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Paramedic-performed Focused Assessment with Sonography in Trauma (FAST) in the Emergency Department

Acil serviste paramediklerce uygulanan travmaya odaklanmış ultrasonografi değerlendirmesi

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BACKGROUND

Our objective was to evaluate the accuracy of paramedic-performed Focused Assessment with Sonography in Trauma (PFAST) for detection of free fluid in patients admitted to the Emergency Department (ED) following trauma.

METHODS

After four hours of didactic and four hours of hands-on training, four paramedics prospectively evaluated trauma patients. Our gold standard was the official radiologist reports of ultrasonography and computerized abdominal tomography (CAT). The sensitivity, specificity, positive and negative likelihood ratios, and diagnostic odds ratio of PFAST were calculated and analyzed using SPSS 15.0 with χ^2 testing.

RESULTS

One hundred and twenty-seven patients were evaluated by the paramedics. Fourteen patients had positive free fluid in the abdomen. Of these, 11 were corroborated by radiology reports and CAT (true positives), and three were found to be negative (false positives). In 113 cases, PFAST was negative for free fluid. Of these, 111 were determined not to have free fluid (true negatives), whereas free fluid was detected by CAT in 2 (false negatives). The sensitivity, specificity, positive and negative likelihood ratios, and diagnostic odds ratio of PFAST were 84.62, 97.37, 32.15, 0.16, and 203.50, respectively.

CONCLUSION

Our study shows that paramedics can perform FAST in hospital EDs with a high degree of accuracy.

Key Words: Abdominal injury; emergency service; emergency medical technicians; hospital; nurse; ultrasonography.

AMAÇ

Travmayı takiben acil servise başvuran hastalarda paramediklerce uygulanan travmaya odaklanmış ultrasonografi değerlendirmesinin (PFAST) serbest sıvı saptamadaki doğruluğu araştırıldı.

GEREÇ VE YÖNTEM

Dört saatlik teorik ve dört saatlik uygulamalı eğitim sonrası, dört paramedik travma hastalarını ileriye dönük inceledi. Altın standardımız ultrasonografi ve karın bilgisayarlı tomografisinin (KBT) resmi radyolog raporlarıydı. PFAST'in duyarlılık, seçicilik, pozitif ve negatif olabilirlik oranları ve tanısal odds oranı hesaplandı ve ki-kare testi ile SPSS 15.0 kullanılarak analiz edildi.

BULGULAR

Yüz yirmi yedi hasta paramedikler tarafından değerlendirildi. On dört hastada karında serbest sıvı vardı. Bunlardan 11 tanesi radyoloji raporlarıyla ve KBT ile uyumlu iken (gerçek pozitifler), üç tanesi negatif geldi (yanlış pozitifler). Yüz on üç olguda PFAST serbest sıvı için negatif idi. Bunlardan 111 tanesinde serbest sıvı yokken (gerçek negatifler), iki tanesinde KBT ile tespit edildi (yanlış negatifler). Sırasıyla duyarlılık, seçicilik, pozitif ve negatif olabilirlik oranları ve tanısal odds oranı 84,62, 97,37, 32,15, 0,16 ve 203,50 idi.

SONUÇ

Çalışmamız, hastane acil servislerinde paramediklerin yüksek doğruluk oranıyla FAST uygulayabileceklerini göstermektedir.

Anahtar Sözcükler: Karın travması; acil servis; acil tıp teknisyeni; hastane; hemşire; ultrasonografi.

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Focused Assessment with Sonography in Trauma (FAST) is a rapid technique for detecting intraperitoneal or pericardial fluid in patients suffering from torso trauma. The FAST scan is used as an adjunct to the primary or secondary survey assessments depending on the hemodynamic stability of the patients, and it relies on the principle that in a supine patient, free fluid such as blood collects in certain anatomical sites. FAST scanning includes following potential spaces for free fluid in the thorax, abdomen, pelvis, the pericardial space, Morison's pouch (between the liver and right kidney), splenorenal space, and the Pouch of Douglas (rectovesical pouch in the male) behind the bladder.

