

Inclusion of trauma ultrasonography in pre-graduate medical faculty education e-fast in medical school

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Abstract

Objective: To provide comprehensive training in emergency trauma ultrasonography to undergraduate medical students.

Method: The two-phase study was conducted from September 2022 to June 2023 at Biruni University, Istanbul, Türkiye, and comprised final year medical students of either gender belonging to the 2022-23 batch who had enrolled in an emergency medicine internship. The first phase included experimental training with pre-test and post-test evaluation, while the second phase focussed on the evaluation of theoretical and practical trainings with multiple-choice test and practical exam. After the trainings, the subjects were asked to fill out a satisfaction questionnaire. Data was analysed using SPSS 20.

Results: Of the 66 medical students, 35 (53%) were female and 31 (47%) were male. The pre-test score was 84.55 ± 19.2 , while the post-test score was 92.12 ± 18.15 ($p < 0.05$). The mean score was 94.9 ± 9.6 on the multiple-choice question exam, 93.6 ± 6.4 on direct observation of procedural skills, 88.24 ± 10.5 on the written exam, 91.4 ± 5.3 on the oral exam, and 89.7 ± 5.7 on the internship. In the multiple-choice test exam after ultrasonography training, all 66 (100%) students scored at least 60, and the same was the case with the practical exam post-training.

Conclusion: Pre-graduation medical students were found to be ready for ultrasonography trainings in terms of knowledge and skills.

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Introduction

Ultrasonography (USG) training has been introduced in undergraduate and postgraduate medical education programmes around the world over the last 20 years. Learning USG is a skill-based process which requires spatial ability, knowledge of sono anatomy and sono pathophysiology, having a spatial perspective, and understanding the limitations of USG. Although having sonographic knowledge and developing skills does not require lifelong learning, a long-term longitudinal training programme is recommended for USG.¹⁻³ Metin girmek için buraya tıklayın veya dokununuz. Because of its cost-effectiveness, ease of use, and high efficacy, USG has been recognised as the contemporary imaging method.⁴ While ultrasound devices were initially large, difficult to carry, and heavy, the latest generation is small enough to fit in a pocket. With these developments, ultrasound devices have become available for patient care and medical school education.⁵

Because USG is a frequently used imaging modality, it

started to gain attention in postgraduate medical education. Clinical departments focussed on USG training in their clinics for postgraduate specialty students. USG has been frequently used in specialty training in various disciplines, such as emergency medicine, general surgery, and intensive care. Some branches of science have incorporated USG skill training for residents and others through dedicated USG training programmes^{4,6-8}

The Department of Emergency Medicine was the first clinical department to use point-of-care USG (POCUS). The American College of Emergency Physicians (ACEP) in 1990 and the Academic Emergency Medicine Association in 1991 endorsed the use of POCUS.⁴ In 2001, emergency ultrasound guidelines were developed by the ACEP.¹ In Canada and the United States, USG training is included as a standard section of the emergency department postgraduate training programme.⁹

With physicians using USG early in their careers and advanced USG devices available in tertiary, secondary and even primary healthcare institutions, USG is now regarded as the next-generation stethoscope.¹⁰ Therefore, its use is becoming widespread and has been increasingly emphasised in undergraduate medical education. Studies have shown that the inclusion of USG training in undergraduate medical education improves the general knowledge level and physical examination skills of students and increases their satisfaction¹¹⁻¹³

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The integration of USG training into undergraduate medical education programmes is extremely useful, but it presents immense difficulties in planning and implementation for some planners owing to the high cost, lack of available faculty, and difficulty of adding new subjects to tightly structured undergraduate medical education programmes.^{13,14} Despite these obstacles, USG is being integrated into undergraduate medical education programmes with the support of national and regional medical associations. Various medical and biological associations or federations have integrated USG into undergraduate medical school education in their own unique ways^{15,16}

Considering the benefits of USG in medical school and specialty training processes, it is recommended that USG training be started in the first years of undergraduate and postgraduate education, and integrated into training programmes.^{2,3}

The current study was planned to provide extended focused assessment with sonography for trauma (E-FAST) training to undergraduate medical students in order to enable them to better understand trauma assessment using USG in the emergency department.¹⁷

Subjects and Methods

The two-phase study was conducted from September 2022 to June 2023 at Biruni University, Istanbul, Turkiye. A pilot study was conducted at Akdeniz University, Antalya, Turkiye, one year before the main study. As part of the emergency medicine residency programme, following a trauma assessment lecture in the emergency department, resident physicians received theoretical courses on the introduction to USG, including ultrasound physics, E-FAST, and practical courses.

The study's evaluation consisted of two stages: the first phase was an experimental educational evaluation study with pre-test and post-test assessments without a control group, and the second phase was an evaluation of the theoretical and practical trainings via a multiple-choice test (MCT) and a practical exam.

