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Research Article

Accuracy of Focused Assessment with Sonography for Trauma in Diagnosing Abdominal Injuries in Iraqi Emergency Department Settings

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Abstract

Background: The focused assessment with sonography for trauma (FAST) has played a pivotal role in the evaluation of patients presenting with abdominal trauma. Despite its proven advantages, the technique demonstrates variable sensitivity and carries certain limitations. ***Objective***: To evaluate the diagnostic accuracy of the FAST scan in detecting emergent abdominal trauma compared to a reference of abdominopelvic CT scan or intraoperative findings. ***Methods***: A total of 228 patients with blunt or penetrating abdominal trauma were included. Following ATLS protocols and adequate resuscitation, patients without higher-priority conditions underwent FAST to detect intra-abdominal free fluid. Results were compared with CT or intraoperative findings to assess diagnostic accuracy. ***Results***: Among 228 trauma patients. intra-abdominal injuries were confirmed in 39.5% either by CT for stable patients or intraoperative findings for unstable patients. FAST scan identified free fluid in 33.3% of scans, with a sensitivity of 58.88%, specificity of 83.33%, positive predictive value of 69.73%, and negative predictive value of 75.65%. The overall diagnostic accuracy was 73.68%, with an area under the ROC curve of 0.711. Sensitivity was significantly higher in unstable patients than stable patients (p<0.001) and in penetrating trauma compared to blunt trauma (p<0.05). ***Conclusions***: FAST scan shows moderate diagnostic accuracy for detecting intra-abdominal injuries in trauma patients in the ED. Its sensitivity is higher in hemodynamically unstable patients and those with penetrating trauma, while it is lower in stable patients and those with blunt trauma.

Keywords: Abdominal injury, CT scan, Hemoperitoneum, Ultrasonography.

دقة التقييم المركز مع التصوير بالموجات فوق الصوتية للصدمات في تشخيص إصابات البطن في أقسام الطوارئ العراقية

الخلاصة

الخلفية: لعب التقييم المركز مع التصوير بالموجات فوق الصوتية للصدمات (FAST) دورا محوريا في تقييم المرضى الذين يعانون من صدمة في البطن. على الرغم من مزاياها المثبتة، إلا أن هذه التقنية تظهر حساسية متغيرة وتحمل قيودا معينة. **الهدف**: تقييم الدقة التشخيصية لفحص FAST في الكشف عن صدمة البطن الناشئة مقارنة بمرجع التصوير المقطعي المحوسب للبطن أو الحوض أو النتائج أثناء الجراحة. **ألطرائق**: تم تضمين ما مجموعه 228 مريضا يعانون من صدمة بطن حادة أو اختراق. باتباع بروتوكولات ATLS والإنعاش الكافي ، خضع المرضى الذين ليس لديهم حالات ذات أولوية أعلى لعملية FAST للكشف عن السوائل الحرة داخل البطن. تمت مقارنة النتائج مع نتائج التصوير المقطعي المحوسب أو النتائج أثناء الجراحة لتقييم دقة التشخيص. **النتائج**: من بين 228 مريضا بالصدمات. تم تأكيد الإصابات داخل البطن في 39.5٪ إما عن طريق التصوير المقطعي المحوسب للمرضى المستقرين أو النتائج أثناء الجراحة للمرضى غير المستقرين. حدد المسح السريع السائل الحر في 33.3٪ من عمليات المسح، بحساسية 58.88٪، وخصوصية 83.33٪، وقيمة تنبؤية إيجابية بنسبة 69.73٪، وقيمة تنبؤية سلبية تبلغ 75.65٪. كانت دقة التشخيص الإجمالية 73.68٪، مع مساحة تحت منحنى ROC تبلغ 0.711. كانت الحساسية أعلى بشكل ملحوظ في المرضى غير المستقرين مقارنة بالمرضى المستقرين (p<0.001) وفي اختراق الصدمة مقارنة بالصدمة الحادة (p<0.05). **الاستنتاجات**: يظهر فحص FAST دقة تشخيصية معتدلة للكشف عن الإصابات داخل البطن لدى مرضى الصدمات في الضعف الجنسي. تكون حساسيته أعلى في المرضى غير المستقرين من الناحية الديناميكية الدموية وأولئك الذين يعانون من صدمة اختراق، بينما تكون أقل في المرضى المستقرين وأولئك الذين يعانون من صدمة حادة.

