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Original Research Paper

Emergency Medicine

# A PROSPECTIVE STUDY OF DIAGNOSTIC EFFICACY OF E-FAST SCAN IN POLYTRAUMA PATIENTS AT A TERTIARY CARE CENTER

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## ABSTRACT

**Introduction:** Trauma is a significant cause of emergency department visits globally, especially affecting the young, working population. Annually, approximately 5.8 million people die from accidental injuries and violence, with nonfatal injuries contributing to 18% of the world's health burden. Abdomino-thoracic injuries are notably common and can be fatal without rapid intervention. This study evaluates the diagnostic accuracy of the Extended Focused Assessment with Sonography for Trauma (E-FAST) in detecting blunt and penetrating abdominal and chest trauma in polytrauma patients. **Materials and Methods:** This hospital-based observational study was conducted at MGM Hospital, Navi Mumbai, from March 2021 to December 2022, including 138 polytrauma patients. Inclusion criteria were patients over 18 years, of either sex, providing informed consent. E-FAST scans were performed using a Mindray ultrasound machine. Positive E-FAST cases were managed surgically, while negative cases were observed and reassessed. Data analysis was conducted using IBM SPSS Statistics Version 26.0 and Microsoft Excel 2010. **Results:** The mean age was 30.91 years, with 81.9% aged 21-40 years and 81.9% male. Blunt trauma was seen in 92.8% of cases. E-FAST showed an overall sensitivity of 82.6% and specificity of 84.8%, with a PPV of 73.1% and NPV of 90.7%. Diagnostic accuracy was higher for penetrating injuries (87.5% sensitivity, 100% specificity) compared to blunt injuries (81.6% sensitivity, 84.4% specificity). The overall mortality rate was 7.2%. **Conclusion:** E-FAST is effective for assessing abdominal injuries in polytrauma cases, aiding in triage and management decisions, particularly in mass casualty situations. However, its operator-dependent nature necessitates further monitoring and additional investigations, such as contrast-enhanced CT scans, for negative E-FAST cases.

**KEYWORDS :** Trauma, E-FAST, Polytrauma, Abdominal Injuries, Diagnostic Accuracy

## INTRODUCTION:

Trauma is a significant cause of emergency department visits globally, driven largely by the consequences of modernization and the resulting increase in unintentional injuries. Each year, approximately 5.8 million people across all demographics die due to accidental injuries and violence, translating to nearly nine deaths per minute[1]. Nonfatal injuries also contribute substantially to global health issues, accounting for 18% of the world's health burden[2]. In young, working populations, trauma is a leading cause of morbidity and mortality, significantly impacting economic productivity. In India alone, a 2017 report from the Ministry of Road, Transport, and Highways documented 464,910 road accidents resulting in 470,975 injuries, with the highest prevalence among young adults[3,4]. Abdomino-thoracic injuries are particularly common and can be fatal without swift intervention, with mortality increasing by 1% for every three minutes without treatment[5]. Rapid treatment within the 'golden hour' is therefore crucial for improving patient outcomes. However, the initial management of critically injured patients with multiple traumas presents a significant challenge in the emergency department[6,7].

Historically, diagnostic peritoneal lavage (DPL) and chest X-rays have been used to detect intra-abdominal and intrathoracic injuries, but these methods have limitations such as invasiveness, low specificity, and difficulty in execution under emergency conditions[8]. Contrast-enhanced CT (CECT) is the gold standard for diagnosing these injuries but is expensive, time-consuming, and impractical for hemodynamically unstable patients[9]. Bedside ultrasonography (USG), particularly the Extended Focused Assessment with Sonography for Trauma (E-FAST), has emerged as an optimal, non-invasive, and portable alternative for rapid assessment of trauma patients[10]. E-FAST facilitates timely decision-making and triaging in the ED, and its integration into advanced trauma life support courses underscores its importance[5,11]. E-FAST is effective in detecting hemoperitoneum, hemothorax, and pneumothorax, thereby reducing disposition time and improving patient outcomes[12]. Studies have shown that E-FAST has high sensitivity and specificity in ruling out free blood in the pericardial, pleural, and peritoneal cavities, as well as in diagnosing pneumothorax[13,14]. The present study aims to evaluate the diagnostic accuracy of E-FAST in trauma victims, specifically for detecting blunt and penetrating abdominal and chest trauma in polytrauma patients.

