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Evaluation of the Impact of a 2-Day Point-of-care Ultrasonography Course on the Theoretical Knowledge and Practical Skills of Physicians

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Abstract

Aim: This study aimed to evaluate the impact of Turkey's first European accredited 2-day point-of-care ultrasonography (POCUS) course on the theoretical knowledge and practical skills of physicians.

Materials and Methods: Forty physicians and five lecturers attended the course. All the lectures were arranged as per the POCUS Curriculum Guidelines given by the International Federation of Emergency Medicine. At the beginning and the end of the course, a theoretical exam was conducted with the same set of questions. Practical skills were evaluated at the hands-on training stations using checklists. Pre-test and post-test results were statistically compared.

Results: All the attendants of the course were included in the study. The numbers of the correct pre-test and post-test answers were 1.23±0.89 and 1.95±0.64 for abdominal aorta ultrasound (USG), 3.23±1.27 and 5.08±1.07 for cardiac USG, 0.95±0.68 and 1.78±0.42 for USG physics, 3.03±1.42 and 4.48±1.11 for expanded-focussed assessment with sonography in trauma, 1.75±0.74 and 2.35±0.62 for hepatobiliary USG, 1.4±0.71 and 1.85±0.36 for inferior vena cava USG, 1.18±0.55 and 1.48±0.51 for renal USG and 1.88±1.04 and 2.7±0.82 for lung USG, respectively. All the differences were statistically significant.

Conclusion: The study shows that our 2-day basic course has effectively conveyed the fundamental POCUS knowledge and skills.

Keywords: Point-of-care testing, ultrasonography, medical education

Introduction

Point-of-care ultrasonography (POCUS) is a rapidly growing area in medicine and used in nearly all kinds of medical practise, especially in primary care, emergency medicine and critical care departments (1). The most widely used POCUS applications are focused assessment with sonography in trauma (FAST) and expanded-FAST (E-FAST), bedside cardiac ultrasound (USG), aorta and vena cava inferior USG, bedside lung USG, renal USG and bedside hepatobiliary USG. The American College of Emergency Physicians (ACEP) has categorised POCUS into five functional clinical categories: resuscitative, diagnostic, symptom or sign-based, procedure guidance, therapeutic and monitoring (1). Different POCUS applications can be used solely or in a combined manner at the bedside for answering single or multiple queries about the patient's clinical status.

Although it is internationally acknowledged that POCUS is one of the essential skills for clinicians working in all fields of medicine and especially in emergency departments, there is no standardised method of POCUS education for resident physicians or medical students (2-6). The first curriculum study regarding USG training in emergency medicine was conducted by Mateer et al. (7) in 1994. In Turkey, there are efforts to standardise POCUS education, which is provided by senior clinicians in the field and by physician associations.

The Emergency Medicine Physicians Association of Turkey is one of the leading associations in Turkish Medicine and tries to spread

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the POCUS skills among emergency physicians by its branch of the bedside USG education program "SonoSchool". Since its foundation in 2016, Sonoschool has been organising POCUS courses both inside and outside of Turkey. The first basic POCUS course that was internationally accredited by the European Accreditation Council for Continuing Medical Education (EACCME) in Turkey was organised by SonoSchool in Istanbul in December 2018.

In this study, we evaluated the impacts of this accredited 2-day course on the theoretical knowledge and practical skills of physicians.