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INTRODUCTION

Ultrasound is considered a safe, portable, and inexpensive tool for patient assessment. It is widely used across various medical specialties for diagnostic purposes, as it is free of ionizing radiation and offers the advantage of being the easiest noninvasive method to obtain real-time images of cavities and compartments, facilitating the performance of numerous percutaneous and minimally invasive procedures [1]. The focused assessment with sonography for trauma (FAST), since its introduction in the late 20th century, has played a crucial role in the rapid evaluation of patients presenting with traumatic injuries to the thorax and abdomen [2]. Its main purpose is to identify abnormal collections of free fluid in the pericardium, thorax, and abdomen.

These collections appear as hypoechoic or anechoic signals (ranging from dark grey to black) in specific dependent regions, which are examined in a defined sequence [3]. This assessment is typically performed during the primary survey, specifically in the circulation (C) component. Studies have demonstrated that it is a reliable method for detecting injuries that require the activation of rapid management protocols. [4-6]. In cases of abdominal blunt or penetrating injuries, the free fluid can appear either in the two supramesocolic regions of the right flank (Morison's pouch) or the left flank (perisplenic) as well as the inframesocolic retrovesical space; the free fluid collection is mostly regarded as blood unless a bladder injury is detected, and in this case the abdominal free fluid might consist of urine [2]. The FAST has shown variable sensitivity in multicenter studies in detecting abdominal trauma [7-9]. Although FAST has largely replaced the invasive diagnostic peritoneal lavage (DPL), which carries a 1–2% complication rate, it also offers advantages over computed tomography (CT), including lower cost, avoidance of ionizing radiation, and eliminating the need to transfer the patient out of the triage and resuscitation unit. [1] However, FAST cannot fully replace these high-sensitivity tests. It has been associated with false-negative results and cannot reliably detect certain abdominal injuries that do not produce a significant amount of free fluid detectable by sonography. In addition, it is limited in identifying retroperitoneal and pelvic injuries and obtaining accurate images can be challenging in patients with obesity or altered abdominal anatomy.[3] These limitations have positioned FAST as a complementary examination that should neither be neglected nor considered definitively diagnostic. Hemodynamically unstable patients are typically rushed to the operating theater for exploration, while stable patients undergo CT scanning to achieve a conclusive, organ-specific diagnosis after adequate resuscitation [1,3]. The insufficient evidence on the FAST examination from our region has mandated the conduction of the present study to determine the diagnostic accuracy of this tool in Iraqi trauma center settings.

METHODS

Study design and setting

This diagnostic accuracy study was conducted in a single high-traffic trauma center in Baghdad, Iraq, between the 1st of July-2023 and the 1st of July 2025. The study involved 228 adult patients presenting to the Emergency Department at Al-Yarmouk Teaching Hospital, Baghdad, with a confirmed history of blunt or penetrating abdominal trauma who exhibited either local signs and symptoms, including abdominal pain, abdominal rigidity on examination, superficial bruising, deep wounds, or gunshot wounds, or overall systemic instability.

Inclusion criteria

Adult patients of both sexes presenting to the emergency department with a history of blunt or penetrating abdominal trauma, regardless of hemodynamic stability, were included in the study.

Exclusion criteria

Patients were excluded if they were under 18 years of age, refused to undergo a FAST scan, had associated higher-priority injuries or conditions, died during the initial assessment, were pregnant, or had grossly altered abdominal anatomy due to previous abdominal surgeries or adhesions.