### Methodology

This study hospital based observational study was conducted in the Department of Emergency Medicine at MGM Hospital, Kamothe, Navi Mumbai, focusing on patients presenting with a history of polytrauma. The study included 138 patients, with the sample size calculated using the formula: $X = Z_{/2}^{2} * p * (1-p) / d^2$ resulting in 138 participants based on a Z value of 1.96, P value of 10%, and an absolute error of 5%. The study spanned from March 2021 to December 2022. Inclusion criteria encompassed patients over 18 years old, of either sex, who provided informed consent and had polytrauma. Exclusion criteria included patients under 18, pregnant women, those with isolated limb or head injuries, and those who did not consent. Ethical clearance was obtained, and written consent was secured from all participants. Each patient underwent an initial assessment by an emergency medical officer, followed by an EFAST scan using a Mindray ultrasound machine with a curvilinear probe (2–5 MHz) in a supine position, as per standard protocols. The scan included standard views: right upper quadrant (RUQ) for Morison's pouch and right pleural

cavity, subxiphoid for pericardial effusion, left upper quadrant for splenorenal recess and left pleural cavity, transverse and longitudinal pelvis for rectouterine or rectovesicular pouches, and right and left anterior chest views for pneumothorax detection. The ultrasound machine was available 24/7, ensuring consistency throughout the study. The scan was classified as positive if free fluid was detected in any view or if there was an absence of lung sliding in M-mode, indicating a bar code sign. Positive EFAST cases were managed in the operating theatre or intensive care unit and further investigated with X-rays or CT scans. Negative cases were observed in the green triage zone for a minimum of four hours and reassessed at 6 and 12 hours if clinical signs persisted. Data were collected in a pre-designed pro forma, with qualitative data represented as frequency and percentage, and quantitative data as mean ± SD. Statistical analysis was performed using the Chi-Square test for qualitative data and unpaired t-test or Mann-Whitney test for quantitative data, with a p-value $< 0.05$ considered significant. IBM SPSS Statistics Version 26.0 was used for analysis and Microsoft Excel 2010 for graphical representation.

## RESULTS

The study results reveal critical insights into the diagnostic accuracy of E-FAST in polytrauma cases. The data illustrate the prevalence of different injury types and the efficacy of various management approaches.

Table 1 indicates the distribution of study subjects according to age, gender, and type of injury indicates a predominant incidence among young adults, with 81.9% of the cases being between 21 to 40 years of age. The male population was significantly more affected, comprising 81.9% of the subjects, compared to 18.1% females. Blunt trauma was the most common type of injury, observed in 92.8% of the cases, whereas penetrating injuries accounted for only 7.2%. This distribution underscores the high prevalence of trauma among young, working-age males and highlights the predominance of blunt trauma in this demographic.

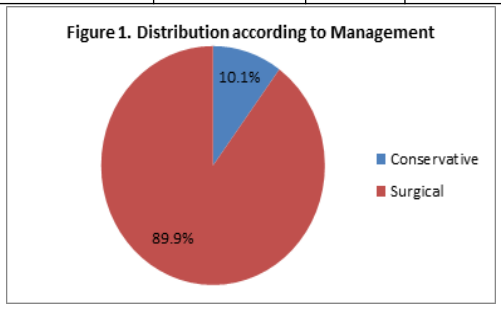
**Table 1. Distribution of study subjects according to the Age, gender, and type of injury**

| Variable | | N | % |
|---|---|---|---|
| Age | <=20 | 8 | 5.80% |
| | 21-40 | 113 | 81.90% |
| | 41-60 | 17 | 12.30% |
| Gender | Male | 113 | 81.90% |
| | Female | 25 | 18.10% |
| Type of Injury | Blunt | 128 | 92.80% |
| | Penetrating | 10 | 7.20% |

Table 2 indicates the baseline parameters at admission reveal several critical insights into the initial status of the study subjects. A majority of the patients (93.5%) presented with a patent airway, while 6.5% had a threatened airway. Respiratory rate (RR) was >20 in 68.8% of cases, indicating potential respiratory distress. Most patients (94.2%) had an SpO2 level ≥95%, suggesting adequate oxygenation at admission. Heart rate (HR) was between 60-100 bpm in 64.5% of patients, while 35.5% had a tachycardic HR >100 bpm. Regarding blood pressure, 75.4% were normotensive, whereas 24.6% were hypotensive, indicating shock in nearly a quarter of the patients. Peripheral pulse was felt in 94.9% of patients, and capillary refill time (CRT) was <2 seconds in 87.7% of cases, reflecting good peripheral perfusion. Finally, the Glasgow Coma Scale (GCS) score showed that 95.7% of patients had a score >12, indicating mild or no impairment in consciousness. These baseline parameters underscore the varied presentation of trauma patients, highlighting the need for rapid and accurate assessment upon admission. A significant majority of the cases, 89.9%, required surgical intervention, indicating that most of the polytrauma patients presented with injuries severe enough to necessitate surgery. Conversely, only 10.1% of the cases were managed conservatively (figure 1).