Materials and Methods

This was a prospective observational study examining the effect of a 2-day basic POCUS course. In total, 40 physicians attended the course, of which 20 were EPs, 15 were anaesthesiologists working in intensive care units, two were paediatric EPs, two were general practitioners and one was a paediatrician. Thirty-six attendants were from Turkey, two were from Jordan, one was from Greece and one was from the United Kingdom. There were five lecturers, all of which were EPs who were experienced in POCUS and had previously taught it. Two of the lecturers were from Turkey, two were from Egypt and one was from India. Two EPs were placed to monitor the course and to make all arrangements during the course, allowing the lectures to focus on the course and the hands-on trainings. The lectures included diagnostic POCUS applications; any POCUS applications for procedural guidance were not included since this was a basic course. The topics of the theoretical lectures and the targets of the hands-on stations were arranged in the guidance of the International Federation of Emergency Medicine (IFEM) POCUS Curriculum Guidelines (2). The topics were as follows: USG physics, E-FAST, cardiac axes, limited bedside echocardiography, abdominal aorta USG, vena cava inferior USG, bedside renal USG, bedside hepatobiliary USG and lung USG (Table 1). There were four theoretical lectures and two hands-on training parts on the first day and four theoretical lectures, two hands-on training parts and one interactive session on the second day (Table 1). Pre-testing was performed at the start of the course, and a post-test was done at the end of the course with the same questions. The test contained 25 questions regarding the course topics; all questions covered the course material. Nineteen questions covered only one topic of the course, and six questions combined the knowledge about two topics of the course. Four stations were arranged for the hands-on training parts, with each station containing one healthy volunteer and a USG device equipped with three probes: curved array, phased array and linear probes. Attendants were divided into four groups, and the groups changed the stations for each hands-on training. Each attendant had a checklist to be completed at the hands-on training station and to be signed by the lecturer. After one of the lecturers had provided some information and practised the USG application, all attendants practised the application on the volunteer and completed all skills on the checklist. This ensured that each attendant gained the targeted skills in the hands-on trainings. At the end of the course, a post-test was performed with the same questions as in the pre-test. After the post-test, attendants were asked to fill a feedback form to evaluate the lecturers for both the theoretical lectures, the hands-on training and the overall course format, using a four-score evaluation form: 1=poor, 2=average, 3=good and 4=excellent.

Statistical Analysis

After the course, pre-test and post-test answers were statistically compared to evaluate the theoretical knowledge of the physicians. The Wilcoxon signed rank test was used to compare the results. Each correct answer was ranked as 2.5 points and each incorrect answer as 0 points for both tests. The results

Table 1. The course program

	Hours	Topic
First day	08.30-09.00	Introduction and pre-test
	09.00-09.40	Ultrasound physics
	09.40-09.50	*Coffee break*
	09.50-10.30	E-FAST
	10.30-12.00	Hands-on training
	12.00-13.00	*Lunch*
	13.00-13.40	Cardiac axes
	13.40-13.50	*Coffee break*
	13.50-14.30	Bedside cardiac ultrasound
	14.30-16.00	Hands-on training
Second day	08.30-09.00	Abdominal aorta and vena cava inferior ultrasound
	09.00-09.40	Lung ultrasound
	09.40-09.50	*Coffee break*
	09.50-10.30	Renal ultrasound
	10.30-12.00	Hands-on training
	12.00-13.00	*Lunch*
	13.00-13.40	Hepatobiliary ultrasound
	13.40-13.50	*Coffee break*
	13.50-14.30	Interactive session
	14.30-16.00	Hands-on training
	16.00-16.30	Post-test
	16.30-17.00	Feedback forms

E-FAST: Expanded focused assessment with sonography in trauma

were compared both as gained points and percentage of correct results; statistical significance was set at $p<0.05$. The feedback forms were evaluated, and the mean values of the points obtained from the forms were calculated for each lecturer. This study protocol has been approved by local ethics committee (2018-186).

Results

All of the 40 physicians who attended the course were included in the study. The numbers of the correct answers for the pre-test and the post-test were as follows: 1.23±0.89 and 1.95±0.64 for abdominal aorta USG, 3.23±1.27 and 5.08±1.07 for cardiac USG, 0.95±0.68 and 1.78±0.42 for USG physics, 3.03±1.42 and 4.48±1.11 for EFAST, 1.75±0.74 and 2.35±0.62 for hepatobiliary USG, 1.40±0.71 and 1.85±0.36 for vena cava inferior USG, 1.18±0.55 and 1.48±0.51 for renal USG and 1.88±1.04 and 2.70±0.82 for lung USG, respectively (Table 2). All differences were statistically significant. The percentages of correct answers for the pre-test and the post-test were as follows: 40.83±29.72% and 65.01±21.30% for abdominal aorta USG, 40.31±15.88% and 63.44±13.39% for cardiac USG, 47.50±33.87% and 88.75±21.15% for USG physics, 43.22±20.31% and 63.90±15.84% for E-FAST, 70.00±35.45% and 92.50±18.08% for hepatobiliary USG, 58.75±27.47% and 73.75±25.29% for renal USG and 46.88±26.06% and 67.50±20.57% for lung USG, respectively (Table 2 and Figure 1). The mean test results were 45.40±11.73% for the pre-test and 68.90±8.23% for the post-test (Table 2). All differences were statistically significant.