Sample size estimation

The sample size was calculated based on prior studies [10] to estimate the diagnostic performance of FAST scan in the ED for detecting intra-abdominal injuries. For the current study, the following formulae were used for diagnostic test accuracy:

$n = \frac{Z^2 \times P \times (1-P)}{d^2 \times Prev}$ for sensitivity, and

$n = \frac{Z^2 \times P \times (1-P)}{d^2 \times (1-Prev)}$ for sensitivity and for specificity

where Z = 1.96 (95% confidence), (P) is the expected sensitivity (0.76) or specificity (0.84), d = 0.10 (precision), and Prev = 0.30 (prevalence) [11]. This resulted in a minimum sample size of 206 patients for sensitivity and 144 for specificity. Accounting for a 10% dropout rate, the sample size was adjusted by dividing by 0.9, resulting in a total of 228 patients adequate to make significant inferences about the diagnostic performances of FAST scans in ED for detecting intra-abdominal injuries in trauma patients.

Intervention and outcome measurement

ATLS protocols were initiated for each patient, followed by a primary survey and careful measurement of vital signs. Patients received adequate resuscitation, and higher-priority injuries or conditions were addressed or excluded. At the same time, a FAST scan was done to look for any free fluid in the abdomen. This could be blood, urine, or any other non-physiological fluid that could mean there was serious damage inside the abdomen. These findings were recorded, and subsequent management decisions were based on hemodynamic status. Hemodynamically stable patients (SBP ≥ 90 mmHg) were transferred to the CT scan unit for detailed imaging of the abdominal cavity and further management. Hemodynamically unstable patients (SBP < 90 mmHg) were taken directly to the operating theater for surgical exploration. The results of the FAST scan were then compared to a reference standard of CT results and/or intraoperative findings to determine the overall diagnostic accuracy of this examination.

FAST tools and procedures

The FAST scan was performed using a portable point-of-care ultrasound unit, ACUSON P500™ (Siemens Healthineers, Erlangen, Germany), with a 1.4–5.0 MHz curvilinear array probe. The examination was done by an experienced senior emergency physician. The patients were examined in the supine position, and the FAST probe was used to examine the standard FAST windows of the right upper quadrant (Morrison's Pouch), the left upper quadrant (Perisplenic area), and the pelvic retrovesical space for the presence of any abnormal hypoechoic and anechoic signals indicating free fluid and their measurements [2]. FAST scan findings were categorized into four outcome descriptions: no fluid detected, free fluid in Morrison's pouch, free fluid in the perisplenic view, and/or free fluid in the pelvic view.

Reference standards

Following the initial assessment and acquisition of FAST results, patients were referred for further evaluation and management. The hemodynamically stable patients were referred to obtain a native abdominopelvic CT scan utilizing the SOMATOM Definition AS™ device (Siemens Healthinners, Erlangen, Germany). The process of scanning and interpretation of the scan results was supervised by a senior, experienced radiologist. On the other hand, hemodynamically unstable patients were taken directly to the operating theater to undergo abdominal exploration utilizing a suitable surgical approach under the supervision of the senior general surgeon on call, and the results of the surgical procedure were obtained from reviewing the postoperative surgical notes in the patient record. The presence or absence of confirmed trauma in any part or organ of the intra-abdominal cavity, utilizing either CT scan or surgical notes, was described in (Positive, Negative) and used as a reference standard to evaluate the accuracy of the preceding FAST scan.

Ethical considerations

The study protocol was approved by the Local Research Ethics Committee of Al-Yarmouk Teaching Hospital, Baghdad, Iraq. Written informed consent was obtained from the conscious patients or first-degree relatives of unstable patients to undergo a FAST scan and participate in the study.