**Table 2. Distribution of Study Groups by Baseline Parameters at Admission**

| Parameters | | N | % |
|---|---|---|---|
| Airway | Patent | 129 | 93.50% |
| | Threatened | 9 | 6.50% |
| RR | <12 | 0 | 0.00% |
| | 12-20 | 43 | 31.20% |
| | >20 | 95 | 68.80% |
| SpO2 | <95% | 8 | 5.80% |
| | >=95% | 130 | 94.20% |
| HR | <60 | 0 | 0.00% |
| | 60-100 | 89 | 64.50% |
| | >100 | 49 | 35.50% |
| Blood Pressure | Hypotensive | 34 | 24.60% |
| | Normotension | 104 | 75.40% |
| | Hypertensive | 0 | 0.00% |
| Peripheral Pulse | Felt | 131 | 94.90% |
| | Not Felt | 7 | 5.10% |
| CRT | <2 sec | 121 | 87.70% |
| | >2 sec | 17 | 12.30% |
| GCS score | 3-8 | 2 | 1.40% |
| | 9-12 | 4 | 2.90% |
| | >12 | 132 | 95.70% |

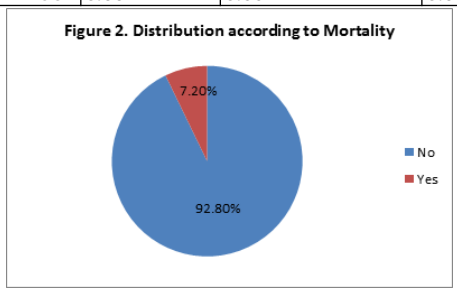



The diagnostic accuracy of the E-FAST scan for polytrauma varies based on the type of injury. For blunt injuries, the E-FAST scan identified hemoperitoneum in 31 out of 38 cases, resulting in a sensitivity of approximately 81.6% and a specificity of 84.4%, given that it correctly identified 76 out of 90 cases without hemoperitoneum. For penetrating injuries, the E-FAST scan had a higher sensitivity of 87.5% as it detected hemoperitoneum in 7 out of 8 cases, and it showed perfect specificity (100%) as there were no false positives. Overall, the E-FAST scan demonstrated a sensitivity of 82.6% and a specificity of 84.8%, with positive and negative predictive values (PPV and NPV) of 73.1% and 90.7%, respectively. This indicates that the E-FAST scan is a reliable tool for detecting hemoperitoneum in polytrauma patients, with higher accuracy in penetrating injuries compared to blunt injuries. The overall diagnostic accuracy of the E-FAST scan for polytrauma was 84.1%, highlighting its effectiveness in rapid trauma assessment (table 3 and table 4). The distribution of mortality among the study subjects shows that, 92.8% survived, while 7.2% of the cases resulted in mortality (figure 2).

Table 3. Diagnostic Accuracy of E-FAST Scan for Polytrauma according to type of injury

| Injury type | E-FAST | Hemoperitoneum | | Total |
|---|---|---|---|---|
| | | Yes | No | |
| Blunt injuries | Positive | 31 | 14 | 45 |
| | Negative | 7 | 76 | 83 |
| | Total | 38 | 90 | 128 |
| Penetrating injuries | Positive | 7 | 0 | 7 |
| | Negative | 1 | 2 | 3 |
| | Total | 8 | 2 | 10 |
| Overall | Positive | 38 | 14 | 52 |
| | Negative | 8 | 78 | 86 |
| | Total | 46 | 92 | 138 |

| Table 4. Diagnostic tests result for E-FAST (Overall) | | | |
|---|---|---|---|
| Parameters | Blunt injuries | Penetrating injuries | Overall |
| Sensitivity | 81.60% | 87.50% | 82.60% |
| Specificity | 84.40% | 100.00% | 84.80% |
| PPV | 68.90% | 100.00% | 73.10% |
| NPV | 91.60% | 66.70% | 90.70% |
| Accuracy | 77.50% | 90.00% | 84.10% |
| Youden Index | 0.66 | 0.88 | 0.67 |




## DISCUSSION:

Trauma is one of the leading causes of morbidity and mortality in the young working population, significantly impacting the highly productive age group of the country. Head injuries or traumatic brain injuries (TBI) pose a major global health challenge, with the highest morbidity and mortality rates among trauma patients[15]. Among traumatic injuries, abdomino-thoracic injuries are the most prevalent and can be fatal without rapid intervention. If intra-abdominal or intrathoracic bleeding is present, the probability of death increases by about 1% every three minutes that pass without intervention[10]. Hence, delays in the treatment of trauma patients can be detrimental to patient outcomes, making the initiation of treatment within the 'golden hour' critical[5].

