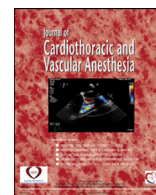




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Pro and Con

Con: Limitations of POCUS Examination: Be Aware of Overdiagnosis and Undertreatment

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ULTRASOUND IS A REVOLUTIONARY, noninvasive imaging tool that, when used and interpreted by trained personnel in the proper clinical situation, can provide correct diagnosis and treatment. Point-of-care ultrasound (POCUS) is defined as a handheld, mobile, broadly applied ultrasound machine capable of performing limited studies at bedside to provide answers to focused, closed-ended, binary questions.¹⁻² Over the last 15 years, the medical literature has demonstrated the importance of this tool in medical practice,³ with applications including delineation of airway structures, lung pathology, cardiac structure and function, gastric volume and content, guided vascular procedures, and emergent focused assessment with sonography for trauma examination.⁴ However, this readily accessible tool cannot completely replace patient history, physical examination, clinical judgment, and other formal imaging modalities read by a specialist for the diagnosis, monitoring, and treatment of patient clinical status. There is a concern for overdiagnosis and undertreatment of various clinical pathologies using POCUS, and future direction is needed to optimize this diagnostic tool and prevent overdiagnosis and undertreatment.

Overdiagnosis With POCUS

There is a persistent concern that without proper, formalized, continuous training, the widespread availability of

ultrasound will result in the overconfident diagnosis of numerous clinical conditions. For example, even expert ultrasonography has variable image quality and interpretation in disease pathologies such as intussusception.⁵ Real-time imaging, inferior probes, and nonsecure image saving of POCUS machinery cause difficult interpretation for even expert ultrasound sonographers. An editorial prefaced that although an increase in diagnostic accuracy and reduced time to diagnosis occurred in the emergency department, there was no difference in clinical outcome.⁶ This is especially relevant in emergent situations where interpretation of data and accuracy of diagnosis vary for both cardiac arrest and full stomach patients.⁷ Perioperative gastric aspiration is an adverse anesthesia-related event in both pediatric and adult populations, and fasting duration does not correlate with “empty stomach” on gastric POCUS.^{8,9} However, to date, there are no studies to support standardized gastric POCUS imaging with protocols for delaying or continuing anesthesia procedures in order to reduce adverse aspiration events. More research is needed to determine standardized protocols for the use of POCUS gastric measurements and its impact on scheduling general or monitored anesthesia care sedating procedures. In addition, there is a concern in understanding the limitations of POCUS in cardiac pathology and when comprehensive cardiac echocardiography is warranted for image quality, interpretation, and, ultimately, patient safety.^{10,11} Specifically, the University of Toronto’s Interdepartmental Division of Critical Care Medicine demonstrated 3 specific patients in whom cardiac POCUS with nonsaved images and incomplete clinical examinations was discordant

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with comprehensive echocardiography, including mitral valve regurgitation, pericardial effusion, and mitral valve stenosis, all requiring urgent surgical interventions.¹⁰ The American Society of Echocardiography 2013 mentioned situations when transthoracic echocardiography (TTE) may be nondiagnostic, including the aorta and left atrial appendage, prosthetic heart valve, native valve masses and paravalvular abscesses, and use in critically ill patients. Also, TTE image quality can be impaired in patients with mechanical ventilation, chest wall injuries, obesity, and those unable to move into the left lateral decubitus position.¹² We are unaware of how the POCUS diagnostic quality and interpretation of data will be compromised by surface echocardiogram limitations for the above pathologies. For example, in the emergency department, one study of 700 patients determined that 27% who presented were obese (body mass index >30).¹³ Obese patients present challenges when using POCUS and TTE image quality and interpretation. More data are needed to determine the utility of POCUS and TTE in obese and morbidly obese patient populations. Although it has been demonstrated that POCUS can have high diagnostic accuracy, physicians must be careful not to allow it to replace a thorough history, physical examination, and additional appropriate standard image modalities with formal interpretation.¹⁴ Drs Agarwal and Lang wrote an editorial highlighting the indispensable modality of POCUS; however, urging caution for the potential harms associated with indiscriminate use.¹⁵ The best example given concerns incidentalomas in various organs, specifically in the kidney, delineated not only with computed tomography (CT) with concern for “more CTs, fewer kidneys” but now extending to include POCUS for overdiagnosis and medical excess distracting from the primary clinical question.¹⁶ This begs the question of in which clinical scenarios and standardized protocols POCUS contribute to reduced morbidity and mortality, not just creating an image.

