ICU Ultrasound

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The Coming Boom

In this issue of CHEST (see page 1416), Melamed and colleagues report their experience in having intensivists perform limited bedside echocardiography. They trained intensivists for 6 h to use a hand-carried device and studied their accuracy in judging left ventricular (LV) systolic function. The “gold standard” was formal transthoracic echocardiography performed by certified sonographers and interpreted by experienced cardiology echocardiographers. Intensivists acquired and interpreted their own images in <10 min. There was excellent concordance regarding LV function. Occasionally, intensivists overestimated LV function but never misclassified severe LV dysfunction as normal.

This study has several limitations. Some intensivists already have experience in echocardiography, either by reviewing formal echocardiographic images in their clinical practice or by garnering experience in LV assessment on their own, using ultrasound devices that are commonly present in ICUs. It is not clear how much prior experience the studied intensivists had; perhaps typical intensivists would do less well after 6 h of training. One must also remember that these intensivists were blinded to the patient’s diagnosis. Real clinicians performing limited echocardiography would integrate the images with other clinical and hemodynamic information. Presumably (but not necessarily), this would improve their accuracy.

Similar results have been reported by others, not only for echocardiography, but also for other forms of ultrasound imaging. For example, Vignon and colleagues demonstrated that, for intensivists performing hand-held echocardiography, two-dimensional imaging was as diagnostically accurate and had a therapeutic impact that was similar to full transthoracic echocardiography. Following 10 h of training, surgical intensivists successfully performed and accurately interpreted limited ultrasound findings in 90 subjects.

Resident physicians can be trained to perform and interpret ultrasound examinations as well, for example, following 8 h of training for echocardiography and after only 30 min of training for brachial artery Doppler examination.

Acceptance of intensivist-performed ultrasound in the United States has lagged that in Europe, but now, largely driven by their success in facilitating vascular access, reducing procedural time, and avoiding complications, these devices have become ubiquitous in ICUs. Indeed, many intensivists now feel that, for nonemergent central venous catheterization, the standard of care requires real-time ultrasound guidance. Yet, ultrasound offers great potential in other critical care realms. Intensivists who have acquired the necessary equipment and learned to use it to place central venous catheters are now aiming their probes at venous thrombi, pleural effusions, abdominal fluid collections, aortic aneurysms, thick-walled gallbladders, paradoxically moving diaphragms, and the heart. Intensivists quickly discover that they can exclude hydronephrosis in a patient with urosepsis more expeditiously by turning on their own ultrasound machine than by ordering a radiology-based examination that will be interpreted many hours later. More subtly, the patient may benefit from a lower threshold for performing an ultrasound examination than for ordering an alternative test. As an example, take the mechanically ventilated patient with ARDS who has some deterioration in gas exchange or hemodynamics. When should the clinician order a portable chest radiograph to exclude pneumothorax? Because it takes only 5 min to accurately exclude pneumothorax with a hand-held ultrasound, the intensivist is more likely to perform that test early or when the clinical probability for pneumothorax is small, rather than waiting for clinical signs to progress in order to “justify” ordering the radiograph.

Intensivists are also learning that they are better positioned to answer certain clinically relevant questions with ultrasound than with their radiologist or cardiologist colleagues. It is now widely recognized that central venous and wedge pressures have little value for predicting fluid responsiveness in hypotensive, septic patients. At the same time, dynamic indexes, such as respiratory pulse pressure and inferior vena caval diameter variation (using ultrasound) are quite...
accurate. Only the intensivist is well positioned to carry out these assessments and to repeat them as clinically indicated.

Thus, intensivists now have the equipment to perform a broad range of ultrasound examinations and, motivated by the desire to help their patients, are beginning to do just that. Indeed, lately there has been an explosion of interest in ultrasound courses, lectures, texts, and other means of acquiring the necessary expertise. But, will this really prove beneficial? Or will well-meaning but inexperienced intensivists misinterpret, misdiagnose, and mistreat their fragile patients?

For many reasons, it is essential that intensivists gain and nurture broad competence in ultrasound. First, they can provide more timely service than is practical from imaging consultants and do so without the need for transporting the unstable patient. Second, direct knowledge of the patient and the clinically relevant question should produce a more finely honed result. These advantages, however, rest on the assumption that intensivists can interpret sonographic images with sufficient expertise. Studies such as that of Melamed et al.1 show that modest expertise will not develop without leadership, organization, and champions. Training programs must incorporate a formal ultrasound curriculum for their fellows, including supervised, hands-on guidance. In parallel, academic faculty must remediate their own discomfort in using, teaching, and supervising the use of a technique they did not grow up with. Challenges are no less outside of academic centers where practitioners often operate without the educational structures and critical mass typical of academic departments. Competencies must be defined, and ways to effectively assess whether trainees and practicing intensivists are qualified to perform ultrasonography should be studied and implemented. Fortunately, some of the professional societies have begun to organize in this regard. The Critical Care NetWork of the American College of Chest Physicians, working with the Société de Réanimation de Langue Française, has just published a list of competencies in ICU ultrasound.8 This is a good start but, as we anticipate the coming boom in ICU ultrasound, it is essential to assure that skills spread as fast as the machines.

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REFERENCES


Clara Cell Protein CC16
A New Lung Epithelial Biomarker for Acute Lung Injury

There has been considerable interest in the contribution of lung epithelial injury to the pathogenesis of acute lung injury (ALI). Injury to the alveolar epithelium leads to alveolar edema, a decrease in surfactant activity, a reduction in alveolar fluid clearance, and more procoagulant and antifibrinolytic activity in the distal airspaces of the lung.1–3 One approach to estimating the degree of lung epithelial injury has been to measure plasma and airspace biomarkers of alveolar epithelial injury in patients with ALI. In addition to providing more insight into pathogenesis, biomarkers of lung epithelial injury may also have diagnostic value for differentiating cardiogenic edema from primary lung injury edema, particu-
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