The sample was raised using convenience sampling methods, and comprised all final year medical students of either gender who had opted to undergo emergency medicine internship, and volunteered to participate. Those not attending any emergency medicine internship trauma assessment or emergency department ultrasonography courses or any of the exams held during the emergency medicine internship.

The pilot study was conducted with 11 second-year students as part of the "anatomy of lower and upper

extremities" training within the scope of a special training module. Theoretical courses and practical training in lower and upper extremity anatomy were combined with ultrasound. This enabled a better understanding of the dynamic and three-dimensional (3D) structure of anatomy. At the end of the pilot study, the students were asked to complete a pre-designed questionnaire. According to the survey, 9 (81.8%) students stated that seeing anatomy in living tissues helped them better understand what they had learned using models and cadavers, 11 (100%) found the hands-on ultrasound courses useful for learning ultrasonography, and 10 (90.9%) stated that the overall ultrasound educational experience improved their medical education. In addition, 11 (100%) students wished to use ultrasound in physiology, pathology, standard patient care and clinical training other than anatomy, and 11 (100%) wished to receive more ultrasound training during medical school. According to the pilot study, undergraduate medical students were found to be prepared for USG training and expressed a desire to incorporate USG as an educational tool in their courses.

In the main study, the intervention lasted five days. Day 1 comprised evaluation of the trauma patients coming to the emergency room as well as slide shows and videos related to the subject. Practical demonstration was given of the evaluation and transportation of the trauma patient coming to the emergency room.

Day 2 comprised implementation of the pre-test on the evaluation of trauma patients presenting to the emergency room. Introduction of emergency USG was done and USG physics was explained with a slide show and appropriate videos. Focused trauma USG was also explained with a slide show and appropriate videos.

Days 3 and 4 involved practice of focussed trauma USG.

Day 5 comprised the post-test on the evaluation of trauma patients presenting to the emergency room. MCT was also held on focussed trauma USG, USG terms, and USG physics, including classic test questions, video questions, and questions with images. Practical exam was also held by direct observation of procedural skills (DOPS).¹⁸ A pre-designed online questionnaire about theoretical and practical USG courses was e-mailed to the students, and they were asked to fill it out.

Data was analysed using SPSS 20. Categorical variables were presented as frequencies and percentages, while continuous variables were presented as mean±standard deviation. Independent samples *t* test, paired samples *t* test, and correlation analysis were used for continuous variables. The Likert scale was used for the items in the

post-training satisfaction questionnaire assessing students' perceptions of the theoretical and practical USG courses. For statistical purposes, the Likert responses "agree" and "strongly agree" were evaluated together. $P < 0.05$ was taken as statistically significant.

Results

Of the 66 medical students, 35 (53%) were female and 31 (47%) were male. The pre-test score was 84.55 ± 19.2 , while the post-test score was 92.12 ± 18.15 . The mean score was 94.9 ± 9.6 on MCT, 93.6 ± 6.4 on DOPS, 88.24 ± 10.5 on the written exam, 91.4 ± 5.3 on the oral exam, and 89.7 ± 5.7 on the internship (Table 1).

More than 95% of the students scored >80 points in the MCT, and $>95\%$ of the students scored >90 points in DOPS.

Male students had a higher mean score in DOPS ($p=0.012$) and female students had a higher mean score in the oral exam ($p=0.042$).

The difference between pre-test and post-test scores was significant ($p=0.014$) (Table 2).

A significant relationship was found between the MCT and post-test scores (Table 3).

A significant positive correlation was found for the written exam with post-test ($p=0.006$) and MCT ($p=0.015$) scores. The relationship of written exam scores was significant with post-test ($p=0.006$), MCT ($p=0.001$) and DOPS ($p=0.001$) scores.

According to the satisfaction survey completed after the

Table-1: Distribution of students' mean scores.

	Mean $\pm$ SD
Pre-intervention	84.6 $\pm$ 19.2
Post-intervention	92.1 $\pm$ 18.5
MCT	94.8 $\pm$ 9.6
DOPS	93.6 $\pm$ 6.4
Written Examination	88.2 $\pm$ 10.5
Oral Examination	91.4 $\pm$ 5.3
Mean Score	89.7 $\pm$ 5.7

MCT: Multiple-choice test, DOPS: Direct observation of procedural skills.

Table-2: Comparison of pre-intervention and post-intervention scores.

	Mean $\pm$ SD	p-value
Pre-intervention	84.6 $\pm$ 19.2	
Post-intervention	92.1 $\pm$ 18.5	0.014

Table-3: Relationship of post-test exam scores with DOPS and MCT.

	Post-Test	p-value
DOPS	0.07	0.9
MCT	0.4	0.001

DOPS: Direct observation of procedural skills, MCT: Multiple-choice test.

trainings, all 66 (100%) students agreed/strongly agreed with the statement, "I enjoyed the USG courses I attended." Similarly, all 66 (100%) students agreed/strongly agreed with the statement, "After this training, I can use ultrasound at a basic level."

