

## Original Article

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# Accuracy of Extended Focused Assessment with Sonography in Trauma (e-FAST) Performed by Emergency Medicine Residents in a Level One Tertiary Center of India

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## Abstract

**Introduction:** It could be claimed that extended focused assessment with sonography for trauma (e-FAST) is the most important use of ultrasound in every emergency department (ED). It is a rapid, repeatable, non-invasive bedside method that was designed to answer one single question, which is, "whether free fluid is present in the peritoneal, pleural and pericardial cavity or not?" This examination may also be used to evaluate the lungs for pneumothorax.

**Objective:** The current comparative study was conducted to assess the accuracy and reproducibility of e-FAST performed by emergency medicine residents (EMRs) and radiology consultants (RCs) in multiple trauma patients.

**Method:** This diagnostic accuracy study was conducted prospectively in patients presenting over a period of 12 months from January 1, 2013, to December 31, 2013 to the ED of Kerala Institute of Medical Sciences (KIMS), Kerala, India. All multiple trauma patients older than 18 years of age presenting within 24 hours of their traumatic event, who underwent both e-FAST and thoracoabdominal computed tomography (CT) scan were included. The e-FAST exams were first performed by the EMRs and then by RCs. The thoracoabdominal CT scan findings were considered as the gold standard. The results were compared between both groups to assess the inter-observer variability. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy were calculated both for EMRs and RCs.

**Results:** In the study period, 150 patients with a mean age of  $42.06 \pm 18.1$  years were evaluated (76.7% male). Only 19 cases (12.7%) had a history of fall from a height, and the others were admitted due to RTA. Thirty-four cases (22.7%) did not require surgery; but the others underwent various interventions. Both EMRs and RCs reported positive findings in 20 cases (13.3%) and negative findings in 130 cases (86.7%). The correlation of e-FAST done by EMRs with that by RCs was 100%. E-FAST exam had a sensitivity of 90.4%, specificity 99.2%, PPV 95.0%, NPV 98.4%, and accuracy 98%, both for EMRs and RCs.

**Conclusion:** Based on the findings, the sensitivity, specificity, and accuracy of e-FAST exams performed by EMRs were equal to those performed by RCs. It seems that e-FAST performed by EMRs were almost accurate during the initial trauma resuscitation in the ED of a level one trauma center in India.

**Key words:** Emergency service, hospital; Multiple trauma; Patient care; Radiologists; Ultrasonography

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## INTRODUCTION

Trauma is one of the leading causes of death in India which has the dubious distinction of having the worst road traffic accident (RTA) rate worldwide. Lack of trained emergency care providers at different tiers of health care adds up to the existing problem of suboptimal infrastructure in this country. Emergency medicine as a specialty is in a state of infancy in India, and the use of point-of-care ultrasound in the emergency department (ED) is relatively new and growing (1).

It could be claimed that extended focused assessment with sonography for trauma (e-FAST) is the most important use of ultrasound in every ED. It is a rapid, repeatable, non-invasive bedside method that was designed to answer one single question, which is, "whether free fluid is present in the peritoneal and pericardial cavity or not?" It is a valuable investigation for the initial assessment of patients with blunt thoracoabdominal trauma as shown in a large case series from several North American trauma

centers (2, 3). Usually, it is done as a part of trauma resuscitation by radiologists in the trauma team or emergency medicine physicians (EMPs). Despite advance trauma life support (ATLS) and other similar courses having been started recently in India, the circulation assessment of multiple trauma patients by e-FAST examination is still predominantly done by radiologists. In contrast, in most of the trauma centers in other countries, e-FAST is routinely performed by EMPs.

It is obvious that in blunt abdominal trauma, a rapid decision regarding the need for emergency laparotomy is crucial and lifesaving, especially for those with unstable hemodynamics. So, e-FAST done by EMPs, with good sensitivity and specificity and reasonable diagnostic accuracy, will save time, avoid patient transfer to the radiology department, and be a useful tool for early decision making in such cases. But, studies to assess the diagnostic accuracy of e-FAST done by EMPs are still limited in the Indian setting. Considering the importance of this topic, a comparative study was conducted to assess the accuracy and reproducibility of e-FAST performed by emergency medicine residents (EMRs) and radiology consultants (RCs) in multiple trauma patients.