Statistical analysis

Data were collected and organized using Microsoft Excel (Microsoft Office 365), where patient characteristics, vital signs, FAST results, CT findings, operative outcomes, and confirmed injury status were compiled into a structured dataset. Data were exported to IBM SPSS Statistics (version 26), where all statistical analyses were conducted. Descriptive statistics, including means, standard deviations (SD), and proportions, were calculated for patient demographics, clinical parameters, and FAST findings. Diagnostic performance metrics, including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy, were calculated using 2x2 contingency tables with corresponding confidence intervals (CIs) of 95%. Subgroup analyses by hemodynamic status (stable vs. unstable) and mechanism of injury (blunt vs. penetrating) were performed to evaluate differences in FAST performance, with chi-square tests used to compare sensitivity and specificity across subgroups, applying a significance threshold of p-value < 0.05.

RESULTS

The study cohort comprised 228 trauma patients presenting to the emergency department with characteristics presented in Table 1. They had a mean age of 37.2 ± 10.3 years and ranged between 22 to 60 years. The majority (87.3%) were male (n= 199). Blunt trauma was the predominant mechanism of injury, accounting for 95.2% of cases (n= 217), with penetrating trauma accounting for 4.8% (n= 11). Hemodynamic instability (defined by SBP < 90 mmHg) was observed in 39.9% (n= 91) of patients, while the remaining 60.1% (n= 137) were hemodynamically stable with SBP ≥ 90 mmHg. The mean Glasgow Coma Scale score was 14.5 ± 0.7, with a median of 15 for hemodynamically stable patients, while the mean was 9.2 ± 1.1, with a median of 9 for hemodynamically unstable patients. Vital signs varied by hemodynamic status likewise, with unstable patients exhibiting lower SBP with a mean of 78.7 ± 7.4 mmHg and DBP with a mean of 46.7 ± 3.6 mmHg, a higher pulse rate (mean 126 ± 5.3 bpm), and a higher respiratory rate (mean 24.8 ± 1.2 breaths/min), compared to stable patients (SBP mean 120.7 ± 4.6 mmHg; DBP mean 78.2 ± 2.8 mmHg; pulse rate mean 77.3 ± 3.8 bpm; respiratory rate mean 15.9 ± 1.2 breaths/min). Temperature was slightly higher in hemodynamically unstable patients, with a mean of 37.7 ± 0.2°C compared to stable patients, who had a mean of 36.7 ± 0.1°C. Of all patients, 39.5% (n= 90) had confirmed intra-abdominal injuries, either by CT scan for stable patients or intraoperative findings in unstable patients. The most common FAST scan finding was "No fluid detected" (n= 155, 68% of all scans), reflecting negative FAST scan results. Among the 76 positive FAST scans (Figure 1), findings included free fluid in Morrison's pouch (n= 30, 13.2% of positive scans), pelvic view (n= 28, 12.3%), and peri-splenic view (n= 15, 6.6%). The diagnostic Performance of the FAST scan in the emergency department was evaluated on all 228 patients, with results of a 2x2 table shown in Table 2. It was found that the FAST scan yielded positive results in 33.3% (n= 76) of patients, indicating free fluid or injury observed. The reference standard for confirming intraabdominal injury was CT scan for hemodynamically stable patients (n= 137) and operative findings for unstable patients (n= 91). Among the 90 patients with confirmed injuries, FAST correctly identified 53 true positives, yielding a sensitivity of 58.88% (95% CI: 48.63%-68.41%). Among the 138 patients without confirmed intra-abdominal injuries, FAST correctly identified 115 as true negatives, resulting in a specificity of 83.33% (95% CI: 76.23%-88.60%).

