Ultrasound Facilitates Active Learning of Anatomy

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Introduction

Traditional courses in anatomy rely on repetition and passive learning techniques using static cadavers, lectures, and 2D imaging. Consistent with Bloom’s taxonomy, students learn to the level of the test, with little retention of the material. Previous studies have shown that when introduced early to medical students, ultrasound improves subjective measures of anatomy and physiology, with the added benefit of improving student interest in traditionally large and difficult courses. This engages both the emotive and psychomotor domains, creating a more active learning style for students. To our knowledge, the effect that early ultrasound integration has on more objective measures, such as student academic and procedural performance, and long-term student performance on standardized testing, has not been examined before.

The Campbell University School of Osteopathic Medicine took a novel approach by incorporating ultrasound into its instructional design. This allowed for active learning with a more dynamic approach helping students learn multiple anatomical concepts and relationships. We compared a traditional static anatomy course with our dynamic anatomy curriculum integrating ultrasound. We sought to determine if OMS-I students could utilize this dynamic approach to aid in their learning of human anatomy, and collect their attitudes throughout the year to determine if the students would be receptive to this technology.

Our study aimed to look at the effects of the integration of early ultrasound integration into a traditional anatomy course on two medical school classes, and then look at subject matter of student knowledge, with the eventual goal of evaluating more objective indicators, such as grade point average, testing performance, and performance on osteopathic board examinations.

Study Design

This study was a retrospective cohort study. The study was approved by the Campbell University Institutional Review Board under exempted review, with no consent required. A traditional, static anatomy course without ultrasound was implemented in the 2013-2014 academic year with first year (OMS-I) osteopathic medical students. A novel ‘dynamic’ anatomy course with an integrated ultrasound curriculum was implemented the following 2014-2015 academic school year with a new class of OMS-I medical students. This study was conducted throughout the 2014-2015 academic year with the class of 2014-2015 OMS-I medical students who underwent the dynamic anatomy course, and second year (OMS-II) medical students who underwent the static anatomy course.

Online surveys were administered at various points to all students throughout both years, assessing student opinions of ultrasound, medical education, clinical skills, and both the static and dynamic anatomy curricula as appropriate. An online twenty question quiz was administered at the end of the 2014-2015 academic year to both classes, assessing basic anatomical concepts and relationships. Using student records, individual test grades, laboratory practical scores, and overall anatomy course grades were collected for both classes as a whole throughout the year.

Objectives

1. Utilize a novel instructional design to facilitate learning dynamic anatomy in comparison to traditional static anatomy
2. Determine the perceived value of ultrasound by undergraduate medical students
3. Demonstrate changes in knowledge, skills, and attitudes due to the addition of ultrasound to an undergraduate medical curriculum.

Outcomes

Our primary outcome was anatomy grades, including overall grades, as well as test and practical scores, between the OMS-I students in the dynamic anatomy course, and OMS-II students in the static anatomy course. Secondary outcomes were student opinions on ultrasound in general, the best way to learn ultrasound, and their opinions on the integration of ultrasound in an anatomy course.

Curriculum Design

The static anatomy course was designed as a traditional medical school anatomy course, with no integrative ultrasound. A curriculum was designed with variable lectures per week on traditional anatomical topics, with two classical, “static” cadaver dissection labs. Every block had three multiple choice examinations and two cadaver practical examinations. At the end of block four, and the first academic year, the anatomy course was completed. Towards the end of their second year, near the beginning of rotations, the class was introduced to ultrasound through traditional didactic lectures, SimSon computer training sessions (SimSon, Santa Monica, CA), and hands-on ultrasound laboratories.

The dynamic anatomy course was designed as a novel anatomy course with traditional anatomy lectures and labs, but additional integrative ultrasound labs to reinforce current topics. In addition to the variable lectures per week on traditional anatomical topics, with the two classical “static” cadaver dissection labs, introductory ultrasound lectures were added at the beginning of the first year, and the use of the SimSon computer training sessions were introduced earlier as well. In addition to the “static” cadaveric dissection labs, each block featured two hands-on, “dynamic” ultrasound laboratory sessions on topics relevant to the dissection labs.

Setting and Participants

This study was performed at a United States osteopathic medical school. 88 OMS-I medical students who underwent the dynamic curriculum, and 58 OMS-II medical students who underwent the static curriculum opted to participate in the survey. 44 OMS-I medical students, and 17 OMS-II medical students opted to take the quiz.

Methods

We determined the perceived value of ultrasound by undergraduate medical students. 91.3% of OMS-II students either agreed or strongly agreed that self-directed learning using SimSon was a more effective approach than traditional OMS-I students, who believed that hands-on traditional ultrasound labs were more effective. This was statistically significant compared to the 67.7% of OMS-I students who responded the same way. Overall, the student response to ultrasound as a teaching modality was overwhelmingly positive. Dynamic approaches such as ultrasound integration into medical student learning styles through the utilization of tactile and visual sensory inputs. Using the integrated curriculum, students were receptive to the technology, and positively incorporated it into their learning.

Most students agreed that anatomy was a logical place to include ultrasound training, however, also felt that it would be appropriate to integrate more clinical ultrasound into years 1 and 2. The majority of students also began to understand the importance of ultrasound as a growing imaging modality in the clinical setting, and wished to continue it through their clinical years, as well as in residency.

With undergraduate medical education continually expanding to include more topics, it becoming unfeasible for students to learn topics with traditional methodologies. Classical learning and short-term test recall leaves students with little knowledge retention.

We have demonstrated here that hands-on ultrasound education is deemed as a valuable resource to students, assisting them with their long-term education. As we add more ultrasound to the curriculum, the next steps are to evaluate the impact that an early ultrasound education has on COMLEX scores, performance in the OMS-III and IV years, and beyond.

Results

When the first surveys were administered in Fall 2014 to both the OMS-I and OMS-II classes, no statistically significant difference was found between the classes for any of their opinions on ultrasound. There was a significant difference between OMS-II (M=4.04, SD=0.48) and OMS-I (M=3.51, SD=1.06) students when asked whether they preferred a primarily self-directed learning system to hands-on laboratory sessions (M=3.35, p<0.002) (Figure 1). Additionally, it was found that more OMS-II students believed that ultrasound training enhances their clinical skills (M=3.96, SD=0.68) when compared to the OMS-I students (M=3.59, SD=0.97) (M=2.01, p<0.004) (Figure 2).

In addition to pre and post curriculum tests, we included questions that would pertain to medical student perceptions of ultrasound, unrelated to their curriculum. Between both classes, it was found that students believed ultrasound could be integrated into most undergraduate medical school courses, with the majority, 89.6%, selecting OMS-I anatomy (Figure 3). The only course that students did not seem to find a fit for ultrasound was OMS-I anatomy (22.99%), and to a lesser extent, OMS-II systems courses. A majority of students felt that ultrasound would be appropriate to include in OMS-I, OMS-III, IV, and residency training (91.5%, 88.51, 80.46%).

Conclusion and Implications

Ultrasound was appropriate to include ultrasound in your education? BOMS-I and OMS-II students could not find a place that they would want to include ultrasound, however, OMS-II students felt it would be appropriate to include it in almost every course outside of physiology and systems courses. 91.3% and 88.5% of students believed that it would be an appropriate tool to integrate into their OMS-I/IV rotations, respectively.

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References