## METHODS

### Study design

This diagnostic accuracy study was conducted prospectively in multiple trauma patients presenting to the ED of Kerala Institute of Medical Sciences (KIMS), Kerala, India. The study was conducted over a period of 12 months from January 1, 2013, to December 31, 2013. It is worth mentioning that the ED of KIMS has more than 40,000 patient visits annually (100–130 patients per day).

### Ethical consideration

The study was approved by the ethics committee of KIMS. In this observational study, we compared the ultrasound findings which were done during the primary survey without any active interventions, neither causing harm or delay in patient care nor increasing the cost.

### Study population

All patients more than 18 years of age presenting to the ED within 24 hours of an RTA or with a history of fall from a height more than 6 feet who underwent both e-FAST and thoracoabdominal computed tomography (CT) scan were included. Patients with underlying diseases causing fluid accumulation in the abdomen such as cirrhosis, penetrating trauma to the chest or abdomen, and

patients in whom performing e-FAST would potentially delay emergency procedures were excluded. Considering  $\alpha = 5\%$  and  $1-\beta = 80\%$  (power), using the formula  $\frac{\{z_{1-\alpha/2}\sqrt{2p(1-p)} + z_{1-\beta}\sqrt{p_1(1-p_1) + p_2(1-p_2)}\}^2}{(p_1-p_2)^2}$ , the sample size was calculated as 149 cases. Sampling was performed in an accessible manner.

### Data gathering

A checklist related to the demographic and baseline characteristics of the patients was filled. The e-FAST exams were first performed by the EMRs and then by RCs who had already undergone 3 years of postgraduate training in radiology. The thoracoabdominal CT scan findings were considered as the gold standard.

The four EMRs, whose performance was evaluated in the current study, were trained in emergency sonography by radiologists, EMP credentialed by KIMS as emergency bedside ultrasound providers, and performed 30 supervised positive and negative e-FAST exams for free fluid before recruitment into the study.

### Statistical analysis

Statistical analysis was performed using SPSS-version-17. The results were compared between both groups to assess the inter-observer variability. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy were calculated both for EMRs and RCs.

## RESULTS

In the study period, 150 patients with a mean age of  $42.06 \pm 18.1$  (range, 18 to 80) years were evaluated, in which 115 (76.7%) were male. The demographic and baseline characteristics of the studied patients are summarized in table 1. Majority of the cases were in the age group of 21–30 and 31–40 years. Only 19 cases (12.7%) had a history of fall from a height, and the others were admitted due to RTA. Finally, 34 cases (22.7%) who did not require surgery were managed conservatively, and serial e-FAST exams were done for reassessment, but the others underwent various interventions. All the e-FAST scans in this series were completed within a 5-minute period.

Both EMRs and RCs reported positive findings in 20 cases (13.3%) and negative findings in 130 cases (86.7%). The correlation of e-FAST done by EMRs with that by RCs was 100%. Table 2 shows the comparison of the findings of e-FAST with CT scan, the latter being the gold standard in this study. Based on the findings, e-FAST exam had a sensitivity of 90.4%, specificity 99.2%, PPV 95.0%,

Variable	Number (%)
<b>Age (years)</b>	
<20	7 (4.7)
21-30	48 (32.0)
31-40	31 (20.7)
41-50	17 (11.3)
51-60	17 (11.3)
61-70	18 (12.0)
>70	12 (8.0)
<b>Sex</b>	
Female	35 (23.3)
Male	115 (76.7)
<b>Injury mechanism</b>	
Fall	19 (12.7)
Road traffic accident	131 (87.3)
<b>Hemodynamic stability</b>	
Stable	127 (84.7)
Unstable	23 (15.3)
<b>Intervention/Surgery</b>	
Conservative management	34 (22.7)
Tube thoracostomy	14 (9.3)
Orthopedic procedure	87 (58.0)
Laparotomy	6 (4.0)
Neurosurgical procedure	7 (4.7)
Orthopedic and neurosurgical procedure	2 (1.3)

  

	CT scan findings	
	Positive	Negative
<b>e-FAST findings</b>		
Positive	19	1
Negative	2	128

NPV 98.4%, and accuracy 98%, both for EMRs and RCs.

