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POINT-OF-CARE ULTRASONOGRAPHY: NARRATIVE REVIEW

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ABSTRACT Point-of-care ultrasonography (POCUS) is a growing field in medicine that allows clinicians to use ultrasonography at a patient's bedside, and it has transformed how clinicians deliver care. POCUS is used across various medical specialties, and non-radiologists and non-cardiologists can also become competent in the performance of POCUS, leading to increased adoption of this technology in clinical practice. POCUS and consultative ultrasonography are complementary, and both can be used together to provide a more comprehensive assessment of a patient's condition. In addition, POCUS is an invaluable tool that clinicians can use to monitor clinical conditions that can progress rapidly, such as acute respiratory failure, intracranial hypertension, and hemodynamic failure. Advances in POCUS technology have led to its use as a screening tool for the identification of certain disorders such as abdominal aortic aneurysm and for diagnosis of various medical conditions. POCUS has been associated with changes in clinical decision making in medical practice and has shown promising results in facilitating diagnosis and procedural guidance.

KEYWORDS : Ultrasonography, Point-of-care, Consultative, Clinical monitoring, Advances.

INTRODUCTION

Point-of-care ultrasonography (POCUS) is a rapidly growing field in medicine that has transformed the way clinicians deliver care. POCUS refers to the use of ultrasonographic imaging by a treating clinician at the patient's bedside rather than by a radiologist or cardiologist. POCUS is not limited to any specialty, protocol, or organ system and is used in many practice settings and in all phases of care. POCUS has been associated with changes in clinical decision making in medical practice, and has been shown to facilitate confirmation of suspected clinical diagnosis and support changes in initial diagnosis. Advances in POCUS technology have led to the development of smaller and more affordable ultrasound machines, allowing for broader utilization of POCUS across various medical specialties. Nonradiologists and noncardiologists can also become competent in the performance of POCUS, leading to increased adoption of this technology in clinical practice (1,2).

In this article, we aim to provide an overview of key trends in POCUS technology, advances in its clinical applications, and the overlap and complementarity of POCUS and consultative ultrasonography in primary imaging specialties.

METHODS

To begin the search, a range of databases including MEDLINE, Embase, and CINAHL will be searched using appropriate keywords and subject headings. The articles will be screened for eligibility based on the inclusion criteria that will include articles on Point-of-Care Ultrasonography published in English and that have been peer-reviewed. The exclusion criteria will include articles that are not relevant, duplicates, or not meeting the inclusion criteria. The narrative review will conclude with a discussion of the implications of the findings for clinical practice and future research.

POCUS and Consultative Ultrasonography

POCUS has been widely adopted in various clinical settings and is used in all phases of care, from diagnosis to procedural guidance and monitoring. However, it is important to note that POCUS is not intended to replace consultative ultra sonography, which involves a more comprehensive and detailed evaluation of specific organs or organ systems by a specialist. Consultative ultrasonography can provide more detailed information and can be used to confirm or exclude suspected diagnoses. It also allows for more specialized procedures, such as biopsy or drainage, to be performed with greater accuracy and safety. In addition, consultative ultrasonography provides the opportunity for a second opinion from a specialist in cases where there is uncertainty about the diagnosis or management plan (2,3).

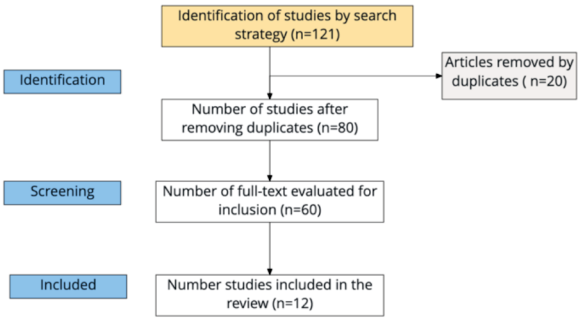

Figure 1. PRISMA

POCUS and consultative ultrasonography are comple mentary and can be used together to provide a more comprehensive assessment of a patient's condition. For example, POCUS can be used as a screening tool to identify potential abnormalities, and consultative ultrasonography can be used to confirm or exclude those findings and provide a more detailed evaluation. In primary imaging specialties such as radiology, gastroenterology, and cardiology, consultative ultrasonography is often performed by a specialist and is considered the gold standard for diagnosis and management. However, in other specialties, such as emergency medicine and critical care, POCUS has become an important tool for rapid diagnosis and decision-making (3).

In these settings, POCUS can be used to quickly identify life-threatening conditions such as pneumothorax or pericardial effusion, allowing for immediate intervention. POCUS can also be used to guide procedures such as central line placement or thoracentesis, reducing the risk of complications (3,4).

POCUS Examinations for Clinical Monitoring

POCUS is an invaluable tool that clinicians can use to monitor clinical conditions that can progress rapidly, such as acute respiratory failure, intracranial hypertension, and hemodynamic failure. POCUS allows for immediate clinical integration and interpretation of ultrasonographic imaging at the patient's bedside, leading to changes in clinical decision making in medical practice. Repeat examinations using semiquantitation or quantitation are necessary for monitoring applications that use POCUS (4).

