

THE FIRST IMAGING OF PATIENT PERFORMED BY EMERGENCY MEDICINE PHYSICIAN IN ED: MULTI-CENTERED AND BLIND QUESTIONNAIRE ON PATIENT RELATIVES

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ABSTRACT Introduction: The study aim was to identify the knowledge and awareness about Point-of-Care Ultrasound (POCUS) and expectations of patients' relatives regarding the first imaging method performed on patients in Emergency Departments (EDs). **Materials and Method:** Başkent University Ethics Committee approved this prospective, cross-sectional, random survey study. A paper-based questionnaire requiring chosen answers in multi choices about POCUS features was given to relatives of patients in 15 EDs. The suitability of the data structure for factor analysis was determined by using the Kaiser–Meyer–Olkin (KMO) and the Bartlett Sphericity Test. The KMO was 0.94. The Bartlett Sphericity Test resulted in a chi-square value of 2408.9 ($p = 0.0001$). The SPSS 23.0 software package was used for statistical analysis of the data. **Results:** A total of 363 completed questionnaires were studied. The significant findings were that the first imaging method should be performed as quickly as possible by the ED physician (57.9%, $n = 210$), be performed at bedside (49.6%, $n = 180$), be harmless and risk-free (55.9%, $n = 203$), differentiate -the first clinical diagnosis (53.7%, $n = 195$), and improve ED patient survival (64.2%, $n = 233$). **Conclusions:** The patients' relatives could not discriminate between the main features of POCUS and those of other ED imaging methods or be unaware of their rights regarding its use.

KEYWORDS Point-of-care ultrasonography, emergency department, patient's relative

Key Messages

Awareness of patient' relatives about POCUS can be a trigger in essential developments in the existence of US device, record convenience, providing in the share of images within national health-systems online, training curriculum in Emergency Medicine, required and compatible within current literature, in

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a formal process in all EDs independent of the level of hospitals.

Introduction

Point-of-care ultrasound (POCUS) can provide the first evidence for use in differential diagnosis and guide treatment and consultation. It is used in many emergencies, such as cardiac arrest, respiratory failure, shock, and to assess various complaints, such as chest pain, dyspnea [1] It increases the probability of survival.[2] However, the lack of formal processes in this issue might impose constraints regarding patient care and management in cases except in a few developed countries.

The objective is to identify the knowledge and awareness about POCUS and expectations of patients' relatives regarding the first imaging method used in the emergency department (ED).

Materials and Methods

This prospective, cross-sectional, random, survey study protocol was approved by the Başkent University Institutional Review Board, and the report adhered to the STROBE guidelines statement.[3] A paper-based questionnaire requiring chosen in multi choices was given to adult participants who were relatives of ED patients. Each question was about a feature of POCUS. All participants were blind to the imaging methods used in the ED, and there were no explanations, introduction, orientation, or any other verbal dialogue provided to the participants about any of the survey's intentions.

Relatives of patients treated at the following 15 EDs simultaneously participated in this study, which was started on March 1, 2017, and completed in the same month: Baskent University (U) Adana Dr Turgut Noyan Training and Research Hospital (TRH), Kayseri TRH, Bağcılar TRH, Ankara Numune TRH, Ege U, Firat U, Akdeniz U, Atatürk U, Duzce U, Baskent U, Alanya TRH, Ufuk U, Baskent U, Bulent Ecevit U, Afyon Kocatepe U and Koc U. The required weighted number of survey responses for each centre was calculated according to the total number of daily patients by using a clustering method prior to the study (Table 1).

Physicians presented the survey to adult relatives of patients who had an emergency severity score of 2–4 and were waiting in the ED sitting areas. The relatives were given a pen and left alone to complete the survey. The completed surveys were requested to be returned to the physician within 15 min. To the relatives of patients with a life-threatening condition had an emergency severity score of 1 and required immediate emergency management and treatment and patients who did not have an emergent condition had an emergency severity score of 5 were not given a survey. Only one patient relative completed a survey for that patient, and we did not record the number of relatives who refused to participate.

