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ORIGINAL ARTICLE

Diagnostic Accuracy of Extended Focused Assessment with Sonography in Trauma (eFAST) for Detection of Blunt Chest Injuries: A Prospective Study Comparing EFAST with CT Chest

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Abstract

Background: Blunt chest trauma is a major cause of illness and death in trauma patients. Early detection of injuries such as pneumothorax and haemothorax is important for timely treatment. Computed tomography (CT) of the chest is the diagnostic gold standard. However, CT may not be easily available in emergency settings due to time and logistical constraints. Extended focused assessment with sonography in trauma (eFAST) provides a rapid bedside imaging option for early diagnosis. **Objectives:** To evaluate the diagnostic accuracy of eFAST in detecting blunt chest injuries in trauma patients, using CT chest as the reference standard. **Methods:** This prospective diagnostic accuracy study was conducted in the Department of Emergency Medicine at a tertiary care teaching hospital in Tamil Nadu over one year. Ninety-nine hemodynamically stable patients with suspected blunt chest trauma underwent bedside eFAST followed by CT chest. The diagnostic performance of eFAST was assessed using sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV). **Results:** Among the 99 patients studied, eFAST showed high specificity (100%) for all thoracic injuries. The sensitivity of eFAST was 75.0% for pneumothorax, 76.9% for haemothorax, 78.9% for rib fractures, and 50.0% for lung contusions. For detection of any chest injury, eFAST showed a sensitivity of 78.1% and a specificity of 100%. The PPV was 100% and the NPV was 90.5%. **Conclusion:** eFAST is a highly specific and reliable bedside tool for the early detection of blunt chest injuries, especially pneumothorax, haemothorax, and rib fractures. Although CT chest remains the definitive imaging modality, eFAST is an effective screening and triage tool in emergency and resource-limited settings.

Keywords: Blunt chest trauma, eFAST, Point-of-care ultrasound, Pneumothorax, Haemothorax, Computed tomography

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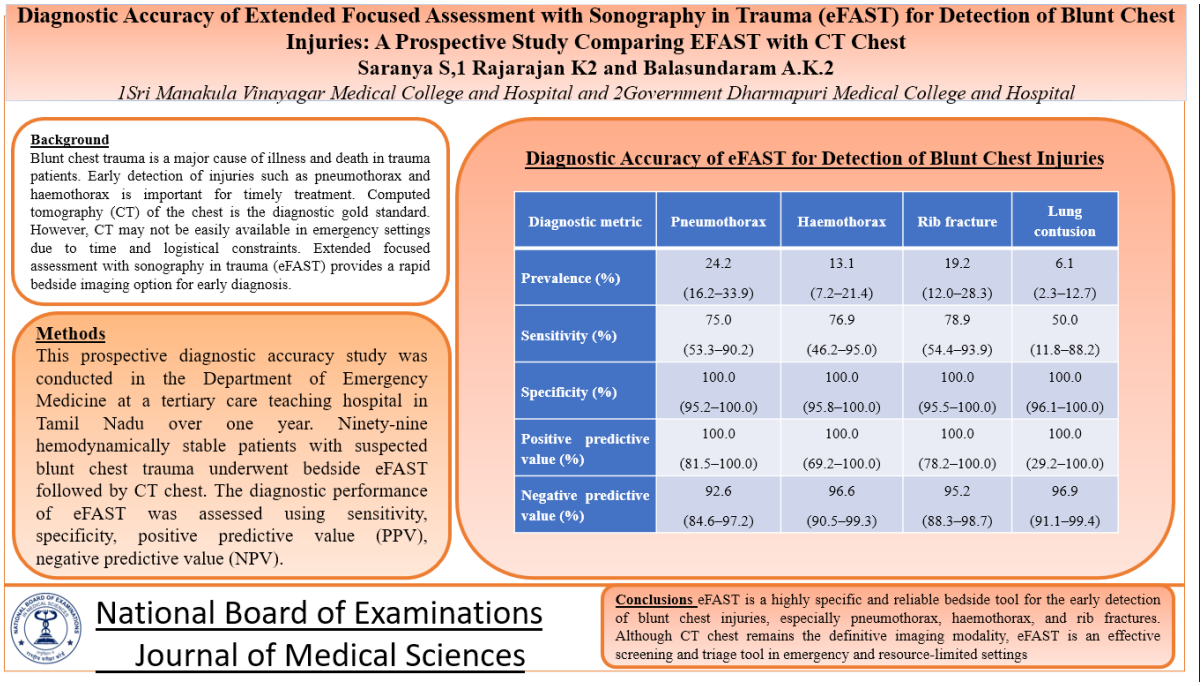
Graphical Abstract



