Original Article

# Focused Assessment with Sonography and CT scan in Trauma (FAST) findings Post Blunt Belly Trauma in Emergency Room

**Kawakib Fawzi Abed [1,*], Walla Taleb Oumran[2], Zainab Kamil Majeed[2]**

[1] Department of Radiology, Musaib General Hospital, Babil Health Directorate, Al-Musayab 51006, Babylon, Iraq.
[2] Department of Emergency Medicine, Musaib General Hospital, Babil Health Directorate, Al-Musayab 51006, Babylon, Iraq.
[*] Corresponding author: drkawakibfawzi@gmail.com

**Submission: October 30, 2025 Accepted: December 12, 2025 Published: December 31, 2025**

## Abstract

**Background:** Trauma remains a major public health concern worldwide, and its history is as old as humankind itself. Over the past two decades, computed tomography (CT) has become the reference standard for diagnosing traumatic injuries, including intra-abdominal trauma. However, the use of CT in trauma and emergency care has expanded far more rapidly than the evidence supporting its appropriate utilization. **Objectives:** This study aimed to evaluate the sensitivity and specificity of the Focused Assessment with Sonography in Trauma (FAST) scan compared with CT scan findings in patients with blunt abdominal trauma (BAT), and to determine whether FAST influenced the clinical disposition of these patients. **Materials and Methods:** A prospective study was conducted from July 1, 2024 to May 1, 2025 in the Emergency Department. After applying exclusion criteria, a total of 100 patients presenting with blunt abdominal trauma were included. All patients underwent FAST examination followed by abdominal CT scanning, and results were compared. **Results:** The overall sensitivity of FAST for detecting intra-abdominal injury (IAI) was 94.34%, with a specificity of 78% and an overall diagnostic accuracy of 86.41%. However, the sensitivity of FAST decreased to 81.67% when detecting specific organ injuries. **Conclusions:** FAST is a valuable, rapid, and non-invasive initial diagnostic tool in the evaluation of blunt abdominal trauma, CT remains the gold standard. Abdominal CT scanning demonstrates higher sensitivity and specificity for intra-abdominal injury, enables precise localization of organ damage, and plays a crucial role in determining patient disposition and in-hospital management.

**Keyword:** Focused Assessment with Sonography, Blunt Belly Trauma, Emergency Room, FAST scan, Intra-abdominal injury

## Introduction

Trauma is the second leading cause of disease worldwide, accounting for approximately 16% of the global burden of disease. The World Health Organization (WHO) estimated that by 2020, trauma would become the leading cause of years of productive life lost globally [1]. Trauma has been described as “the neglected disease of modern society”—and while deaths from other causes have declined in many countries, trauma-related mortality continues to rise [2]. Intra-abdominal injury (IAI) remains a major contributor to trauma-related morbidity and mortality. In the United States alone, more than 600,000 cases of blunt abdominal trauma (BAT) are evaluated annually in emergency departments [3], and over 12 million individuals seek medical care following various forms of injury each year. BAT is one of the most common mechanisms of injury and continues to contribute substantially to adverse outcomes [4]. Recognizing common patterns of trauma assists clinicians in accurate

assessment and timely diagnosis by correlating findings with the mechanism of injury. For example, children are more likely than adults to be pedestrians struck by vehicles, a scenario often associated with Waddell's Triad head injury, splenic laceration, and femoral fracture. Similarly, unrestrained or improperly restrained vehicle occupants frequently sustain characteristic injury patterns [5]. BAT occurs more frequently than penetrating abdominal trauma and often presents a diagnostic challenge [2]. Early identification of intra-abdominal injuries is crucial to minimizing morbidity and mortality due to delayed or missed diagnoses [6]. Historically, invasive diagnostic techniques such as diagnostic peritoneal lavage (DPL) and exploratory laparotomy were commonly employed for detecting intra-abdominal injury. However, advances in imaging particularly ultrasound have revolutionized trauma assessment, with numerous studies validating its role in detecting hemoperitoneum in trauma patients [7]. The term Focused Assessment with Sonography for Trauma (FAST) was first introduced by Rozycki et al. in 1996 and has since become the standard acronym. The conventional FAST protocol includes four sonographic views: perihepatic (Morison's pouch), perisplenic, pelvic, and pericardial. The technique's rapid, noninvasive, and bedside applicability has made it an indispensable tool in the initial evaluation of BAT [8]. More recently, the Extended FAST (e-FAST) protocol has been developed to include evaluation of both hemi-thoraces, allowing for the detection of pneumothorax and hemothorax in addition to intra-abdominal fluid [9]. The primary objective of FAST is to identify free fluid, which in the context of acute trauma typically represents blood. Early versions of the technique focused solely on a single view Morison's pouch to detect free fluid. However, over the past three decades, the FAST examination has become increasingly standardized and comprehensive [10]. It is now an integral component of trauma resuscitation, endorsed by international consensus panels and incorporated into the Advanced Trauma Life Support (ATLS) guidelines [11]. While CT scanning remains the gold standard for diagnosing intra-abdominal injuries, particularly those involving solid organs, it is less sensitive in detecting bowel and mesenteric injuries. Authors demonstrated that CT findings such as bowel wall thickening, discontinuity, extraluminal air, and mesenteric hematoma are reasonably specific (84%, 95%, 100%, and 94%, respectively) but have limited sensitivity (50%, 58%, 44%, and 54%) [12]. The aims of this study are to calculate the sensitivity and specificity of the FAST scan compared with CT scan results in patients with BAT, determine the sensitivity and specificity of FAST in detecting any amount of hemoperitoneum, assess whether there is a difference in the sensitivity and specificity of FAST when performed by clinicians with different levels of training and evaluate whether FAST findings influence the clinical disposition and management of patients with BAT.