The respondents could choose one of the following multiple-choice answers: definitely yes, yes, undecided, no and definitely no, which corresponded to a 5-point Likert scale. The completed surveys were sent to the first author and archived in the ED for the subsequent ten years. There was a place on the title page of the survey to provide written and signed consent to participate and had three parts: 1) This questionnaire was presented to you as a relative of a patient by an Emergency Physician (EP) at the Baskent University Department of Emergency Medicine and other centres participating in the study in order to evaluate your awareness level about the first imaging performed on an

emergency patient to improve the service provided to these patients. Please answer all questions in order to achieve reliable results in the assessment, and thank you for your contribution. 2) Personal sociodemographic information, age, sex and degree of education of the volunteer relative should be provided. 3) I agree to participate in this survey; name, surname, date and signature.

The age, sex, International Classification of Diseases, and Emergency Severity Index (ESI) of each patient were recorded on the survey by an EP. Surveys that were incomplete or unsigned were excluded. The following outcomes were assessed: 1) the knowledge level for differentiation the features of POCUS, 2) expectations of relatives regarding the first imaging method used in the ED.

The survey was developed by the investigator. The goals of the study were asked as research questions and tested for reliability and validity to determine the required number of participants prior to the study. For each relative, 30 surveys were required. The suitability of the data structure for factor analysis was assessed by using the Kaiser–Meyer–Olkin (KMO) and the Bartlett Sphericity Test. The KMO was 0.94. The Bartlett Sphericity Test resulted in a chi-square value of 2408.9 ($p = 0.0001$).

When the factor structure used in the principal components factor analysis was examined according to Kaiser's normalised varimax transformation, it was found that the survey should be evaluated based on the total score of the answers (scores of 1 to 5 each) and not based on subfactors. The SPSS 23.0 software package was used for statistical analysis of the data. Categorical measurements were summarized as numbers and percentages and continuous measurements as averages and standard deviations. Chi-square test or Fisher test statistics were used to compare categorical variables. One-way ANOVA or the t-test was used for the variables that fulfilled the parametric distribution prerequisite assumption, and the Kruskal–Wallis test or Mann–Whitney U test was used for variables that did not fulfil the parametric distribution prerequisite assumption. The statistical significance level was set to 0.05 for all tests. This survey study did not contribute to risk or benefit in the care of the patients related to the participating relatives. No incentive to participate was provided.

Results

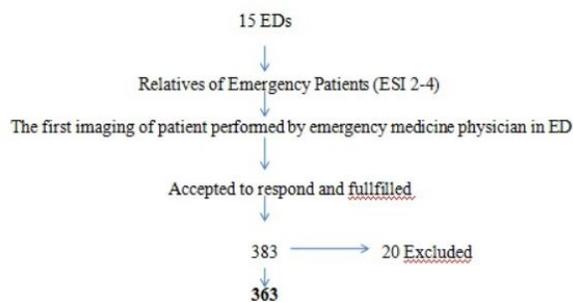
A total of 363 surveys were studied. The mean age of the relatives was 39.4 ± 12 (range, 16–83) years, and that of the patients was 44.7 ± 25.6 (range, 1–92) years. There were 117 (32.2%) female relatives and 149 (41.0%) female patients. The educational levels of the relatives were high school (30.6%, $n = 111$), primary school (29.5%, $n = 107$), undergraduate (22%, $n = 80$), middle school (11.3%, $n = 41$), associate degree (4.7%, $n = 17$), graduate (1.4%, $n = 5$), and analphabet (0.6%, $n = 2$). The percentages for ESI scores were 23.7% ($n = 86$) for a score of 2, 37.7% ($n = 137$) for a score of 3, and 38.6% ($n = 140$) for a score of 4.

Figure 1 presents the flowchart followed by the survey respondents. The questions and the answers on the survey completed by the patient' relative are presented in Table 2. The answers of patient' relatives about the name of the imaging method asked in 12 questions on the survey and the comparison, according to the demographics were stated in Table 3.

Table 1 The weighting of the size in numbers calculated in Cluster method.