Introduction

Trauma is a leading cause of death worldwide and is the most common cause of mortality among individuals aged 5–29 years, accounting for nearly 10% of all global deaths [1]. Chest trauma, particularly blunt thoracic injury, contributes significantly to trauma-related illness and death and is responsible for approximately 25% of trauma fatalities [2].In India, the burden of blunt chest trauma has increased markedly, mainly due to road traffic accidents, with more than 150,000 trauma-related deaths reported each year [3].Blunt thoracic injuries include a wide range of conditions such as pneumothorax, haemothorax, pulmonary contusion, rib fractures, and injuries to the heart or mediastinum. These injuries commonly present with mild signs or sometimes with some non-specific clinical signs. Early diagnosis is particularly difficult in unconscious or intubated patients [4]. Delay in identifying these injuries can result in hypoxia, shock, cardiac tamponade, and multi-organ dysfunction, leading to increased preventable mortality [5].

Computed tomography (CT) of the chest is considered the gold standard for diagnosing thoracic injuries because of its high sensitivity and ability to detect occult injuries not seen on plain chest radiographs [6].CT imaging has been shown to change clinical management in up to one-third of trauma patients by identifying important injuries missed during initial assessment [7]. However, CT requires patient transfer, exposes patients to ionizing radiation, and may not be readily available in emergency settings, especially in low- and middle-income countries [8].

Extended focused assessment with sonography in trauma (eFAST) builds upon the traditional FAST examination by adding thoracic views to detect pneumothorax, haemothorax, and pericardial effusion. eFAST is a rapid, portable, repeatable, and radiation-free imaging tool. These features make it suitable for bedside use during

trauma resuscitation [9]. Several studies have shown that eFAST has high specificity and moderate to high sensitivity for detecting pneumothorax and haemothorax. In many cases, it performs better than supine chest radiography [10–12].

Despite increasing international evidence supporting its use, data on the diagnostic accuracy of eFAST in Indian emergency departments remain limited. Differences in patient characteristics, availability of resources, and operator experience highlight the need for region-specific evaluation. Therefore, this study was conducted to assess the diagnostic accuracy of eFAST compared with CT chest in detecting blunt chest injuries in a tertiary care emergency setting in India.

Materials and Methods

Study Design and Setting

This was a prospective diagnostic accuracy study conducted in the Department of Emergency Medicine at Government Dharmapuri Medical College and Hospital, Tamil Nadu, India. The study was carried out over a one-year period from August 2023 to July 2024.

Study Population

Consecutive trauma patients presenting with suspected blunt chest injury and requiring CT chest evaluation were screened for inclusion in the study.

Inclusion Criteria

- Patients with blunt chest trauma
- Hemodynamically stable at the time of presentation
- Patients who underwent both eFAST and CT chest imaging
- Patients who provided informed consent

Exclusion Criteria

- Patients with penetrating chest trauma
- Hemodynamically unstable patients requiring immediate intervention
- Patients with prior intercostal drain insertion
- Pregnant women
- Patients with contraindications to CT imaging

Study Procedure

All eligible patients underwent a detailed clinical examination. This was followed by a bedside eFAST examination performed by trained emergency physicians. The eFAST assessment was used to identify pneumothorax, haemothorax, rib fractures, and lung contusions. All findings were recorded immediately using a standardized proforma. After the eFAST examination, all patients underwent CT chest imaging. CT chest served as the reference standard. The CT images were interpreted by a radiologist who was blinded to the eFAST findings.

Outcome Measures

The primary outcome measure was the diagnostic accuracy of eFAST compared with CT chest for detecting individual thoracic injuries and for identifying any chest injury.

Statistical Analysis

Data were entered and analyzed using STATA version 14. Diagnostic performance was assessed by calculating sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), with 95% confidence intervals.

Ethical Considerations

The study was approved by the Institutional Human Ethics Committee. Written informed consent was obtained from all participants or from their legally authorized representatives.

Results

The baseline characteristics of the study participants are shown in Table 1. The average age of the patients was 43.5 years, showing that blunt chest trauma was common in middle-aged adults. Most patients were male. Road traffic accidents were the most frequent cause of injury. Clinical signs of chest injury were present in only one-third of patients, indicating that many chest injuries may not be obvious on initial examination.

