

Ultrasound in Emergency Medicine



EFFECTS OF STUDENT-PERFORMED POINT-OF-CARE ULTRASOUND ON PHYSICIAN DIAGNOSIS AND MANAGEMENT OF PATIENTS IN THE EMERGENCY DEPARTMENT

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Abstract—Background: Despite the increasing integration of ultrasound training into medical education, there is an inadequate body of research demonstrating the benefits and practicality of medical student–performed point-of-care ultrasound (SP-POCUS) in the clinical setting. **Objectives:** The primary purpose of this study was to evaluate the effects that SP-POCUS can have on physician diagnosis and management of patients in the emergency department, with a secondary purpose of evaluating the diagnostic accuracy of SP-POCUS. **Methods:** SP-POCUS examinations were performed in the emergency department by medical students who completed year one of a 4-year medical school curriculum with integrated ultrasound training. Scans were evaluated by an emergency physician who then completed a survey to record any changes in diagnosis and management. **Results:** A total of 641 scans were performed on the 482 patients enrolled in this study. SP-POCUS resulted in a change in management in 17.3% of scans performed. For 12.4% of scans, SP-POCUS discovered a new diagnosis. SP-POCUS reduced time to disposition 33.5% of the time. Because of SP-POCUS, physicians avoided ordering an additional imaging study for 53.0% of the scans performed. There was 94.7% physician agreement with SP-POCUS diagnosis. **Conclusions:** This study showed that SP-POCUS is feasible and may potentially have a meaningful impact on physician diagnosis and management of

patients in the emergency department. In addition, the implementation of SP-POCUS could serve as an ideal method of developing ultrasound skills in medical school while positively impacting patient care. © 2017 Elsevier Inc. All rights reserved.

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INTRODUCTION

Since the 1970s, ultrasound has become less expensive and increasingly portable, leading to the growth of point-of-care ultrasound (POCUS) in clinical medicine, otherwise defined as clinician-delivered ultrasonography at the patient’s bedside (1,2). Ultrasound is nonionizing, noninvasive, and portable, and therefore a patient’s anatomy can safely be assessed in real-time using focused ultrasonographic examinations to systematically rule in or out certain diagnoses (1,3,4). POCUS is currently a well-established practice and has proven to be an essential diagnostic modality in many settings (5–12). Moreover, some specialties now require a certain level of education in ultrasound before completion of residency because of mandates set forth by the American College of Graduate Medical Education (ACGME) (13–20).

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In an effort to prepare students for residency, medical schools across the nation have begun to incorporate ultrasound training into their respective 4-year curricula (21). Current medical school teaching curricula expose students to ultrasonography mostly through didactic education and hands-on training sessions using healthy human models or cadavers (19,22–25). Recent studies have shown that an active, hands-on learning approach is superior to classroom didactic education and that medical students with limited training can identify pathologies and possibly impact patient outcomes from their findings (24,26,27).

Despite the growing popularity of POCUS and its incorporation into medical school curricula, there has not been an adequate evaluation of the diagnostic accuracy and utility of medical student-performed POCUS (SP-POCUS) in the clinical setting. Previous studies have focused on how physician-performed POCUS can change diagnosis and management (28,29). However, it is unclear what effect SP-POCUS can have on the management of patients. This study was designed to expand upon the feasibility and utility of SP-POCUS performed on a diverse patient population in the emergency setting using an array of ultrasonographic applications. To achieve this goal, a protocol was developed that would assess the correlation between a student's ultrasound scan and the physician's delivery of patient care. The primary purpose of this study was to evaluate the effects that SP-POCUS can have on physician diagnosis and management in the emergency department (ED). The secondary purpose of this study was to assess the diagnostic accuracy of SP-POCUS examinations, measured by physician agreement.

METHODS

Study Design

This was a prospective observational study. Data were collected in the ED of a single tertiary academic level I trauma center. Patients included in the study were a convenience sample of adult patients (≥ 18 years of age) in the ED who required POCUS (indicated scans) or would consent to receive a scan for educational purposes (training scans). Patients excluded were patients with psychiatric disorders, pediatric patients, and patients who already had an ultrasound examination performed in the same visit. All patient data were accessible only to research personnel. The local institutional review board approved this study.

Ultrasound Machines

Ultrasound scans were performed with the following machines: SonoSite M-Turbo (SonoSite, Inc, Bothell, WA),

GE Logiq E (General Electric Company, Fairfield, CT), and Ultrasonix SonixTouch (Ultrasonix Medical Corporation, Richmond, BC).

Data Collection Forms

Two forms were created for data collection. The first form was created for students to record their findings and diagnoses of each patient. Students were able to perform the following 10 scans: aorta, biliary, cardiac, inferior vena cava (IVC), extended focused assessment with sonography for trauma (eFAST), renal, pulmonary, obstetrics, ocular, and soft tissue (Appendix A). The student would then report an ultrasound finding of "normal" or "abnormal." If the student could not visualize the structures needed to complete the examination, then they would report "nonvisualized" and these were considered nondiagnostic by the physicians. The second form was created for physicians to complete after reviewing the students' ultrasound images and diagnoses. Physicians evaluated and reported agreement with the students' findings of "normal" vs. "abnormal," and whether the scan performed resulted in a change of their initial diagnosis, management, or amount of time needed to make a decision about a patient's disposition (Appendix B).

Student Preparation

Five medical students from a 4-year U.S. medical school participating in a summer ultrasound elective were selected for this study. All students had just completed year one of medical school that included a year-long physical examination course with integrated hands-on ultrasonography using normal human models. The ultrasound curriculum gave students a basis for the normal anatomic appearance of soft tissue, vasculature, lungs, heart, liver, kidneys, spleen, aorta, and bladder. All students were exposed to an average of 10 h of ultrasound during their first year, including 3 h of online didactics and approximately 30 hands-on scans. In addition, the students fulfilled approximately 15 h of online didactics by completing 13 required SonoSim modules prior to data collection. The 13 SonoSim modules were: fundamentals of ultrasound, aorta/IVC, bladder scanning, cardiology, eFAST, intestinal/biliary, musculoskeletal, obstetrics/gynecology, ocular, pulmonary, rapid ultrasound in shock and hypotension (RUSH), renal, and soft tissue. The modules provided didactic training through instructional videos and quizzes that required passing scores of $>75\%$. The purpose of these modules was for students to learn standard scanning protocols and techniques for pathologies that can be reliably detected by POCUS, and to serve as a basis for standardizing the way each student performed scans on each

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