Departments of Emergency Medicine	Daily patient (n)	Weighting	Target (n)	Delivered surveys to the 1st author by cargo (n)	Excluded (n)	Included (n)
Baskent University (U) Adana Dr.Turgut Noyan Training and Research Hospital (TRH)	120	0.02	7	7	0	7
Kayseri TRH	2000	0.30	116	116	7	109
Bagcilar TRH	1200	0.18	70	70	5	65
Ankara Numune TRH	750	0.11	44	44	5	39
Ege U	550	0.08	32	32	0	32
Firat U	400	0.06	23	23	0	23
Akdeniz U	320	0.05	19	19	1	18
Atatürk U	300	0.05	17	17	1	16
Duzce U	250	0.04	15	15	0	15
Baskent U Alanya TRH	150	0.02	9	9	0	9
Ufuk U	130	0.02	8	8	1	7
Baskent U	120	0.02	7	7	0	7
Bulent Ecevit U	120	0.02	7	7	0	7
Afyon Kocatepe U	120	0.02	7	7	0	7
Koc U	60	0.01	3	3	0	3
Total	6590		383	383	20	363

Figure 1. The flowchart followed by the survey respondents.



Discussion

The prespecified hypotheses of this paper that it can enlighten and accelerate the developments of required formal revisions in quality criteria, machines, training, procedures, processes and responsibility of institutions about POCUS by demands of relatives.

POCUS is practised daily by EPs even for stable patients who present with acute complaints in ED [4] and includes all critical care US with extended systems. Consultative US is indicated for suspected diagnoses or insufficient findings when interpreting POCUS.[5] There are many reports of cases in the literature that have benefited from differential diagnosis assessed by POCUS in the short time frames required in an ED. Early detection of a clinical problem and integration of this knowledge with the choice of management of an emergency patient

has decreased morbidity, and mortality.[4] Multiorgan POCUS solves the questions of a problem with clues on ultrasonography imaged on systems. [6] The first curriculum on emergency medicine ultrasound was released in 1994 by ACEP.[7] POCUS is an independent practice of an initial physical examination performed by an EP and integrated in patient care. It has been used generally in EDs by following the international statements issued concerning emergency US for three decades.[8]

Additionally, improvements as quality criteria in accreditation and standardisation in all hospitals have to be the main goals. The participation of patients' relatives to assess their level of knowledge has been an essential part of this developmental process. However, only a few studies have investigated the opinions, expectations and awareness of patients and relatives about the US, primarily as used in EDs. In our study, the findings of this survey about the first imaging performed by EPs were shared with patients' relatives, and we expected positive responses about the features of POCUS. However, most of them (46.6%, n = 169) thought that posteroanterior chest X-ray, POCUS and computed tomography all shared the features presented in the survey. The survey participants were not yet able to discriminate between the imaging methods used in an ED.

A previous study investigated only the basic modality features of US, tomography and magnetic resonance in non-emergency patients. Only 46% of the participants knew the US technique, and 36% of the participants gave correct answers in their survey. The US was mentioned as being used in differential diagnosis by 58% of the participants (n = 213).[9] That

Table 2 The questions and the answers on a survey completed by patient' relative.

The first imaging of the emergency patient performed by EP in ED					
It should be performed	Definitely yes % (n)	Yes % (n)	Undecided % (n)	No % (n)	Definitely not % (n)
As fast as EP can perform.	57.9 (210)	37.7 (137)	3 (11)	0.8 (3)	0.6 (2)
With an appropriate and sufficient device.	54 (196)	42.7 (155)	3 (11)	0.3 (1)	0 (0)
On bedside without transporting anywhere, even without changing the position of the patient.	49.6 (180)	33.9 (123)	11 (40)	5.5 (20)	0 (0)
Evidence-based with a high accuracy ratio	58.7 (213)	39.1 (142)	1.9 (7)	3 (1)	
Recorded in an archive	51.8 (188)	44.6 (162)	3 (11)	0.3 (1)	0.3 (1)
Harmless and risk-free	55.9 (203)	4.5 (147)	3.3 (12)	0.3 (1)	
The first clinical diagnose with imaging prior the physical examination findings occurred of the emergency disease	53.7 (195)	40.8 (148)	3.9 (14)	1.1 (4)	0.6 (2)
Increasing the possibility of life-saving in life-threatening situations	64.2 (233)	34.7 (126)	1.1 (4)	0 (0)	
Accessible in along 24 hours	60.3 (219)	36.6 (133)	2.8 (10)	0.3 (1)	
Compatible within current and accepted scientific guidelines	52.9 (192)	43.3 (157)	3.6 (13)	0.3 (1)	
Easily repeatable	44.9 (163)	47.9 (174)	6.1 (22)	1.1 (4)	
Able to provide the control and demonstrate the effect of the emergency treatments directly	46.8 (170)	49.9 (181)	3 (11)	0.3 (1)	
Informed legally and able to request	53.4 (194)	39.9 (145)	5.2 (19)	0.8 (3)	0.6 (2)

