More HOCUS POCUS: Advocating for Point-of-Care Ultrasound Teaching in Medical School

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Abstract

Point-of-Care Ultrasound (PoCUS) is hailed as the "stethoscope of the future". Especially in acute and critical care settings, PoCUS has countless applications and has been shown to improve diagnostic and procedural outcomes. Although residency programs are starting to adopt ultrasound teaching, it seems that North American undergraduate medical programs have much room for improvement. For instance, a 2016 Canadian survey showed that only half of Canadian medical schools had integrated PoCUS into their curricula, with only 0-5 hours of teaching per year. Medical schools are constantly seeking to innovate education, and PoCUS should be no exception. This Review and Editorial will highlight the importance of PoCUS in acute and critical care, and advocate for increased ultrasound teaching in undergraduate medical programs.

Background

Point-of-Care Ultrasound (PoCUS) is hailed as the "stethoscope of the future". While physical exams often rely on an integration of maneuvers and auscultation – all helpful for arriving at a diagnosis – the ultrasound now permits immediate and direct visualization of anatomy and physiology.[1] Conceivably, this is a powerful tool in Intensive Care Units (ICU), acute care, and trauma settings where patients require swift diagnoses at the bedside. For example, intensivists can use PoCUS to accurately assess for cardiac function, pneumothoraces, fluid status, and many other life-threatening conditions that previously required detailed radiographic studies.[1,2]

Despite the advantages of PoCUS, some argue that it is not being applied or taught to its full potential. In a survey of 101 American emergency departments, less than half of physicians were credentialed to use bedside PoCUS, with lower rates in community compared to academic departments.[3] In another survey of mostly junior doctors, only 43.1% used PoCUS in their practice and only 39.2% had received formal training in ultrasound. In this cohort, the top barriers to developing a PoCUS training program were availability and cost of ultrasound machines, lack of a formal curriculum, and time required to train faculty members and learners.[4] Given the growing importance of PoCUS, the current editorial aims to i) review the roles of PoCUS in critical and acute care settings; 2) describe the current state of PoCUS education; 3) advocate for increased PoCUS teaching in medical school.

Applications of PoCUS in Critical Care

The role of PoCUS is becoming as broad as it is essential. This was exemplified in rescue efforts after the devastating 2008 Wenchen earthquake, which led to mass casualty of over 69,000 deaths and hundreds of thousands injured. In a local hospital, PoCUS was used on 1207 wounded patients to guide interventions, triage injuries, and diagnose cases of hemoperitoneum, pleural effusion, visceral organ damage, arterial tears, venous thrombosis, and soft tissue hematoma.[5] Even in a more controlled ICU setting, PoCUS has been shown to provide new diagnoses and changes to clinical management in 65.5% and 36.9% of cases, respectively.[6] While there are many uses of ultrasound, these are considered to be essential techniques based on the Canadian Point of Care Ultrasound Society and the critical care literature:[2,6,7]

Cardiac Ultrasound

Focused cardiac ultrasound ("FoCUS") – the foundation for Critical Care Echocardiography (CCE) – classically involves five views of the heart: parasternal long axis, parasternal short axis, apical four-chamber, subcostal inferior vena cava, and subcostal four-chamber views. These allow evaluation of ventricular size and function (e.g., shock or heart failure), myocardial size and motion (e.g., cardiomyopathy or infarct), pericardial effusion, inferior vena cava size and mobility (e.g., volume status in the hypotensive patient), and aortic pathology (e.g., dissection or aneurysm). In hemodynamically unstable patients, FoCUS is very valuable in providing diagnosis and guiding treatment.[2,8,9]

Lung Ultrasound

Through ultrasound, the lung can be visualized as the chest wall, pleura, and subpleural space, which are associated with various pathologies: pneumothorax, pleural effusion, in-

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terstitial disease, edema or consolidation, etc. Over the years, several imaging signs and decision-tools have been validated. For instance, lung sliding at the pleural line can rule out pneumothorax even more accurately than supine chest x-ray. PoCUS in the acutely dyspneic or hypoxic patient can guide life-saving diagnosis and treatment.[10,11]