Table 1: Patients' characteristics, baseline values, and trauma-related characteristics

Variables		Hemodynamically Stable	Hemodynamically Unstable	Total	*p*-value
Age (year)		31±6	47±8	37.2 ± 10.3	<0.0001
Gender	Male	108(78.8)	91(100)	199(87.3)	<0.0001
	Female	29(21.2)	0(0.0)	29(12.7)	
Mechanism of injury	Blunt	133(97.08)	84(92.3)	(95.2)	0.1
	Penetrating	4(2.91)	7(7.69)	11(4.8)	
GCS		14.5±0.685	9.2 ± 1.1	12.4±2.7	<0.0001
SBP		121±5	79±7	103.96±21.42	<0.0001
DBP		78±3	47±4	65.58±15.78	<0.0001
Pulse rate		78±4	126± 5	96.96±24.1	<0.0001
Respiratory rate		16±1	25±1	19.43±4.5	<0.0001
Tempreture		36.7±0.1	37.7±0.2	37.06±0.5	<0.0001
FAST scan findings, n (%)	No fluid detected	109(79.9)	46(50.5)	<0.0001	
	Free fluid in Morrison's pouch	0(0.0)	30(33)	30 (13.2%)	<0.0001
	Free fluid in peri-splenic view	15(10.9)	0(0.0)	15(6.6)	
	Free fluid in pelvic view	13(9.5)	15(16.5)	28(12.3)	
CT-scan results, n (%)	Positive	42(30.7)	0(0.0)	42(18.4)	<0.0001
	Negative	95(69.3%)	0(0.0)	95(41.7)	
	Not available	0(0.0)	91(100)	91(39.9)	
Intra-operative findings, n (%)	Positive	0(0).0	48(52.7)	48(21.1)	<0.0001
	Negative	0(0.0)	43(47.3)	43(18.9)	
	Not available	137(100)	0(0.0)	137(60.1)	
Confirmed injury	Injury not confirmed	95(69.3)	43(47.3)	138(60.5)	0.001
	Injury confirmed	42(30.7)	48(52.7)	90(39.5)	

Values were expressed as frequency (%), and mean±SD.

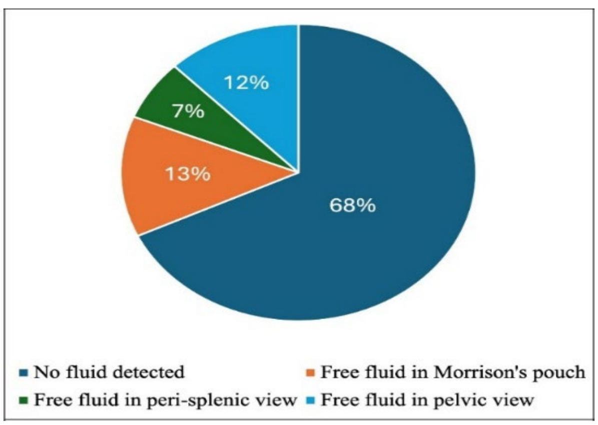

Figure 1: A pie chart displays the distribution of FAST scan findings across 228 patients.

Table 2: A 2x2 contingency table illustrates the diagnostic performance of FAST against the reference standard

FAST result	Confirmed injury: Injury confirmed	Confirmed injury: Injury not confirmed	Total	*p*-value
Positive	53	23	76	<0.0001
Negative	37	115	152	
Total	90	138	228	

The positive predictive value (PPV) was 69.73% (95% CI: 58.64%-78.92%), and the negative predictive value (NPV) was 75.65% (95% CI: 68.24%-81.78%). The overall diagnostic accuracy of FAST was 73.68% (95% CI: 67.55%-78.99%). The diagnostic performance of FAST for detecting intra-abdominal injuries was further assessed using receiver operating characteristic (ROC) curve analysis. The area under the receiver operating characteristic (ROC) curve (AUC) was 0.711 (95% CI: 0.640 - 0.783, *p*-value < 0.001), indicating a fair diagnostic accuracy of FAST in this cohort (Figure 2).