Table 1. Baseline Characteristics and Injury Profile of Study Participants (n = 99)

Variable	**Category**	**n (%)**
Age (years)	**Mean ± SD**	43.5 ± 15.1
Sex	**Male**	79 (79.8)
	Female	20 (20.2)
Mode of injury	**Road traffic accident**	71 (71.7)
	Accidental self-fall	17 (17.2)
	Assault	11 (11.1)
Clinical signs of chest injury	**Present**	33 (33.3)
	Absent	66 (66.7)

Table 2 shows the imaging findings detected by eFAST and CT chest. CT chest identified chest injuries in about one-third of patients, while eFAST detected positive findings in about one-quarter of cases. This shows that eFAST may miss some injuries detected by CT, especially minor or subtle injuries. However, eFAST was able to detect most clinically important chest injuries at the bedside.

Table 2. Distribution of Imaging Findings on eFAST and CT Chest (n = 99)

Imaging modality	**Finding**	**n (%)**
eFAST findings	**Positive**	25 (25.3)
	Negative	74 (74.7)
CT chest	**Positive**	32 (32.3)
	Negative	67 (67.7)

The diagnostic accuracy of eFAST for specific thoracic injuries is shown in Table 3. Pneumothorax was the most common injury, followed by rib fractures and haemothorax, while lung contusion was less common. eFAST showed good sensitivity for pneumothorax, haemothorax, and rib fractures. However, its sensitivity was lower for lung contusion, as lung contusions are difficult to detect with ultrasound. eFAST showed very high specificity for all injuries, meaning that no false-positive cases were identified. This indicates that when eFAST was positive, the injury was truly present.

Table 3. Diagnostic Accuracy of eFAST for Detection of Blunt Chest Injuries Compared with CT Chest (n = 99)

Diagnostic metric	**Pneumothorax**	**Haemothorax**	**Rib fracture**	**Lung contusion**
Prevalence (%)	24.2 (16.2–33.9)	13.1 (7.2–21.4)	19.2 (12.0–28.3)	6.1 (2.3–12.7)
Sensitivity (%)	75.0 (53.3–90.2)	76.9 (46.2–95.0)	78.9 (54.4–93.9)	50.0 (11.8–88.2)

Specificity (%)	100.0 (95.2–100.0)	100.0 (95.8–100.0)	100.0 (95.5–100.0)	100.0 (96.1–100.0)
Positive predictive value (%)	100.0 (81.5–100.0)	100.0 (69.2–100.0)	100.0 (78.2–100.0)	100.0 (29.2–100.0)
Negative predictive value (%)	92.6 (84.6–97.2)	96.6 (90.5–99.3)	95.2 (88.3–98.7)	96.9 (91.1–99.4)

Table 4 presents the overall performance of eFAST in detecting any chest injury. eFAST correctly identified most chest injuries and did not falsely label any patient as having an injury. The high positive predictive value shows that all patients with positive eFAST findings truly had chest injuries. The negative predictive value was also high, showing that eFAST was reliable in ruling out injury in most patients. Overall, eFAST showed excellent diagnostic accuracy as a screening tool.

Table 4: Diagnostic Accuracy of eFAST In Detecting Any Chest Injury Compared to CT Chest (Reference Standard) (n=99)

Diagnostic Metric	**Value**	**95% CI**
Prevalence	32.3%	23.3% - 42.5%
Sensitivity	78.1%	60.0% - 90.7%
Specificity	100.0%	94.6% - 100.0%
Positive Predictive Value	100.0%	86.3% - 100.0%
Negative Predictive Value	90.5%	81.5% - 96.1%

Table 5 shows the diagnostic accuracy of clinical examination alone. Clinical findings were sensitive in detecting chest injuries, meaning many injured patients had some clinical signs. However, clinical examination had lower specificity compared to eFAST, indicating that some patients without injury were wrongly

suspected to have chest injuries. This highlights that clinical examination alone is not sufficient and should be supported by imaging.

Table 5. Diagnostic Accuracy Of Clinical Findings In Detecting Chest Injury Compared To CT Chest (Reference Standard) (n=99)

Diagnostic Metric	**Value**	**95% CI**
Prevalence	32.3%	23.3% - 42.5%
Sensitivity	87.5%	71.0% - 96.5%
Specificity	92.5%	83.4% - 97.5%
Positive Predictive Value	84.8%	68.1% - 94.9%
Negative Predictive Value	93.9%	85.2% - 98.3%

Overall, these findings show that eFAST is a reliable and highly specific bedside imaging tool for the evaluation of blunt chest trauma. While it may miss some minor injuries, especially lung contusions, it is very useful for early detection and decision-making in emergency settings, particularly where CT facilities are limited.

