to physicians, even those with documented training, for performing and interpreting diagnostic imaging. Future reimbursement trends will likely continue to be based on those enforced by the Centers for Medicare & Medicaid Services, who have at least 9 billing codes and modifiers for intraoperative echocardiography.

Barriers to the national adoption of training and education standards and protocols for perioperative US modalities specific to anesthesiology residency training programs remain many and varied. The costs required for purchasing and maintenance of US equipment, access to existing equipment, and sufficient numbers of appropriately trained faculty are but a few of these obstacles. Enhanced learning via simulation is not universally available. It will take a commitment of time and effort to train the tens of thousands of practicing anesthesiologists interested in developing similar expertise. However, we need not completely reinvent the wheel. The American College of Emergency Physicians and American College of Surgery had similar growing pains when they adopted comprehensive training requirements for Bedside Limited Echocardiography and Focused Assessment with Sonography for Trauma consensus statements, respectively. With similar concerns that graduates of emergency medicine training programs must demonstrate competence in 11 core US applications, the American College of Emergency Physicians successfully established a scope of practice and training requirements along with an alternate pathway for demonstration of competence by practicing emergency room physicians nearly a decade ago. Yet, rather than becoming obsolete, emergency medicine programs have adapted accordingly. The framework is therefore already established, and proof of concept for a successful integration of a whole-body point-of-care US curriculum within an anesthesiology program was recently published by Ramsingh et al. Indeed, portions of the FORESIGHT protocol have been separately validated in the perioperative environment. For example, Zhang and Critchley recently demonstrated that the inferior vena cava collapsibility index (part of the FORESIGHT protocol) can be used preoperatively to predict hypotension accompanying induction of general anesthesia, allowing anesthesiologists the opportunity to optimize volume status before ever reaching the operating room. Is the FORESIGHT protocol they promote the one we should adopt as a specialty? That remains to be seen, although the applicability of a protocol that incorporates abdominal, intrathoracic, and intracranial surveys along with airway evaluation and gastric volume assessments would seem to be an attractive component of the Perioperative Surgical Home.

We believe that a systematic effort to incorporate a perioperative US curriculum as part of core residency training in anesthesiology is achievable and should be a high-priority, short-term goal of our specialty’s relevant leadership groups in education and training. The barriers to success mentioned above do not necessarily represent a complete impasse but need to be critically examined and thoughtfully addressed as we move forward.

As Skubas commented in a recent editorial, “it is possible that ultrasound imaging may become the stethoscope of the future.” One can argue that we have not yet fulfilled the potential of that revered device (as illustrated by the lack of widespread adoption of more expensive digital-based devices). US equipment, although increasingly portable, remains considerably more complex technologically and logistically and, of particular importance, more expensive. However, the information obtainable is useful for myriad applications at the bedside to improve outcome.

We believe the future is now.


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