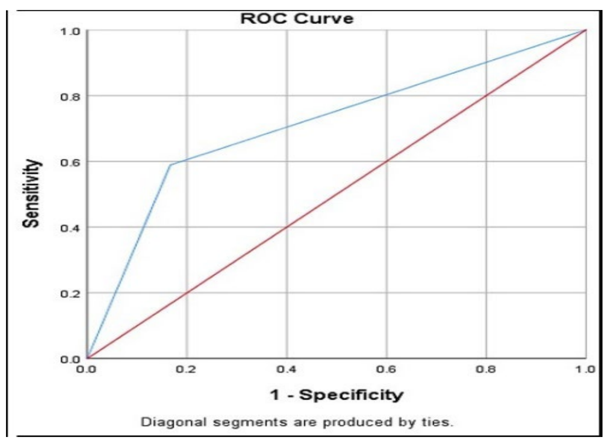

Figure 2: Receiver operating characteristic (ROC) curve of the FAST scan for the detection of intra-abdominal injury in the emergency department.

Diagnostic performance was analyzed separately for hemodynamically stable patients (n=137) and unstable patients (n= 91), with results presented in Tables 3 and 4. Among stable patients, the FAST scan demonstrated a sensitivity of 40.48% (95% CI: 27.14%–55.32%) and a specificity of 88.42% (95% CI: 80.63%–93.30%).

Among hemodynamically unstable patients, the FAST scan demonstrated a sensitivity of 75% (95% CI: 61.42%–84.76%) and a specificity of 72.09% (95% CI: 57.32%–83.16%).

Table 3: FAST result and confirmed injury in subgroups according to hemodynamic status and mechanism of injury

Variables			Injury confirmed	Injury not confirmed	Total	*p*-value
Hemodynamic status (n)						
SBP > 90 mmHg	FAST result	Positive	17	11	28	<0.0001
		Negative	25	84	109	
	Total		42	95	137	
SBP < 90 mmHg	FAST result	Positive	36	12	48	<0.0001
		Negative	12	31	43	
	Total		48	43	91	
Mechanism of injury (n)						
Blunt	FAST result	Positive	47	21	68	<0.0001
		Negative	37	112	149	
	Total		84	133	217	
Penetrating	FAST result	Positive	6	2	8	0.026
		Negative	0	3	3	
	Total		6	5	11	

Table 4: Diagnostic Performance of FAST scan overall in subgroups according to hemodynamic status and mechanism of injury

Metrics	Overall	SBP > 90 mmHg Stable (n=137)	SBP < 90 mmHg Unstable (n=91)	Blunt (n=217)	Penetrating (n=11)
Sensitivity (%)	58.88 (95% CI: 48.63%–68.41)	40.48 (95% CI: 27.14-55.32)	75.00 (95% CI: 61.42–84.76)	55.95 (95% CI: 45.10–66.11)	100 (95% CI: 60.96–99.99)
Specificity (%)	83.33 (95% CI: 76.23–88.60)	88.42 (95% CI: 80.63–93.30)	72.09 (95% CI: 57.32–83.16)	84.21 (95% CI: 77.11–89.47)	60 (95% CI: 23.09–88.25)
PPV (%)	69.73 (95% CI: 58.64–78.92)	60.71 (95% CI: 42.39–76.46)	75 (95% CI: 61.42–84.76)	69.12 (95% CI: 57.45–78.73)	75 (95% CI: 40.66–92.85)
NPV (%)	75.65 (95% CI: 68.24–81.78)	77.06 (95% CI: 66.65–83.95)	72.09 (95% CI: 57.32–83.16)	75.17 (95% CI: 67.87–81.40)	100 (95% CI: 43.86–100.00)
Accuracy (%)	73.68 (95% CI: 67.55–78.99)	73.72 (95% CI: 65.93–80.39)	73.63 (95% CI: 63.76–81.51)	73.27 (95% CI: 66.97–78.71)	81.82 (95% CI: 52.37–94.89)

The higher sensitivity observed in unstable patients was statistically significant ($p < 0.001$). Among patients with blunt trauma (n= 217), the FAST scan demonstrated a sensitivity of 55.95% with a 95% CI of 45.10%-66.11%, and specificity was 84.21% with a 95% CI of 77.11%-89.47%. For penetrating trauma (n= 11), the small sample size limited robust analysis, but the FAST scan correctly identified all 6 confirmed injuries, yielding a sensitivity of 100% and a 95% CI of 60.96%-100.00%. Furthermore, FAST correctly identified 3 of 5 non-injured cases with a specificity of 60% and a 95% CI of 23.09%-88.25%. The high sensitivity in penetrating trauma was statistically significant (*p*-value < 0.05).