Discussion

This prospective diagnostic accuracy study assessed how well eFAST detects blunt chest injuries, using CT chest as the reference standard. Road traffic accidents were the most common cause of injury in this study. This finding is similar to national trauma patterns reported in India and other low- and middle-income countries [3,13].

In the present study, eFAST showed a sensitivity of 75.0% and a specificity of 100% for detecting pneumothorax. These results are comparable to earlier systematic reviews and meta-analyses, which reported sensitivities between 69% and 92% and specificities close to 99–100% [10,14,15]. The high specificity indicates that when eFAST detected pneumothorax, the diagnosis was accurate. This allowed early treatment without waiting for CT confirmation. The cases missed by eFAST were mostly small or occult pneumothoraces, which are known limitations of ultrasound-based imaging [11].

For haemothorax, eFAST demonstrated a sensitivity of 76.9% and a specificity of 100%. These values are similar to previously reported sensitivities of 64–80% and specificities above 97% [14,16]. The false-negative cases were likely due to very small amounts of pleural fluid or technical limitations during scanning, especially in patients examined in the supine position.

eFAST showed good sensitivity and excellent specificity for detecting rib fractures. Previous studies have shown that ultrasound can identify rib fractures better than chest radiography, particularly for

fractures located anteriorly, while posterior fractures are more difficult to detect [17]. The findings of this study support the use of eFAST as an additional tool for identifying clinically important rib fractures during the initial assessment of trauma patients.

Detection of lung contusions was the main limitation of eFAST, with a sensitivity of only 50%. This finding is consistent with existing literature, which shows that ultrasound has limited ability to detect deep lung injuries that do not involve the pleural surface [18]. CT chest therefore remains essential for accurate diagnosis and assessment of pulmonary contusions.

When compared with clinical examination alone, eFAST showed lower sensitivity but higher specificity. This reduced the number of false-positive diagnoses. Although clinical examination is an important part of trauma assessment, it is not reliable when used alone for diagnosing thoracic injuries, especially in patients with multiple injuries [19].

Overall, the findings of this study support current Advanced Trauma Life Support (ATLS) recommendations, which advocate the use of eFAST as an adjunct to the primary survey in trauma patients [20]. In settings with limited resources, eFAST is particularly valuable as a triage tool. It helps in the early detection of life-threatening injuries and guides timely management while awaiting definitive imaging.

Strengths and Limitations

The strengths of this study include its prospective design and the use of CT chest as the reference standard. Imaging findings were interpreted independently, which reduced bias. Data were collected in a uniform manner using a standardized format, which improved reliability. The study also has some limitations. It was conducted at a single center with a relatively small sample size. Ultrasound findings depend on the skill and experience of the operator. Hemodynamically unstable patients were not included in the study, which may limit the applicability of the results to all trauma patients. Also the eFAST operators weren't blinded about the clinical examination findings which could possible influence the outcome.

Conclusion

eFAST is a useful bedside imaging tool for detecting blunt chest injuries. It has high specificity and good overall accuracy. Although it cannot replace CT chest, it is helpful as an initial screening and triage method, especially in emergency and resource-limited settings. Regular use of eFAST in trauma protocols can help in early diagnosis and lead to better patient outcomes.

Author Contributions

Author 1 has contributed to the conceptualization and definition of the intellectual content of the manuscript, design of the study, data acquisition, Author 2 contributed to the literature search, manuscript editing, and manuscript review. Author 3 contributed towards Statistical analysis, Manuscript review and editing. Author 2 will serve as the corresponding author / guarantor of the manuscript

Data availability statement

The datasets generated and analysed in this study are available from the corresponding author on reasonable request. They are not publicly shared because they contain sensitive information that could indirectly identify participants.

Ethical approval

This study has been approved by the Institution Ethics Committee – Government Dharmapuri Medical College Dharmapuri, carrying approval number IHEC-07/2023 dated 10.08.2023.

Informed Consent

Written informed consent was obtained from all participants after explaining the study procedures, potential risks and benefits. Consent covered both participation and publication of anonymised findings, with assurance of confidentiality and data privacy.

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Usage of AI Tools: Authors declare to have used Chat-GPT 5.0 to enhance the grammar and readability of the article but have rechecked its contents before submission. We take the full responsibility of the contents and confirm that AI tool usage is for content moderation alone.

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