All attendants completed the checklists for the hands-on training and therefore gained the ability to perform USG scanning on a healthy subject. However, unfortunately, we have no information about their scanning abilities on real patients and in real clinical cases.

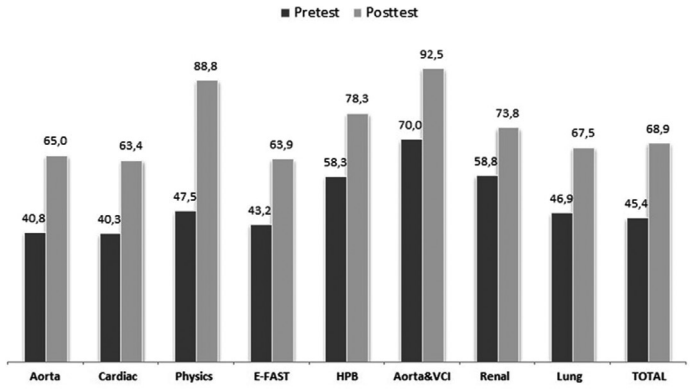

Figure 1. Graphic of the correct answers by percentages for pre-test and post-test

E-FAST: Expanded focused assessment with sonography in trauma, HPB: Hepatobiliary, VCI: Vena cava inferior

Table 3. Mean scores for the instructors obtained from feedback forms (0: worst, 4: best)

Mean points		
Instructor	**Theoretical lessons**	**Hands-on training**
Instructor-1	4.00	4.00
Instructor-2	4.00	4.00
Instructor-3	4.00	4.00
Instructor-4	4.00	3.75
Instructor-5	3.90	4.00

Table 4. Mean scores for the overall course format obtained from feedback forms (0: worst, 4: best)

Category	Mean score (0 to 4 points)
Quality of the event	3.95
Relevance of the event	4.00
Suitability of formats used during the event	3.82
Ways the event affected the participants´ practice	3.95
Commercial bias	4.00

Table 2. Correct answers by numbers and percentages for pre-test and post-test

	Correct answers by number			Correct answers by percentage		
Topic	**Pre-test (Avg ± SD)**	**Post-test (Avg ± SD)**	**p**	**Pre-test (Avg ± SD)**	**Post-test (Avg ± SD)**	**p**
Aorta	1.23±0.89	1.95±0.64	0.000	40.83±29.72	65.01±21.30	0.000
Cardiac	3.23±1.27	5.08±1.07	0.000	40.31±15.88	63.44±13.39	0.000
Physics	0.95±0.68	1.78±0.42	0.000	47.50±33.87	88.75±21.15	0.000
E-FAST	3.03±1.42	4.48±1.11	0.000	43.22±20.31	63.90±15.84	0.000
HPB USG	1.75±0.74	2.35±0.62	0.000	58.33±24.75	78.33±20.74	0.000
Aorta & VCI USG	1.40±0.71	1.85±0.36	0.000	70.00±35.45	92.50±18.08	0.000
Renal	1.18±0.55	1.48±0.51	0.005	58.75±27.47	73.75±25.29	0.005
Lung	1.88±1.04	2.70±0.82	0.000	46.88±26.06	67.50±20.57	0.000
Total	-	-	-	45.40±11.73	68.90±8.23	0.000

E-FAST: Expanded focused assessment with sonography in trauma, HPB: Hepatobiliary, USG: Ultrasonography, VCI: Vena cava inferior, Avg: Average, SD: Standard deviaton,