DISCUSSION

Overall, the FAST scan demonstrated a sensitivity of 58.88% (95% CI: 48.63%–68.41%), a specificity of 83.33% (95% CI: 76.23%–88.60%), and a diagnostic accuracy of 73.68% (95% CI: 67.55%–78.99%) for detecting intra-abdominal injuries among 228 trauma patients presenting to the Emergency Department. These findings support the role of FAST scan as a valuable tool for rapid trauma assessment in the ED, particularly in resource-limited settings where advanced imaging may be unavailable; however, FAST should not be considered definitive for diagnosis. Moreover, this study has shown that the prevalence of intra-abdominal injuries was 39.5%, indicating a relatively high burden within the trauma population. Compared to previous studies, the sensitivity of 58.88% in this study is lower than that reported in the literature, which often reports sensitivity ranging from 33% to 100% for FAST in detecting intra-abdominal injuries [12]. For example, a previous study reported a sensitivity of 78.5% [13], while a 2024 study evaluating the effectiveness of FAST in blunt torso trauma reported a lower sensitivity of 20.3% despite a higher specificity of 87% [14]. The low sensitivity observed in the current study may be attributed to the high prevalence of blunt trauma, which is often associated with more subtle injuries that are less likely to be detected by FAST scan [15]. On the other hand, the specificity observed in the current study (83.33%) aligns closely with global estimates. A previous study by Ziesmann *et al*. reported a specificity of 85.7% [16]. A recent literature review by Najeeb Ullah *et al*. in 2022 reported a pooled specificity ranging from 55% to 100% [10]. This suggests that FAST remains reliable for ruling out intra-abdominal injuries when results are negative, consistent with their role as a screening tool [2]. The area under the receiver operating characteristic (ROC) curve (AUC) of 0.711 (95% CI: 0.640-0.783) in the current study indicates fair diagnostic accuracy, comparable to findings from a 2019 meta-analysis in military settings (AUC: 0.85, 95% CI: 0.82-0.88), which also included data from Iraq [17]. The slightly lower AUC observed in the current study may reflect the challenges of FAST in civilian emergency departments, where patient heterogeneity with varying injury mechanisms and hemodynamic status complicates interpretation [18]. Operator experience likely also influenced the results, as FAST accuracy is known to depend on training and skill level [6]. For instance, a previous study in 2016 reported a FAST sensitivity of 78.5% for emergency residents and 85.7% for radiology residents [13]. Studies have emphasized that emergency physicians with limited ultrasound training achieve lower sensitivity compared to radiologists [19]. In this study, subgroup analysis based on hemodynamic status revealed significant differences in FAST scan performance. It is observed that in hemodynamically unstable patients, the FAST scan demonstrated a significantly higher sensitivity of 75% (95% CI: 61.42-84.76%) than the 40.48% (95% CI: 27.14-55.32%) in stable patients (p-value<0.001). This finding aligns with a 2024 study that reported higher sensitivity (82%) in unstable patients due to larger volumes of intraperitoneal free fluid, which FAST is more likely to detect [20]. The lower sensitivity observed in hemodynamically stable patients aligns with previous studies, which reported that small or slow-accumulating hemorrhages are often missed by the FAST scan [21,22]. This suggests. The FAST scan is particularly valuable in unstable patients, where rapid identification of free fluid can guide urgent surgical intervention [23]. On the other hand, the specificity in unstable patients of 72.09% was lower than that in stable patients (88.42%), which may be attributed to the false positives caused by operator misinterpretation under time pressure or non-traumatic fluid collections [3]. A previous study in 2019 highlighted that false positives in unstable patients can lead to unnecessary laparotomies, highlighting the need for confirmatory diagnostics, like the gold standard CT scan [24]. These study findings support the use of FAST scans as an initial triage tool in unstable patients but highlight their limitations in stable patients, where CT remains the gold standard [2,22]. Moreover, FAST performance varied according to