## Materials and Methods

### Study design

A prospective study in Emergency Department. This study was conducted through July 1, 2024 to May 1, 2025 and after applying the exclusion criteria a sample size of 100 patients was produced.

**Inclusion criteria:** BAT, Extremity paralysis, Bone fractures

**Exclusion criteria:** Penetrating trauma, Mental retardation, Cerebral palsy

### Data collection

Data collected has included patient demographics, mechanisms of injury, physical examination findings, and physician suspicion of IAI before any imaging. The FAST examination, abdominal CT scans, and patient hospitalization were done. Medical records were reviewed.

### FAST and CT scan

The first and second FAST ultrasound devices (ultrasound, model; Hs50, marka; Samsung, country kuria) examinations were performed. Four views (the Morrison pouch, the splenorenal junction, pelvis, and pericardial) were used. The routine protocol in our center is that every patient with suspected abdominal trauma should undergo FAST. All patients, regardless of negative or positive FAST, underwent further evaluation, including CT, laparotomy, and clinical follow-up. The CT scan device used in the emergency department was (CT, model; 2014, marka; philips, country; America.). Obtained images were interpreted immediately for final analysis. All investigators were blinded to the purpose of the study and the results of FAST and clinical findings.

### Statistical analysis

The SPSS (Statistical Package for Social Sciences V.25) was used, the categorical data were presented as percentages. Fisher's test was used. A 95%CI and a $p<0.01$ was considered as significant.

### Ethical consideration

The Medical Ethical Committee of the Department of Radiology, Musaib General Hospital, Babil Health Directorate, approved this study (Approval No. 5, dated 12/2/2024). Verbal consent was obtained from all participants before sample collection.

## Results

Demographics and mechanism of trauma were shown in **Table (1)**. 100 BAT patients; 66 (66%) were males and 34 (34%) females; the predominant age group was 20-40 years constituting 47.6% of patients. Road traffic accidents involving both pedestrians and vehicular accidents accounted collectively for (60.1%) majority of injuries. More than half of the patients presented within 6 hrs of the incident.

**Table 1: Basic lines of the sample.**

| Parameter | No. | % |
|---|---|---|
| **Gender** | | |
| Male | 66 | 66 |
| Female | 34 | 34 |
| **Age (years)** | | |
| 0-20 | 34 | 35.9 |
| 20-40 | 49 | 47.6 |
| >40 | 17 | 16.5 |
| **Mechanism of trauma** | | |
| MVC | 47 | 45.6 |
| Pedestrian | 15 | 14.5 |
| FFH | 27 | 26.2 |
| Handle bar | 2 | 1.9 |
| Non accidental trauma | 12 | 11.6 |
| **Route of arrival** | | |
| Ambulance | 43 | 44.7 |
| Private car | 30 | 29.1 |
| Taxi | 27 | 26.2 |
| **Time of Presentation to ED** | | |
| < 7hrs | 92 | 89.3 |
| 7-12hrs | 4 | 6.8 |
| More than 12 hrs | 4 | 3.9 |

Table (2) reveals the sensitivity, and specificity of both groups based on the sample prevalence. It is worthy to mention that ($p<0.01$). The

accuracy of Emergency Residents is 86.5% and 83.1% for radiology residents which has no significant difference according to the sample size examined by both groups.