The feedback forms were also evaluated, and the mean points for the lecturers and for the overall course format were calculated. Three of the lecturers achieved a score of 4.00 for both theoretical lectures and hands-on training. One lecturer achieved a score of 4.00 for theoretical lectures and a score of 3.75 for hands-on training, while one lecturer obtained 3.90 for theoretical lectures and 4.00 for hands-on training (Table 3). The mean points of the overall course ratings were as follows: 3.95 for the quality of the event, 4.00 for the relevance of the event, 3.82 for the suitability of formats used during the event, 3.95 for the ways the event affected the participant's practice and 4.00 for commercial bias (Table 4). These results show that the attendants were pleased both by the lecturers and the overall course format.

Discussion

Our study consisted of the evaluation of a basic POCUS course given by five expert instructors. We implemented a formal 2-day POCUS course for physicians practising in different areas. Our course format was approved and accredited by EACCME. This accreditation improves our course program's validity for different areas of medicine. Different clinical scenarios require different types of knowledge about POCUS, and we tried to include the complete spectrum of basic POCUS knowledge that can be required at the patient's bedside. We arranged our course topics upon the IFEM POCUS Curriculum Guidelines (2).

The necessity for POCUS instruction is clear, but the best methods of attaining these skills remain poorly defined (8,9). We tried to combine the theoretical lessons with PowerPoint presentations, hands-on training, interactive sessions and pre- and post-tests. Our results showed that such a course could improve skills in USG knowledge, normal image acquisition on healthy volunteers, image interpretation and comfort with USG technique. These improvements were apparent immediately after the course by the difference between pre-test and post-test and hands-on training checklists. There was a statistically significant difference between pre-test and post-test results, suggesting that our approach was highly efficient.

The hands-on training sessions were also effective because all attendants completed a checklist at the hands-on stations and practised each POCUS application on the checklist. The checklists included all of the required basic POCUS practical abilities of the related topics.

The rapidly expanding POCUS literature supports a multisystem approach for the evaluation of the patients, especially critically ill ones (10-12). We organised our course program to meet this need and included major organ systems such as lung USG, bedside cardiac USG, abdominal USG, hepatobiliary USG and aorta and vena cava inferior USG. Established protocols require integrated knowledge about all of these organ systems, and we integrated this knowledge with both interactive sessions and some questions in our pre- and post-tests. In our interactive sessions, we used a web-based simulation program. A case-scenario was introduced to a group of three attendants who then decided to use one of the basic POCUS applications and applied it to a healthy volunteer; the pathologic image based on the scenario was shown to the class. Subsequently, the attendants made a diagnosis or used another POCUS application until they reached a diagnosis. This way, the integration of the acquired knowledge could be improved.

Based on a previous study, students feel that hands-on practise is the best way to learn technical POCUS skills (8). We performed hands-on training sessions for every topic included in our course and asked the attendants to practise every POCUS skill by him- or herself on healthy volunteers. We also used active-learning methods in our interactive sessions.

We asked the students to answer a feedback form about our course structure and about our instructors. Based on the results, the students found our course structure effective and our instructors sufficient. This point is very important because both aspects play a crucial role in the students' interest in the lessons and in their willingness to gain new skills. Unsatisfaction in this regard results in a lower interest and has a negative impact on learning.

Study Limitations

One limitation of our study is that practical hands-on training was performed on healthy subjects. All attendants completed the checklists for the hands-on training sessions and therefore gained the ability to perform USG scanning on a healthy subject. However, unfortunately, we have no information about their scanning abilities on real patients and in clinical settings.

Conclusion

Our study shows that our 2-day basic POCUS course integrating theoretical lessons, hands-on training on healthy volunteers, interactive sessions, pre- and post-tests and feedback forms is effective to provide basic POCUS knowledge to a range of multidisciplinary physicians.

Ethics

Ethics Committee Approval: The study protocol has been approved by local ethics committee (approval number: 2018-186).

Informed Consent: Informed consent was obtained from the patients.

Peer-review: Externally peer-reviewed.

Financial Disclosure: The author declared that this study received no financial support.

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