the mechanism of injury. For blunt trauma, sensitivity was 55.95% (95% CI: 45.10%–66.11%) and specificity was 84.21% (95% CI: 77.11%–89.47%). In comparison, a 2022 study reported a sensitivity of 33.3% and a specificity of 98.8% for blunt abdominal trauma [25]. The relatively low sensitivity of FAST in blunt trauma is likely attributable to injuries such as solid organ lacerations or hematomas that produce minimal free fluid, which may not be detected by FAST scan [22,26]. In contrast, FAST achieved 100% sensitivity (95% CI: 60.96%–100.00%) in penetrating trauma, although in a small sample (n= 11), consistent with a 2025 study reporting near-perfect sensitivity of 98% for penetrating injuries due to more obvious free fluid or organ disruption [2]. However, the specificity for penetrating trauma (60%) was lower, possibly due to false positives from subcutaneous air or non-injurious fluid [27]. The high sensitivity in penetrating trauma, though statistically significant ($p < 0.05$), should be interpreted with caution due to the small sample size, which limits the generalizability of this finding. A recent study in 2023 similarly reported that small sample sizes in penetrating trauma studies overestimate sensitivity results [28]. The observed prevalence of intra-abdominal injuries was 39.5% in the current study, which is notably high compared to other studies, such as a 2016 Iranian study reporting a prevalence of approximately 12% [13], or a 2022 study reporting that abdominal injuries may occur in up to one-third of all patients who suffer severe trauma [29]. This high prevalence likely reflects the trauma-heavy population in the current study, dominated by blunt trauma and a significant proportion of unstable patients. It is well established that high prevalence enhances the positive predictive value (PPV) of FAST, as seen in this study's results, 69.73% [30]. However, the high prevalence may also overestimate the false negatives, contributing to the lower sensitivity observed, as FAST scans miss subtle injuries in complex trauma cases [31]. The findings of the current study highlight FAST's scan role as a rapid, non-invasive tool for initial trauma assessment in the ED, particularly in hemodynamically unstable patients and those with penetrating trauma. Its moderate sensitivity and high specificity support its use for ruling out significant intra-abdominal injuries, reducing the need for immediate CT scans [32]. However, the lower sensitivity in stable patients and blunt trauma highlights the need for confirmatory imaging, such as a CT scan, to detect subtle injuries in addition to integration with clinical judgment [32]. While in stable patients, negative FAST scan results should not preclude further imaging [33,34]. Future research should focus on multicenter studies in Iraq to enhance generalizability and explore FAST scan performance. Standardizing operator training could improve sensitivity. A larger sample of penetrating trauma patients is needed to confirm the high sensitivity observed in the current study. Additionally, integrating FAST with extended FAST (eFAST) and contrast-enhanced ultrasound could further refine its role in trauma care and improve detection of subtle injuries [35,36].

Limitations of the study

Several limitations should be acknowledged. First, the single-center design may limit the generalizability of the findings. Second, the small sample size for penetrating trauma (n = 11) restricts the ability to draw robust conclusions for this subgroup. Finally, the reliance on CT scans for stable patients and intraoperative findings for unstable patients as reference standards may introduce potential verification bias, as not all patients underwent both diagnostic modalities.

Conclusions

This study demonstrates that the FAST scan is a moderately accurate tool for detecting intra-abdominal injuries in trauma patients in the ED, with higher sensitivity in hemodynamically unstable patients and those with penetrating trauma. By integrating FAST scans with clinical judgment and advanced imaging, clinicians can optimize trauma care in resource-constrained settings.

Conflict of interests

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Data sharing statement

Supplementary data can be shared with the corresponding author upon reasonable request.

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