There was one false positive case, that of bladder injury in which the free fluid detected was urine, and two cases which were missed (false negative) on e-FAST exam had occult pneumothorax which was managed conservatively and diagnosed by further CT scan. Patients with a negative scan were observed clinically, and none of these patients developed abdominal complications.

**DISCUSSION**

Based on the findings of this study, e-FAST exams performed by trained EMRs had good accuracy, comparable with that of RCs.

CT scan is overall accepted as a sensitive tool for the investigation of stable blunt abdominal trauma patients. In addition to providing evidence of bleeding, it gives detailed anatomical information about the injuries present. However, it is not appropriate for the unstable injured patients (4, 5). Diagnostic peritoneal lavage (DPL) is another sensitive modality to investigate patients for possible abdominal bleeding and was previously considered as the gold standard for the abdominal investigation of unstable trauma patients. But, it has fallen from favor because of its invasive nature

and the high incidence of non-therapeutic laparotomy after a positive result (6, 7).

The e-FAST exam has previously been compared favorably to CT scan and DPL in the investigation of blunt abdominal trauma (8-10). There are several studies which have assessed the diagnostic accuracy of ultrasound performed by non-radiologists and reported a sensitivity of 80%–88% and specificity of 90%–99% in detecting hemoperitoneum using the e-FAST technique (11). Jehangir *et al.* from India reported a sensitivity of 91% and specificity of 100% for e-FAST in identifying fluid by radiologists in blunt abdominal trauma (12). The sensitivity and specificity of e-FAST exam performed by RCs in the present study was 90.4% and 99.2%, respectively, which are equal with that of e-FAST exam performed by EMRs. It seems almost equal to that reported by Jehangir *et al.*

With regard to unstable patients and those in a state of shock, the accuracy of e-FAST decreased to a small extent. Gaarder *et al.* reported a sensitivity and specificity of 62% and 96%, respectively, with an overall accuracy of 88% among unstable patients. The PPV and NPV were reported as 84% and 88%, respectively (13).

The e-FAST exam should ideally be performed

within minutes, as we did in the current study. The horizontal organization of the trauma team allowed e-FAST to proceed without any delay or disruption in the flow of the resuscitation process. It is suggested that a negative e-FAST examination be repeated at intervals or another diagnostic procedure considered (14-16).

In summary, e-FAST is a useful diagnostic procedure for the primary assessment of trauma patients in ED. It is a portable and non-invasive procedure but is operator dependent. Although radiologists and radiology residents are sufficiently trained to perform such scans, EMRs can achieve the same proficiency when given adequate training as part of their academic curriculum. The e-FAST exam can be done simultaneously with the resuscitation of the unstable patient. On the basis of the high NPV of e-FAST performed by EMRs in the current study (almost 98%), e-FAST could be an effective screening tool in trauma patients. Also, the level of reproducibility indicates that EMRs, who are available at all times, can perform e-FAST reliably.

#### **Limitations**

This study was conducted in a single center and limited to the performance assessment of four EMRs. Performing multicenter surveys following the establishment of ultrasound courses for EMRs would be definitely more valuable.

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#### **CONCLUSIONS**

The sensitivity, specificity, and accuracy of e-FAST performed by EMRs were 90.4%, 99.2%, and 98%, respectively; these were equal to that of e-FAST performed by RCs. It seems that e-FAST performed by EMRs were almost accurate during the initial trauma resuscitation in the ED of a level one trauma center in India.

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#### **AUTHORS' CONTRIBUTION**

All the authors met the standards of authorship based on the recommendations of the International Committee of Medical Journal Editors.

#### **CONFLICT OF INTEREST**

None declared.

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