Table 3 The answers of patient' relatives about the name of the imaging method asked in 12 questions on the survey and the comparison, according to the demographics were stated.

What is the name of the imaging method had all features mentioned in 1-12 questions?	P-A Chest X-ray	Point of Care Emergency Ultrasound	Computed Tomography	All 3 of them	I do not know	p-value		
						Age	Sex	Education Degree
						12.1(44)	7.2 (26)	12.7 (46)

study provided prior information about the procedure but did not provide the relevance of US in patient medical management and care.

On the other hand, there was no opposition by patients to the use of POCUS by EPs. Durston reported a patient satisfaction score of 8.9, and the accuracy of interpretations in solving the clinical problem was 99.1%. The patient satisfaction score was 8.8 for the radiology department.[10]

POCUS is a responsibility of EPs in emergency patient care according to the policies and recommendations are given in guidelines.[11] The criteria concerning the provision of the essential conditions needed for suitable instrumentation to record US images and archive them through a Wi-Fi network have to be formally documented and supported by legal quality criteria in all EDs regardless of levels of the hospitals. The patients' relatives in our study agreed and expected that the first imaging of a patient performed by EP with an appropriate device, which should be accessible in along 24 hours in EDs and fast and at the bedside. Additionally, such imaging should provide reliable evidence, be recorded for storage in an archive, and be harmless and risk-free. The participants expected that the first differential diagnosis should be made by imaging performed prior to the physical examination, should improve survival of patients in life-threatening situations, and should be compatible with current and accepted scientific guidelines.

The participants in our study were aware of their general legal rights on being informed and able to request the first imaging for the patient. Unfortunately, they have not known or discriminate POCUS, yet. On the other hand, the practice of bedside clinical US prevents the possibility of malpractice.[12] The filing of lawsuits is related to the level of awareness and expectations of patients and their relatives about POCUS. Lawsuits might also be filed if the rights of patients are violated, and the hospital's quality criteria are not followed. However, no study has examined the level of awareness of relatives of emergency patients concerning the use and value of POCUS in the differential diagnosis.

A previous retrospective study searched court cases about emergency POCUS in 20 years and found only one case. The unexpected reason for this low number of studies is the lack of use of POCUS by EPs. The accusation found mentioned above was not associated in practice or the interpretation. However, hundreds of cases were found that involved lawsuits against radiology and gynaecology departments.[13] Another study concluded that between 2008 and 2012, there were five malpractice cases in POCUS performed by EPs, four of which resulted in unfavourable outcomes. The study found that the lawsuits were based on faulty interpretation and failure to perform POCUS. EPs were accused of failure to perform POCUS or of performing it late. In three of the cases, extremity US was not performed. Current algorithms recommend performing cardiac and lung US before extremity US in the differential diagnosis of suspected or probable embolus.[14] No case related to interpretation or misdiagnosis was found in the same study. There were seven malpractice cases excluded in that study that did not involve the core applications described by the American College of Emergency Physicians guidelines.

Limitations of the study

The participants represented only a sample of volunteers. Additionally, the survey questions were indirectly inquiries presented in multiple choices.

Conclusion

Unfortunately, this survey study found that there was very little knowledge or awareness by patients' relatives about POCUS, that it has been increasingly used as an independent application and the primary imaging method, or that it has been an effective method for contributing to the survival of patients in EDs over the last three decades. Further studies are needed to reveal the importance and difference of POCUS noticed by patient relatives.

Ethics committee approval

No human or animal experiments were conducted in this study. No participation consent was needed. All sources used for documentation were adequately mentioned concerning copyright laws.

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Conflict of interest

Author declare no conflict of interests.

Data availability

The authors declare that data supporting the findings of this study are available within the article.

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