Undertreatment With POCUS

Overconfidence in the interpretation of ultrasound imaging, without conjunctive evidence of patient clinical status, can lead to incorrect or undertreatment of disease pathology, which is especially evident in critically ill patients. A systematic review (n = 852) in the emergency department demonstrated that although POCUS increased diagnostic confidence of shock, it did not differentiate appropriate clinical management regarding fluid bolus, vasopressor, or inotropic administration.¹⁷ Additionally, when treating critically ill patients, a large-scale randomized trial (n = 96) demonstrated that POCUS delayed chest compression and prolonged no-flow time, defibrillator attachment, first-rhythm analysis, and advanced airway management, leading to a lower likelihood of return of spontaneous circulation and survival to hospital discharge.^{18–20} In the nontraumatic, critically ill patient with hemodynamic instability, the use of POCUS in the emergency department leads to higher in-hospital mortality due to significant delays in treatment, such as aggressive, immediate resuscitation. The goal of all imaging

modalities, including POCUS, is to aid in optimizing patient management without delaying or causing further patient harm. There is concern that clinical judgment is dependent more on imaging modalities than the assessment of patient status in acute scenarios. Additionally, overtreatment without the correct diagnosis and complete pathophysiology can lead to overresuscitation associated with higher mortality.²¹ In a recent editorial, Drs Koratala and Kazory demonstrated that multiorgan POCUS could enhance diagnostic accuracy and guide therapy when appropriately integrated with clinical and laboratory values; however, future research is needed to compare various individual sonographic organ parameters with patient clinical outcomes.²² This argues that systematic, comprehensive, multiorgan POCUS images and diagnostic measurements are needed to properly guide shock therapy. The difficulty of accurately interpreting real-time images and administering proper treatment in critically ill patients with POCUS cautions against the widespread use of the tool without proper competency.

Overdiagnosis and Undertreatment With POCUS in Anesthesia

Although critical care-trained anesthesiologists were at the forefront of POCUS clinical integration as an additional diagnostic tool, there has been a broad expansion of research into using this technology in all aspects of patient anesthetic care. A study attempted to use POCUS in the preoperative setting to complement the physical examination and existing diagnostic tools; however, the lack of high-level evidence diminished the potential advantages, as well as which patient populations are appropriate to screen.²³ The lack of trained POCUS anesthesiologists, standardized protocols, and clinical pathways limit the utility of broadening POCUS application safely. The postanesthesia care unit POCUS has attempted to reduce the time to diagnose and treat acute hypotension, hypoxia, and, ultimately, postanesthesia care unit stay. However, successful POCUS had no impact on hospital length of stay or 30-day hospital readmission. Also, limitations exist to expanding POCUS research into randomized controlled trials to compare management strategies and formalize improved perioperative care metrics.²⁴ Without national standardized practices, there is a concern for overdiagnosis and/or undertreatment in patient care anesthesia management. Pediatric anesthesiologists caution against novice application of POCUS in the evaluation of cardiopulmonary assessments, instead advocating for formal echocardiography interpretation of cardiac hemodynamic data. In addition, novice sonographers evaluating lung pathology, especially when performed in one position or in the presence of loculated effusions or consolidations, is caution for missed diagnosis.²⁵ Furthermore, there is a need for large, multicentered, controlled trials needed to determine the appropriate application of POCUS in the range of anesthetic care in lieu of advanced, gold standard imaging with formalized interpretation, quantitative invasive and/or noninvasive monitors, and physical examination assessment.