While 49 (74.2%) students responded "strongly agree" to the statement, "I have learned the basics of ultrasound physics", 53 (80.3%) responded "strongly agree" to the statement, "After these courses, I can visualise the liver, spleen, pelvis, heart and lungs at a basic level".

While 50 (75.8%) students responded "strongly agree" to the statement, "Focussed trauma USG courses improved my trauma management", 62 (93.9%) students agreed/strongly agreed that they would like to receive more USG training during their medical school education.

The responses of the students to the open-ended question about their opinions on the focussed trauma USG training revealed that the students were generally satisfied with the training provided.

In their comments, students most frequently made the following statements:

"Ultrasound is not as vague as it used to be; I can now interpret the images."

"Training was very productive, and doing things correctly in a practical course encouraged me further towards my educational and professional goals."

"Images and topics that were meaningless on paper made sense after practising, and I started to enjoy ultrasound, which I used to find boring."

Discussion

The students in the current study were satisfied with the USG training, and wanted to receive further training. The training increased students' knowledge, skills and attitudes related to emergency trauma evaluation.

One of the aims of the present study was to evaluate the benefits of using ultrasound as an educational aid in undergraduate medical school education. Most studies in the literature evaluate the use of ultrasound as an educational aid during basic medical education.^{16,19-21} Metin girmek için buraya tıklayın veya dokununuz. Studies reported that using ultrasound as an educational aid, especially in anatomy education and physical examination skills training, increased the success of the students, showing significant difference between the pre-test and post-test scores.^{3,4} The present study also showed that the addition of integrated ultrasound training in clinical education increased success rate, indicating that

ultrasound is useful as an educational aid in clinical training.

As USG has a key role in trauma assessment, many medical schools integrate POCUS training in trauma assessment.²² Studies have revealed that students feel satisfied with such a training.^{23,24} In the present study, the mean score of the students in the MCT was 94.8 out of 100, with a score range of 60-100. The mean score of the students in the DOPS assessment was 93.6 out of 100, with a score range of 65-100. These results showed that medical students acquired strong theoretical knowledge of E-FAST because of the training provided, and exhibited sufficient E-FAST skills. Also, the willingness of the students to use ultrasound, as clearly demonstrated in the survey, showed that they would adopt and use E-FAST assessment in the intervention of trauma patients.

In a review by Usman et al. analysing 112 articles on ultrasound training programmes in undergraduate medical education, it was observed that structured skills exams were used to evaluate the students in 37.5% of the studies and that pathological and clinical evaluations were performed on real patients in 11.6% of the studies. After the review, the authors recommended the use of more skill-oriented and meticulously prepared assessment methods in education programmes. In the present study, DOPS and MCT were chosen as the assessment methods, which was consistent with the recommendation of Usman et al.²⁵ Employing recommended assessment and evaluation methods allowed for thorough student evaluation, resulting in a mean test score of 90 out of 100. These findings indicate that the students acquired ultrasound skills effectively.

When DOPS scores measuring the focused trauma USG skill level were evaluated, it was observed that the mean score of male students (95.7) was significantly higher compared to the mean score of female students ($p=0.012$). This is consistent with other studies showing that males are more successful in skills exams in medical school education.²⁶

A correlation was found between scores in the multiple-choice end-of-internship exam, which covered emergency medicine topics, including trauma, and the scores obtained in the post-test and DOPS. Taken together with the strong agreement with the statements of the satisfaction survey (*I enjoyed the courses; I would like to receive more ultrasound training during my medical education*), it suggests that ultrasound training promotes interest in the programme, increases participation, improves enthusiasm, and ultimately increases success.

After the theoretical and practical training on ultrasound

devices and physics as well as focused trauma assessment, the self-evaluation of the students showed that most of them were confident about using ultrasound at a basic level, had learned the basics of ultrasound physics, and could visualise the liver, spleen, pelvis, heart and lungs at a basic level. The results showed that after the theoretical and practical trainings, students' confidence in both using ultrasound and evaluating patients increased. Therefore, such trainings can have a positive effect on medical students at the start of their careers.

The current study has limitations. First, because there were no ultrasound skill laboratories at the university, the students had to receive their practical training under the supervision of an instructor within a limited time. Therefore, they were not provided with opportunities to review, repeat and work on their skills. Ultrasound training was given for the first time in the medical faculty of the university where the study was conducted. Therefore, peer education could not be performed.

Conclusion

Undergraduate medical students were found to be ready for USG training in terms of knowledge and skills, and that the use of USG as an educational aid in clinical internships in medical school education increased interest and satisfaction in the training given, and provided deep learning.

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Author Contribution:

FS: Design, data collection, analysis and processing.

EG: Data analysis.

YS: Design and data analysis.

MD & GA: Data collection and processing.