Abdominal Ultrasound

Some abdominal pathologies can be identified on PoCUS, such as cholecystitis, abdominal aortic aneurysm or rupture, bowel perforation, renal perfusion or obstruction, or urogynecological disease. Specific to trauma, the Focused Assessment with Sonography for Trauma (FAST) scan helps to identify free fluid in the abdomen as a sign of intraperitoneal bleeding. Thus, the abdominal ultrasound serves as an efficient and radiation-free alternative to CT-scans.[11,12]

Procedural Guidance

By providing direct visualization of anatomy, ultrasound has become the standard for various procedures including regional anesthetic blocks, central venous catheter or arterial line placement, para- and thoracenteses, and percutaneous tracheostomy. Being able to perform these techniques efficiently with ultrasound is key when patients have difficult vascular or airway access following trauma or critical illness.[11]

Airway Management

While still primarily an academic interest, PoCUS can be used to guide airway and ventilation management in critical care. In a small study, diaphragm thickening fraction on ultrasound demonstrated high sensitivity and specificity in predicting successful ventilator weaning. There is also growing body of literature on PoCUS in guiding endotracheal and tracheostomy tube size, confirming tube positioning, localizing airway structures for emergency access, and predicting difficult airways.[13,14]

Other

More specific applications PoCUS include vascular scanning for deep vein thrombosis, optic nerve assessment for increased intracranial pressure (i.e., in neurotrauma or stroke), and transcranial doppler for vasospasm or cerebral ischemia. However, these are not standardly performed or taught in PoCUS curricula.[11]

Current PoCUS Teaching

Recognizing the importance of PoCUS, some faculties have been enthusiastic to test and adopt formal curricula. In a 2016 survey of 13 Canadian medical schools, around half of respondents (6/13) had implemented ultrasound education since 2013; commonly, this was taught in clerkship through emergency medicine, internal medicine, or anesthesia rotations by non-radiologist physicians. There was also an emphasis on practical, hands-on teaching with a clinical problem-based approach, with the help of online resources and textbooks.[15] In addition, several reports by American medical schools, such as Harvard or Ohio State University, have described their experiences with incorporating PoCUS training into basic anatomy and physical exam courses, preclinical years, clerkship, or even throughout all years of medical school.[16-19] Teaching usually involves a combination of didactic lectures, hands-on training with patient-models or ultrasound simulators, clinical cases, and final projects or objective structured clinical examinations (OSCEs). Topics covered generally include systems anatomy, image acquisition and interpretation skills, abdominal FAST scans, cardiac scans, and lung ultrasound for pneumothorax sliding.[20-22]

While enthusiasm for PoCUS has "trickled" to the medical school level, there is room for improvement. In a 2014 survey of American undergraduate medical programs, only 62.2% reported some ultrasound training and 18.6% claimed it as an area of priority.[23] Similarly, in the 2016 Canadian medical school survey, most schools reported only 0-5 hours of teaching per year.[15] Top barriers to implementation included lack of space in the established curriculum, lack of financial support and infrastructure, and lack of ultrasound machines. Given the ever-growing role of PoCUS, medical schools must leverage their ultrasound curricula to better prepare the future generation of doctors. Some strategies might include dedicating more curricular time for PoCUS teaching, partnering with hospitals to access ultrasound equipment, relying on free online resources and videos for teaching, and recruiting residents or senior medical students to teach junior trainees. On a national scale, as was recently done by American programs, Canadian medical faculties should also define minimum standards for PoCUS skills before students move on to residency.[24]

Conclusion

PoCUS is an essential skill in a physician's diagnostic and interventional toolbox. While residencies such as Emergency Medicine, Anesthesiology, Critical Care, and Obstetrics/Gynecology have eagerly adopted ultrasound teaching, medical schools should play their part by providing increased and early exposure to PoCUS. Future work should aim to establish a feasible and effective PoCUS curriculum, determine ways to assess competency at a medical school level, and set a national standard for ultrasound teaching in medical school.

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