The Journal of Emergency Medicine, Vol. 46, No. 2, pp. 231–240, 2014

0736-4679/$ - see front matter

ELSEVIER

http://dx.doi.org/10.1016/j.jemermed.2013.08.028

Education

ULTRASOUND EXPOSURE DURING GROSS ANATOMY

Stephanie M. Dreher, MD,* Robert DePhilip, PHD,† and David Bahner, MD, RDMS‡

*Emergency Medicine Resident, PGY-1, Medical College of Wisconsin, Milwaukee, Wisconsin, †Division of Anatomy, The Ohio State University, Columbus, Ohio, and ‡Department of Emergency Medicine, The Ohio State University Medical Center, Columbus, Ohio
Reprint Address: Stephanie M. Dreher, MD, Emergency Medicine Resident, PGY-1, Medical College of Wisconsin, 8701 Watertown Plank Road, Milwaukee, WI 53226

☐ **Abstract—Background: As medical schools seek to standardize ultrasound training and incorporate clinical correlations into the basic science years, we proposed that ultrasonography should have a greater role in the anatomy curriculum. Objectives: To describe the introduction of ultrasound into the curriculum of a first-year medical student anatomy course and evaluate the utility of this introduction. Methods: First-year medical students attended two ultrasound lectures and three small-group hands-on sessions that focused on selected aspects of musculoskeletal, thoracic, abdominal, and neck anatomy. Pre and post surveys were administered to assess student perception of their ability to obtain and interpret ultrasound images and the utility of ultrasound in the anatomy course. Understanding of basic ultrasound techniques and imaging was tested in the practical examinations. Results: Of the 269 first-year medical students who completed the course, 144 students completed both surveys entirely, with a response rate of 53%. Students' interest and self-perceived experience, comfort, and confidence in ultrasound skills significantly increased ($p < 0.001$) as a result of this early introduction to ultrasonography. Objective evidence, provided by practical examination scores on ultrasound images, is consistent with this self-perceived confidence reported by students. Conclusions: Ultrasound can be effectively incorporated into an anatomy course for first-year medical students by utilizing didactics and hands-on exposure. Medical students found the addition of ultrasound training to be valuable, not only in enhancing their understanding of anatomy, but also in increasing their interest and experience in ultrasound imaging. © 2014 Elsevier Inc.**

☐ **Keywords—ultrasound; anatomy; curriculum; education**

INTRODUCTION

Though traditionally performed by sonography technicians and radiologists, ultrasound is becoming more widely used by physicians in over 20 specialties who are using ultrasound for procedural guidance, diagnostic assessment, and screening (1). Procedural guidance ultrasound can include central and peripheral vascular access, thoracentesis, paracentesis, arthrocentesis, regional anesthesia, incision and drainage of abscesses, localization and removal of foreign bodies, lumbar puncture, biopsies, and nerve blocks (2).

If a wide range of clinicians can rely on this noninvasive, accurate, and user-dependent tool, the question arises whether the necessary instruction to use ultrasonography is embedded into medical education appropriately. The technology of ultrasound traditionally outpaced the education of the operators. As usage of ultrasonography diffuses across many medical specialties, there is a need to ensure competence, and to define the benefits of appropriate use (3–6). The challenge lies in determining the training and assessment of that training that will be required to ensure competent use of the technology (1).

In 2000, the Residency Review Committee for Emergency Medicine announced it would require ultrasound

RECEIVED: 21 November 2012; FINAL SUBMISSION RECEIVED: 25 April 2013;
ACCEPTED: 14 August 2013

training in emergency medicine residency programs, and subsequently, ultrasound questions began to appear on board certification and in-service examinations (7,8). Some within emergency medicine saw that focused ultrasound could be a part of a longer-term training paradigm in undergraduate medical education and could have a lasting effect by the time students enter their residency program. Students could carry this knowledge into whichever residency of choice. Currently, exposure to ultrasound in medical school is nonuniform and limited during clinical clerkships, with the majority of training in bedside ultrasound occurring during residency (9). However, one medical education study demonstrated that medical schools cannot rely on the clerkship model of education alone to provide adequate training and practice to students in all of the basic clinical skills and procedures (10). Ultrasound may be one of these skills that require additional instruction outside of the clinical setting.

With appropriate well-designed training, *preclinical* medical students can attain a sufficient degree of ultrasound proficiency and can apply these skills successfully (9). A group of first-year medical students have been successfully taught cardiac ultrasound and anatomy using hand-held ultrasound devices (11). Likewise, real-time ultrasound has been used by second-year medical students to improve their diagnostic accuracy of measuring the liver (12). Another study compared the ability of first-year medical students using ultrasonography after 18 h of ultrasound training with board-certified cardiologists using stethoscopes to accurately diagnose various presentations of cardiac disease (8,13). In this comparison, the students using ultrasonography were more accurate. Clearly, ultrasound is a skill that even junior medical students can learn with appropriate training.

Recently, novel curricular adjustments have been made in several U.S. medical schools to include a 4-year vertical curriculum in clinical ultrasound (8,14). As medical schools seek to incorporate more clinical correlations into the basic science years, it has also been proposed that diagnostic imaging should have a greater role in the anatomy curriculum (15). In addition to the donor-cadaver, the anatomy atlas, and computer-assisted instruction, ultrasound could contribute to anatomy education by combining surface anatomy with sectional anatomy. The dynamic ultrasound imaging of live models provides reference for students that conventional radiographs and computed tomography images cannot. The impact of hands-on active learning of ultrasound anatomy cannot be overemphasized because this will be the same task needed at the clinical bedside.

Convinced that ultrasound imaging will be an important skill for future physicians in a wide range of medical specialties, we looked for the best ways to incorporate an introduction of ultrasound into the medical curriculum at this College of Medicine. Beginning in 2006, we introduced a clinical correlation of a case of cholecystitis that included ultrasound imaging as part of the patient work-up. In subsequent years, we added optional hands-on laboratory experience using the device. Students learned to image the extremities, torso, and neck anatomy on a live model as part of a curriculum that paralleled their dissections in the cadaver laboratory. Based on student feedback, ultrasound remained part of the anatomy curriculum as an introductory exposure to ultrasound in medical school.

The study describes and evaluates the current version of our introduction of ultrasound into the anatomy course of first-year medical students. Currently, students receive instruction on basic elements of ultrasound imaging, on how to use the ultrasound device, and how to obtain ultrasound images of targeted areas of musculoskeletal, trunk, and neck anatomy, all in parallel with their dissections. The objectives of this study were 1) to demonstrate the utility of incorporating ultrasound into preclinical medical students' anatomy education; and 2) to determine if ultrasound imaging enhances first-year medical students' understanding of anatomy.

METHODS

Study Design

This cohort study was approved by the hospital Institutional Review Board.

Study Setting and Population

The study population consisted of 269 first-year medical students enrolled in Gross Anatomy during August through November 2011.

After the successful incorporation of abdominal ultrasound imaging into first-year medical students' study of anatomy during the 2008–2009 academic year, the Anatomy Division at this College of Medicine modified the curriculum to also include ultrasound imaging of the musculoskeletal system and neck in 2009–2010. The curriculum was further refined with student and faculty feedback through pre- and postexperience surveys in 2010–2011, culminating in a complete and defined curriculum design for the 2011–2012 academic year.

Study Protocol

Students attended two 1-h ultrasound instructional didactic sessions during their scheduled anatomy lecture time. One of the authors (D.P.B.) is the Director of Ultrasound and presented the lectures. During the first didactic and