**Table 2: Sensitivity and specificity of radiology doctors conducted FAST vs. Emergency Medicine Residents.**

| Parameter | Radiologist | Emergency Medicine doctors |
|---|---|---|
| **Sensitivity** | 91.98% (63.9 to 99.8%) | 95.4% (83.1 to 99.3%) |
| **Specificity** | 74.75% (39.3 to 93.8%) | 79.49% (63.4 to 90.7%) |
| **PPV** | 79.1% (57.4 to 90.1%) | 85.07% (72.4 to 90.4%) |
| **NPV** | 89.92% (56.7 to 98.8%) | 90.75% (79.8 to 98.2%) |
| **Accuracy** | 83.1% (61.9 to 94.7%) | 86.5% (78.1 to 93.8%) |

Table (3) shows the FAST results with clinically significant hemoperitoneum (Moderate and large only) 30 patients had significant hemoperitoneum (all by CT Scan). All of them had a true positive FAST (sensitivity = 100%). FAST results for hemoperitoneum see that the sensitivity of FAST drops to 81.67%, which make FAST will most likely miss an IAI if the associated amount of fluid was mild.

**Table 3: FAST findings for hemoperitoneum.**

| Amount of Free Fluid in FAST Positive Scan | Positive CT Scan (n (%)) | Negative CT Scan (n (%)) |
|---|---|---|
| **Mild** | 18 (34.84) | 11 (21.5) |
| **Moderate** | 20 (40.39) | 0 |
| **Large** | 7 (13.2) | 0 |

Table (4) shows the specific organ injuries found in all positive performed CT Scans in comparison with amount of free fluid detected in the first FAST scan. We found that 18 of the cases had mild free fluid, 20 had moderate free fluid and 5 had large, yet, 4 had no free fluid.

**Table 4: Specific organ trauma in positive CT Scan.**

| CT Scan | 1st FAST | | | |
|---|---|---|---|---|
| | No FF (Negative FAST) (n) | Mild (n) | Moderate (n) | Large (n) |
| **Multi-Organ** | 0 | 4 | 3 | 4 |
| **Liver** | 1 | 6 | 7 | 1 |
| **Splenic** | 0 | 4 | 8 | 0 |
| **Kidney** | 0 | 1 | 2 | 0 |
| **Intestinal** | 0 | 1 | 0 | 0 |
| **Bladder** | 1 | 0 | 0 | 0 |
| **Free Fluids** | 2 | 2 | 0 | 0 |

The overall sensitivity of FAST for IAI in this study to be 93.7% and specificity of 79.1% and an accuracy of 87.5%, (Table 5).

**Table 5: Overall sensitivity and specificity of FAST compared to CT scan.**

| Parameter | Value |
|---|---|
| **Sensitivity** | 93.7% |
| **Specificity** | 79.1% |
| **PPV** | 83.4% |
| **NPV** | 91.7% |
| **Accuracy** | 87.5% |

## Discussion

In our study, the overall sensitivity, specificity, and accuracy of the FAST examination for the detection of free fluid were found to be 93.7%, 79.1%, and 87.5%, respectively. These findings suggest that, according to our sample size, the diagnostic ability of FAST to detect intra-abdominal injury (IAI) is positively correlated with the volume of free fluid identified during the scan. The Royal College of Radiologists (RCR) Guidelines for Imaging of Trauma (2014) reported a review comparing mixed and standalone major trauma centers (MTCs). It demonstrated that patients managed in mixed MTCs were more likely to undergo multiple area