Emergency physicians (EPs) and trauma surgeons have used focused ultrasound (USG) to evaluate trauma patients since the early 1980s.[1-4] There is a growing body of evidence that patient care is improved when FAST is included in the diagnostic workup of such patients.[5,6] Deployment of USG in prehospital care and Emergency Departments (EDs) could potentially provide critical information about traumatized patients and thereby optimize triage and transport of patients with multiple injuries. The portability, accuracy and noninvasiveness of USG create its potential as an effective imaging modality to provide diagnostic information in the prehospital arena.[7,8] With a functioning triage system, patients who sustain major traumatic injury are brought directly to the trauma unit of the EDs. On arrival in the trauma unit, patient assessment begins and a physician performs FAST or radiology physicians are called for this procedure. However, trauma resuscitations are not attended 24 hours per day by FAST-trained physicians. Therefore, all patients suffering from trauma do not have the benefit of a FAST scan on arrival in the resuscitation room. Paramedics and nurses are often a more consistent workforce in the Emergency and Trauma Departments. With appropriate training, it was considered that paramedic-performed FAST (PFAST) might be a practical alternative that could increase the availability of FAST.

Our objective was to evaluate the accuracy of PFAST for detection of free fluid in the peritoneal cavity and pericardial space in patients admitted to the ED following trauma.

MATERIALS AND METHODS

This was a prospective study undertaken in a research and training hospital with an annual ED attendance of approximately 220,000. The study received prior Human Research Ethics Committee approval.

All patients who attended the trauma unit of the ED between January and September 2010 with a calculated Injury Severity Score (ISS) greater than 16, age over 18 years, and who were nonpregnant were eligible for enrolment. The ISS is an anatomical scoring system that provides an overall score for patients with multiple injuries. Each injury is assigned an Abbreviated Injury Scale (AIS) score and is allocated to one of six body regions (Head, Face, Chest, Abdomen, Extremities, External). Only the highest AIS score in each body region is used. The three most severely injured body regions have their score squared and totaled to produce the ISS score.[9] Patients were managed in the ED according to standard trauma principles.[10,11]

Four senior paramedics working in the triage of our hospital underwent four hours of didactic and four hours of hands-on training by a radiologist for FAST scanning and presence of free fluid. PFAST results were recorded as positive/negative for free fluid in each case. Images were recorded and stored in the computer. In those granting consent, the paramedics performed PFAST using a Mindray M7 model USG machine with a 3.5 MHz convex transducer (Shenzhen, China), and B-mode static views were recorded, a procedure that took less than four minutes. After PFAST by paramedics was completed, patients then underwent abdominal USG by radiology specialists who were blind to the study protocol but not to the clinical status of the patients, without time loss. They used the same machine as paramedics that also took less than four minutes. Computerized abdominal tomography (CAT) was ordered as desired by general surgeon consultants and evaluated by radiologists who were blind to the study. Our gold standard for the presence of free fluid was the official radiologist reports of USG and CAT.

Data Analysis

The sensitivity, specificity, positive and negative likelihood ratios, and diagnostic odds ratio of PFAST were calculated and analyzed using SPSS 15.0 (SPSS, Inc., Chicago, IL, USA) with χ^2 testing, with 95% confidence intervals.[12-14]

RESULTS

During the study period, 127 patients with ISS over 16 were evaluated by the paramedics in our ED. The mean ISS score was 20.62±3.83, range 16-29. All 127 patients (24.4% female, 75.6% male, mean age 37.94±1.27 years, range 18-87 years) agreed to participate in the study. The most common mechanism of injury was motor vehicle accidents (Table 1).

Fourteen patients had positive free fluid in the abdomen. Of these, 11 were corroborated by radiology reports and CAT (true positives), and three were found to be negative (false positives) (Table 2). In 113 cases, PFAST was negative for free fluid. Of these, 111 were determined not to have free fluid (true negatives), whereas free fluid was detected by CAT in 2

Table 1. Mechanisms of injury

Trauma mechanism	n (%)
Motor vehicle accident	99 (78)
Fall from height	21 (16.1)
Assault	7 (5.5)

Table 2. PFAST results for free fluid in 127 trauma patients

PFAST results for free fluid	
(n=14)	11 diagnosed to have free fluid by RUS or CAT
	3 diagnosed not to have free fluid by RUS or CAT
(n=113)	111 diagnosed not to have free fluid by RUS or CAT
	2 diagnosed to have free fluid by RUS or CAT

PFAST: Paramedic-performed Focused Assessment with Sonography in Trauma; RUS: Radiologist-performed ultrasonography; CAT: Computerized abdominal tomography.