Medicolegal Ramifications

There has been controversy over the medicolegal litigation implications of widespread POCUS use in both outpatient clinics and inpatient hospitalization. A medicolegal review of 19 cases found minimal medicolegal risk for POCUS, with beneficial cost reduction and increased efficiency.²⁶ Although a litigation review of the Westlaw database in 2021 did not demonstrate concern for POCUS lawsuits as a diagnostic tool in internal medicine, pediatrics, family medicine, or critical care medicine, the increased implementation of POCUS could significantly increase the opportunity for subsequent lawsuits.²⁷ The POCUS is not free from medicolegal litigation, and increased frequency of POCUS usage, especially in emergency operative situations, has led to missed diagnoses, misinterpreted sonograms and lesions, delay in communication of clinical information, failure to perform ultrasound in appropriate situations, and fraud cases due to operator knowledge and skill, including appropriate transducer, frequency selection, and suboptimal imaging acquisition.²⁸ Currently, the litigation implications of POCUS within the field of anesthesiology are unknown. Standardized protocols and image interpretation for appropriate clinical pathologies are critical to reducing inaccurate diagnosis, delayed treatment, and medicolegal consequences.

Future Direction

Recently there has been a push to integrate POCUS education early into resident trainees' curriculum. Emphasis has been placed on the need for a standardized curriculum to achieve competency and credentialing.^{29,30} Current limitations to POCUS curriculum integration include lack of regulation, rapid expansion into many specialties, unestablished standards, and monitored on-the-job scanning to ensure provider proficiency and patient safety.³¹ Although multiple knowledge and assessment banks (ie, FORESIGHT, FATE, BLUE, FALLS) for anesthesia residents have been developed, there is a lack of consistent, structured training.³² In addition, many of the education guidelines established are institution-specific, with no extensive systematic application of curricula.³³ There have been systematic reviews of heterogeneous education practices, which have provided evidence for core applications, combination lectures with hands-on practice, and pre- and/or posteducation examinations, with longitudinal follow-up to be most effective POCUS education.^{34,35}

National multidisciplinary training committees, including cardiology, anesthesia, and emergency medicine, are needed to effectively develop and integrate POCUS medical curricula and advocate for adequate time and resources. Although the American Society of Regional Anesthesia and Pain Medicine commissioned this narrative review to provide recommendations for POCUS, it still requires institution faculty, equipment execution (ie, 5G-based tele-remote and cloud-based data storage), and quality improvement.^{36–40} To maximize safety and ethical practices, formal standardized guidelines regarding diagnostic limitations, obtaining appropriate consent, secure

image archiving, and documentation security are vital.³⁷ Although 5G-based teleremote POCUS, cloud-based POCUS, and specialty-oriented POCUS are coming up and might help with overdiagnosis and undertreatment, enough studies have not been done yet. Before the assessment of individual physician competency in POCUS, there needs to be national and institutional support structure in place to ensure success and maintain rigorous patient safety. Within the POCUS curriculum, an individual's competency for a specific organ scan should not be determined based only on the number of attempts but rather on a graded scale facilitating increased independent practice. These graded standards should be based on education targets with specific skills, demonstrated proficiency, and independent clinical decision-making while supervised for knowledge accountability and patient safety.⁴⁰ Medical education in POCUS is longitudinal, and competencies should be reevaluated often with standardized written and supervised assessments.

Conclusion

Although POCUS is a noninvasive tool, it is not a tool without risk, and clinicians need to be aware of appropriate indications, clinical questions, standardized protocols, training and skills, ongoing quality assurance practices, and discussion of near misses, as it is critically important for patient safety using this diagnostic tool.⁴¹ The ubiquitous use of POCUS could create a false sense of security in the clinical setting, with a threat to the quality of care, lowered value of ultrasound examination, diminished exploration of disease pathophysiology, and medicolegal implications.⁴² Multidisciplinary teams are needed to establish a longitudinal, standardized curriculum in medical education at all levels of training. This is not to say that POCUS is without merit to enhance patient safety noninvasively and produce better outcomes. However, caution must be used when ruling out advanced imaging modalities with formalized readings, disease mechanisms, and clinical judgment with limited POCUS imaging.⁴³ To paraphrase Helen Keller, while POCUS alone can do so little, in conjunction with clinical tools and pathophysiology, physicians can increase diagnostic efficacy and optimize treatment for their patients.

Conflict of Interest

None.

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