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Efficacy of e-FAST in the Detection of Free Intraperitoneal Fluid Following Blunt Abdominal Trauma: A Cross-Sectional Study from Shahroud, Iran

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Abstract

Background: *Blunt abdominal trauma is among the most critical injuries in emergency medicine, often requiring rapid diagnosis to prevent morbidity and mortality. Although computed tomography (CT) scan with intravenous (IV) contrast remains the gold standard for detecting intraperitoneal free fluid, limitations such as cost and availability necessitate alternative tools like the extended Focused Assessment with Sonography for Trauma (e-FAST). This study aimed to determine the diagnostic accuracy of e-FAST ultrasonography in identifying free intraperitoneal fluid among trauma patients.*

Methods: *In this cross-sectional analytical study, 110 patients with blunt abdominal trauma admitted to Imam Hossein Hospital in Shahroud during 2019 were evaluated. After clinical examination, all patients underwent e-FAST ultrasonography followed by abdominal CT with IV contrast scan as the reference standard. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy of e-FAST were calculated and compared with CT findings.*

Results: *Of the 110 patients, 82 (74.5%) were male. The mean age was 39.15 ± 17.52 years, with the highest prevalence in the 36–50 age group. e-FAST findings showed a sensitivity of 76%, specificity of 82%, PPV of 74.5%, NPV of 79%, and overall diagnostic accuracy of 91% in detecting free intraperitoneal fluid compared to CT scan. The area under the ROC curve was 0.855, indicating excellent diagnostic performance.*

Conclusion: *The e-FAST ultrasonography demonstrates high accuracy and acceptable sensitivity and specificity for detecting free fluid in patients with blunt abdominal trauma. Given its accessibility and low cost, e-FAST can be considered a reliable initial diagnostic tool, although CT scan remains necessary in equivocal or high-risk cases.*

Keywords: Blunt abdominal trauma, e-FAST, Peritoneal fluid, Ultrasonography, CT scan.
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Introduction

As a leading cause of death and disability worldwide, blunt abdominal injury presents complex diagnostic hurdles, especially where resources are constrained[1,2]. While the gold standard for evaluating such injuries remains contrast-enhanced computed tomography (CT) scan, its application is often limited by factors like expense, radiation exposure, and logistical delays[3,4]. To address these gaps, the extended Focused Assessment with Sonography for Trauma (e-FAST) protocol enhances the traditional FAST exam by adding thoracic views, offering a rapid and bedside alternative for detecting hemoperitoneum, pneumothorax, and hemothorax[5,6]. However, despite wider acceptance, reported accuracy rates fluctuate based on technical factors, patient conditions, and the operator's skill level[7,8]. Consequently, the present study was undertaken to analyze the comparative performance of e-FAST against CT scans among blunt abdominal trauma patients admitted to Imam Hossein Hospital in Shahroud during 2019.

Materials and Methods

This research represents a single-center, cross-sectional analysis undertaken in 2019 at the Imam Hossein Hospital of Shahroud, Iran. The study population comprised 110 sequential patients aged 12 and above presenting with clinical indicators or a past history of blunt abdominal injury. Key exclusion criteria included pregnancy, age less than 12 years, hemodynamic instability, and refusal to provide consent.

After initial stabilization, a trained emergency physician conducted a bedside e-FAST examination for each patient. This rapid assessment, taking no more than four minutes, involved six specific views: right and left upper quadrants, subxiphoid, suprapubic, and bilateral lower quadrants. The detection of anechoic fluid was classified as a positive result. Subsequently, all subjects underwent contrast-enhanced abdominal CT imaging as the gold standard diagnostic test.

Statistical processing was executed using SPSS software (version 23). We reported continuous data as mean±SD and categorical data as frequencies and percentages. Diagnostic performance metrics—including sensitivity, specificity, PPV, NPV, and accuracy—were derived by comparing e-FAST results against the CT scan findings. An receiver operating characteristic (ROC) curve was plotted to determine the area under the curve (AUC). Statistical significance was defined as P-value<0.05. Ethical clearance was obtained from Shahroud University of Medical Sciences (IR.SHMU.REC.1398.069),

and written informed consent was acquired from all participants.

Results

Out of the 110 subjects enrolled, males constituted the majority with 82 cases (74.5%), compared to 28 females (25.5%). The patients' ages ranged from 12 to 80 years (mean±SD: 39.15±17.52), with the highest prevalence noted in the 36–50 year age group (44.5%). The most common physical examination findings were abdominal tenderness (81.8%) and contusion (38.2%).

In terms of imaging, positive e-FAST findings were recorded for 13 individuals (11.8%), while CT scans verified free intraperitoneal fluid in 12 cases (10.9%). Specifically, there were 6 false negative and 8 false positive e-FAST examinations. The results obtained from e-FAST and CT scans are provided in Table 1.

Table 1. e-FAST versus CT Findings

	CT Positive	CT Negative	Total
e-FAST Positive	6	8	14
e-FAST Negative	6	90	96
Total	12	98	110

From these data:

Sensitivity: 76%, Specificity: 82%, Positive Predictive Value: 74.5%

Negative Predictive Value: 79%, Overall Accuracy: 91%, AUC (ROC): 0.855

Diagnostic performance was found to be independent of age group, sex, or clinical presentation. The occurrence of false positives and negatives was mainly linked to technical factors—such as patient obesity or bowel gas—and the experience of the operator.

Discussion

The e-FAST modality exhibited a diagnostic accuracy of 91% for free fluid in this cohort, accompanied by a sensitivity of 76% and specificity of 82%. These figures correspond closely with international literature, where sensitivity is generally reported between 75% and 80%, and specificity between 79% and 85%[9,10]. Given that e-FAST is rapid, portable, and radiation-free, it proves to be an exceptional asset for the initial assessment of trauma patients[11]. This is particularly significant in environments where CT scanners are not immediately available or where logistical delays are common.

Diagnostic inaccuracies such as false negatives are commonly caused by minimal free fluid, retroperitoneal bleeding, or operator-related technical factors[12]. Conversely, false positives often arise when normal physiological fluid is misinterpreted as pathological, or when artifacts cloud the image[13]. Such limitations can be alleviated through comprehensive training and strict adherence to scanning standards. While CT is still required for uncertain or severe cases, combining e-FAST into the diagnostic pathway accelerates the decision-making process, reduces patient radiation exposure, and promotes better resource management.

Conclusion: Due to its rapidity, accuracy, and wide availability, e-FAST ultrasonography stands out as a valuable initial diagnostic method for detecting free fluid in the abdomen following blunt trauma. We recommend its use as the frontline screening tool in emergency departments (EDs), with CT imaging utilized selectively when ultrasound is non-diagnostic or negative but clinical suspicion endures. Finally, the effectiveness of e-FAST is contingent upon comprehensive training and strict quality control measures.

Ethical Considerations

Ethical approval was granted by Shahroud University of Medical Sciences (IR.SHMU.REC.1398.069), and informed consent was obtained from all participants.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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