Table 3. PFAST results with 95% confidence intervals

	PFAST Results (95% Confidence Intervals)
Sensitivity (%)	84.62 (57.77-95.67)
Specificity (%)	97.37 (92.55-99.10)
+ Likelihood ratio	32.15 (10.28-100.58)
– Likelihood ratio	0.16 (0.04-0.57)
Diagnostic odds ratio	203.50 (30.64-1351.66)

PFAST: Paramedic-performed Focused Assessment with Sonography in Trauma.

(false negatives) (Table 2). The sensitivity, specificity, positive and negative likelihood ratios, and diagnostic odds ratio of PFAST are listed in Table 3.

DISCUSSION

Previous studies of FAST performed by non-radiologists have demonstrated a sensitivity of 42-96% and specificity of 85-100%, with an overall accuracy of 82-99%.[2,15-25] The results of our study suggest that the accuracy of FAST performed by paramedics working in the ED, and trained in FAST, is comparable to non-radiologist-performed FAST. To our knowledge, this is the first study to assess the accuracy of FAST when performed by paramedics in the ED, trained in the performance and interpretation of FAST. There was one study in the English literature about paramedic-performed FAST, but it was designed in the prehospital area and for prehospital triage.[26] We found that our results were well correlated with this study as well. A literature search showed that USG performed by healthcare personnel other than doctors, such as nurses and paramedics, was accurate in other areas such as intravenous cannula insertion, echocardiography, abdominal aortic aneurysm detection, and obstetric USG.[27-30]

The data from our study showed that paramedic-performed USG can be successfully introduced into a hospital ED with quality and accuracy if trained paramedics are carefully supervised by USG-trained EPs. Our hypothesis was that paramedic-level personnel could perform USG with high quality and accuracy while working in the EDs. This is important in Turkey, where paramedics and other healthcare personnel are working more frequently in the urban and rural EDs and patients cannot access USG-performing physicians 24 hours a day. Because Turkey uses radiology physicians as the primary emergency USG providers, examining outcomes such as effect on time to diagnosis and survey of the patients is appropriate in that system. However, given that the Emergency System in Turkey has been built on using radiology specialists as the bedside USG providers for trauma patients and the number of these physicians is inadequate for 24 hour-care in emergency, we felt a pilot study looking at paramedic accuracy would be an important contribution to Turkish hospital USG literature.

Although prehospital USG has been successfully implemented and is being consistently utilized throughout much of Europe, specifically in Germany, France, Italy, and some Scandinavian countries, it is newly started in our country, even in EDs.[31] The opportunity to improve patient care outcomes in the areas of trauma care, critical medical conditions and cardiac resuscitation will likely accelerate the use of emergency bedside USG by non-physicians in the future. The horizon for emergency USG is enlarging. How, where, and to what extent emergency USG will be developed in Turkey is still a matter of debate. Our study did not attempt to answer these questions, but rather acts as a hypothesis-generating study to promote further research in this important area. The hypothesis derived directly from our study is: What clinical impact can paramedic-performed USG in EDs have for improving patient care?

One of the limitations of our study was that paramedics were not blinded to the study. Since the paramedics knew they were being evaluated, they were more motivated to enhance their performance of the criteria being studied. Because no standards exist for training paramedics in USG, we cannot assume that our training program was adequate. However, we based our training program on our emergency resident training program for FAST. Further research needs to be performed to validate our suggested PFAST.

In conclusion, emergency USG has the potential to improve patient outcome by improving time to diagnosis and early prompt care of critically ill patients who are amenable to time-dependent life-saving interventions. It also has the promising ability to assist in making appropriate destination decisions for the patients. Our study shows that paramedics can perform FAST in hospital EDs with a high degree of accuracy.

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