One area where POCUS has shown particular benefit is in cardiopulmonary resuscitation (CPR). During CPR, a POCUS operator can use rapid image acquisition during the brief periodic interruptions of chest compressions to assess cardiac function serially. This approach allows for the recognition of pseudo-pulseless electrical activity, which is associated with potentially treatable conditions, and the detection of a carotid pulse, which is essential for proper CPR. Despite concerns that using POCUS for characterization of cardiac arrest might prolong the time to the pulse check, studies have shown that using POCUS during CPR can reduce the duration of pulse checks (4,5).

POCUS also has applications in monitoring patients with decompensated heart failure or coronavirus disease 2019 (Covid-19), facilitating clinical decision making during triage, evaluation of implemented therapeutic interventions, and tracking of disease activity. A prospective, randomized, controlled study of the value of limited transthoracic echocardiography as a monitoring tool in patients with severe injuries and hypotension who were seen in the trauma section of an emergency department showed that the use of this form of POCUS reduced mortality and the time to operative intervention. POCUS can also be useful in identifying pericardial effusion that responds to pericardiocentesis and providing clinical guidance in deciding whether to cease or continue CPR when the capnographic values are very low or gas is present in the hepatic vein (5).

Advances in the Clinical Application of POCUS

Point-of-care ultrasound (POCUS) has gained popularity in recent years due to its low cost, time efficiency, and ease of use. POCUS is effective as a screening tool for the identification of certain disorders, such as abdominal aortic aneurysm, and has shown promising results in the diagnosis of various medical conditions, as compared with traditional imaging techniques (6).

A prospective study involving 2683 patients evaluated for dyspnea in the emergency department found that there were no significant differences in accuracy between POCUS and standard evaluation, which included chest radiography, for the diagnosis of acute coronary syndrome, pneumonia, pleural effusion, pericardial effusion, pneumothorax, or dyspnea from other causes. However, POCUS was more sensitive for the diagnosis of heart failure, while standard evaluation performed better in the diagnosis of chronic obstructive pulmonary disease and pulmonary embolism (8).

Another study involving 128 patients presenting to the emergency department with dyspnea and chest pain found that a chest radiograph did not add actionable clinical information for patients with a normal thoracic POCUS study. This indicates that POCUS may be a more efficient diagnostic tool for respiratory distress and chest pain than chest radiography. In a consensus statement, an international, multispecialty expert panel evaluated clinically integrated, multiorgan POCUS for management of Covid-19 and suggested that POCUS was useful in nine clinical domains, including the diagnosis of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection, initial triage and risk stratification, diagnosis of Covid-19 pneumonia, and screening for venous thromboembolic disease (9).

POCUS has also been shown to be more cost-effective and time-efficient than traditional ultrasonography in obtaining data that may decrease the length of stay in the emergency department for evaluation of nephrolithiasis, uncomplicated biliary disease, early intrauterine pregnancy, and soft-tissue infection. The implementation of POCUS for a broad range of clinical conditions in general medical practice has led to a measurable reduction in planned referrals. While evidence that the use of POCUS reduces morbidity and mortality remains elusive, a systematic review partially supported the use of POCUS to guide fluid resuscitation in surgical patients and septic nonsurgical patients with shock, reducing adverse effects, organ failure, and mortality. However, the first randomized clinical trial evaluating the effect of early POCUS on hospital discharge and 30-day mortality showed little benefit with respect to survival, length of stay, fluid administration, and use of inotropes when POCUS was used to assess patients with hypotension, as compared with conventional clinical management without POCUS. Methodologic limitations of the study included the use of a limited POCUS examination, early termination of patient enrollment, and lack of information about whether the use of POCUS to establish diagnoses resulted in appropriate management decisions (10).

Competence and Training in POCUS

POCUS has become a widely used diagnostic tool in healthcare settings. However, it is crucial that clinicians who use POCUS are competent and adequately trained to avoid harming patients. The Joint Commission on Accreditation of Healthcare Organizations and the Emergency Care Research Institute identified the adoption of POCUS without necessary safeguards as a major health technology hazard. Therefore, developing training curricula and methods to assess competence is essential for the safe and effective use of POCUS.

At the medical school level, some schools have implemented focused ultrasound training programs, which have shown to improve medical students' ability to accurately identify abnormalities and decrease triage time. The American Society of Echocardiography and the Canadian Society of Echocardiography have created a cardiovascular POCUS curriculum for medical students. However, it is unclear how widely this curriculum has been adopted. For postgraduate medical training, specialty-specific training in POCUS and methods that test for competence are important. The Accreditation Council for Graduate Medical Education defines requirements for ultrasonographic training in emergency medicine and anesthesiology residencies. Regional, multiday cooperative courses have been developed to provide standard initial training followed by on-site training during critical care fellowships (11,12).

Although the United Kingdom and Australia and New Zealand have well-designed national standards for certification in specialty-specific POCUS, national-level postgraduate certification is generally not available for the many applications of POCUS in the United States and Canada. However, the National Board of Echocardiography offers national certification in advanced critical care echocardiography, which is open to international physicians (12).

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