Contrast-enhanced CT (CECT) remains the gold standard for diagnosing intra-abdominal and intrathoracic injuries, but it is an expensive and time-consuming test[9]. The Extended Focused Assessment with Sonography for Trauma (E-FAST) has emerged as a valuable method for detecting hemoperitoneum, hemothorax, and pneumothorax in trauma patients during the initial assessment in the Emergency Department[12]. It plays a crucial role in the rapid, non-invasive assessment of thoracoabdominal trauma and helps accelerate decision-making for surgical interventions.

In our study, we aimed to evaluate the diagnostic accuracy of the E-FAST technique for trauma victims in the ED, specifically for detecting blunt and penetrating abdominal and chest trauma in polytrauma patients. The study included 138 patients who presented to the emergency department with a history of polytrauma. The mean age of the study cases was 30.91 years, with most cases (81.9%) between 21 to 40 years of age. A significant majority (81.9%) were males, reflecting the higher incidence of trauma in this demographic, consistent with other studies[15,16] . Blunt trauma was observed in 92.8% of cases, while 7.2% reported penetrating injuries.

Trauma and unintentional injury are leading causes of death for individuals aged 15 to 39, resulting in a major cost burden for healthcare systems (Mehta et al., 2017) . Similar studies have reported that trauma is more frequent in males aged 21-30 years, primarily due to automobile accidents resulting in blunt abdominal trauma[10] . The peak incidence of trauma is often observed in individuals aged 14-30 years[15].

Conservative management was done in 10.1% of cases, while 89.9% required surgical intervention. The mortality rate among polytrauma cases in our study was 7.2%. This is comparable to other studies, reporting between 6.3% to 11%mortality rate[9,11,15] .

On E-FAST scanning, hemoperitoneum was observed in 37.7% of cases, while on CT scan, it was observed in 33.3% of cases. The overall sensitivity and specificity of the E-FAST scan for predicting abdominal injuries in polytrauma cases were 82.6% and 84.8%, respectively, with a positive predictive value (PPV) of 73.1% and a negative predictive value (NPV) of 90.7%. The overall accuracy was 84.1%. For blunt trauma, the sensitivity and specificity were 81.6% and 84.4%, respectively, with an accuracy of 77.5%. For penetrating trauma, the sensitivity and specificity were 87.5% and 100%, respectively, with an accuracy of 90%.

These results are consistent with previous studies. Brooks et al. reported a sensitivity of 92% and specificity of 100% for detecting hemothorax after trauma[10]. Ollerton et al. found a sensitivity of 64% and specificity of 100% for detecting free intraperitoneal fluid, with higher sensitivity for blunt torso trauma[17]. Hsu et al. reported overall sensitivity, specificity, PPV, and NPV of 78%, 97%, 91%, and 93%, respectively, for FAST in detecting free fluid[18]. Tsui et al. reported sensitivity and specificity of 86% and 99%, respectively, with an overall accuracy of 97% for FAST in blunt abdominal trauma patients[19]. Brenchley et al. found a sensitivity of 78% and specificity of 99% for FAST scans[20]. Netherton et al. systematically reviewed the diagnostic accuracy of E-FAST, finding pooled sensitivities and specificities for pneumothorax, pericardial effusion, and intra-abdominal free fluid at 69% and 99%, 91% and 94%, and 74% and 98%, respectively[21] . Basnet et al. reported a sensitivity of 94.8% and specificity of 99.5% for E-FAST, with an overall accuracy of 99.4% [22].

To summarize, the results of the present study suggest that E-FAST examination performed by first-line healthcare providers is a useful method for the assessment of abdominal injuries. E-FAST was found to have a high sensitivity (82.6%) and negative predictive value (90.7%), making it an effective technique for ruling out intra-abdominal injuries in polytrauma cases and aiding in effective triage and management decisions, especially in cases with mass casualties.

## CONCLUSION

The results of this study suggest that E-FAST is a highly effective method for assessing abdominal injuries, with a sensitivity of 82.6% and a negative predictive value of 90.7%, making it valuable for ruling out intra-abdominal injuries in polytrauma cases. It aids in effective triage and crucial management decisions, particularly in mass casualty situations. However, due to its operator-dependent nature, further monitoring and additional investigations like Contrast-enhanced CT scans are recommended for negative E-FAST cases.

**Conflicts of interest:** None
**Funding source:** None

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