scans than those in standalone MTCs, with 9% versus 3% of cases, respectively, receiving multiple-region imaging [13, 14]. Fox et al. highlighted that CT scanning is primarily used for stable trauma victims to locate injuries and identify both free air and free fluid. They emphasized that any amount of free fluid on CT is suspicious for intra-abdominal injury, and that follow-up may involve serial abdominal examinations, repeated CT, or exploratory laparotomy [15]. Similarly, Negus et al. acknowledged that whole-body CT is justified in cases of potentially massive blunt complex polytrauma, provided it is performed promptly following physiological stabilization [16]. Hershkovitz et al. further reinforced that CT imaging remains the gold standard diagnostic modality for evaluating hemodynamically stable adult patients with blunt trauma [17]. In a prospective cohort study conducted in New York, Allen et al. reported that abdominal CT correctly identified intra-abdominal injuries in trauma patients, with a sensitivity of 94.1% and a negative predictive value (NPV) of 98.8% [18]. Similarly, van Schuppen et al. found that although the sensitivity of FAST for detecting parenchymal laceration is relatively low (30–60%), its sensitivity for detecting free fluid is considerably higher, approaching 99% [19]. Richards et al. reported that FAST has acceptable sensitivity (69–98%) for the detection of free fluid but lower sensitivity (63%) for detecting solid organ injury, potentially leading to underestimation of injury severity particularly in hemodynamically stable patients without detectable free fluid. They also noted that performing serial FAST examinations can improve overall sensitivity to 72–93% [7]. A major limitation frequently discussed in the literature is the operator dependency of the FAST examination. Pak et al. demonstrated this by infusing diagnostic peritoneal lavage (DPL) fluid into the peritoneal cavity and found that only 10% of participants, across all levels of training, were able to detect volumes below 400 mL [20]. Finally, Marx et al., in Rosen's Emergency Medicine, emphasized that while the diagnostic test of choice for evaluating IAI in stable, high-risk patients is abdominal CT, FAST can serve as a useful adjunct. However, the presence of intraperitoneal hemorrhage on ultrasound does not necessarily indicate a need for surgical intervention [13]. Similarly, Tintinalli's Emergency Medicine describes FAST as having limitations in trauma assessment due to anatomical and physiological differences, noting that approximately 30% of patients with solid organ injury may show no demonstrable free fluid on ultrasound [21]. Although abdominal CT scanning remains the gold standard for diagnosing intra-abdominal injury (IAI) following blunt abdominal trauma (BAT), its use is limited by several factors. CT scans require patient stability for transport to the radiology suite, and therefore may not be feasible in hemodynamically unstable patients. Additionally, CT imaging exposes patients to ionizing radiation and contrast agents, which may carry risks such as nephrotoxicity and allergic reactions. The high cost and limited availability of CT scanners in resource-constrained settings can also restrict access. FAST scanning, while rapid, noninvasive, and repeatable at the bedside, is operator-dependent and has lower sensitivity for detecting certain injuries, such as bowel or mesenteric trauma, or small amounts of intraperitoneal fluid. Furthermore, a negative FAST result does not exclude intra-abdominal injury, potentially delaying definitive diagnosis if CT is not performed. Finally, variability in training and experience among Emergency Medicine, Surgery, and Radiology residents can influence

the accuracy and reliability of FAST examinations. Ensuring standardized training and ongoing competency assessment remains an important challenge in optimizing the use of FAST and CT in trauma care.

## Conclusion

Abdominal CT scan is a highly sensitive and specific imaging modality that can accurately identify the location and extent of IAI. Compared to the FAST scan, abdominal CT is considered the gold standard and the most essential diagnostic tool for detecting IAI following BAT. The presence of any amount of free intra-abdominal fluid on CT should raise suspicion of injury. The findings of an abdomino-pelvic CT scan after BAT play a crucial role in determining patient disposition and subsequent in-hospital management. Studies have shown no significant difference in the sensitivity and specificity of FAST scans performed by clinicians at different levels of training. Therefore, it is essential that Emergency Medicine and Surgery residents, along with Radiology trainees, gain sufficient hands-on experience with FAST scans as part of their training programs. However, a negative FAST result alone is insufficient to exclude IAI; in such cases, patients should undergo a CT scan for accurate diagnosis. Since most IAIs are managed conservatively, the use of CT scanning can help reduce the number of unnecessary (negative) laparotomies. Finally, encouraging more Emergency Medicine physicians to pursue fellowships in Point-of-Care Ultrasound (PoCUS) can further enhance diagnostic proficiency and patient care in trauma settings.

.

**Funding:** None

**Conflicts of interest:** None

## References

[1] Mehta N, Babu S, Venugopal K. An experience with BAT: evaluation, management and outcome. *Clin Pract.* 2014 Jun 18;4(2):599.

[2] Sakran JV, Greer SE, Werlin E, McCunn M. Care of the injured worldwide: trauma still the neglected disease of modern society. *Scand J Trauma Resusc Emerg Med.* 2012 Sep 15;20:64.

[3] Sokolove PE, Kuppermann N, Vance CW, Lee MO, Morris BA, Holmes JF. Variation in specialists' reported hospitalization practices of patients sustaining BAT. *West J Emerg Med.* 2013 Feb;14(1):37-46.

[4] Menaker J, Blumberg S, Wisner DH, Dayan PS, Tunik M, Garcia M, et al. Use of the focused assessment with sonography for trauma (FAST) examination and its impact on abdominal computed tomography use in hemodynamically stable patients with blunt torso trauma. *J Trauma Acute Care Surg.* 2014 Sep;77(3):427-32.

[5] Wegner S, Colletti JE, Van Wie D. Pediatric BAT. *Pediatr Clin North Am.* 2006;53(2): 243-256.

[6] Ugalde IT, Chaudhari PP, Badawy M, Ishimine P, McCarten-Gibbs KA, Yen K, et al. Validation of Prediction Rules for Computed Tomography Use in Patients With Blunt Abdominal or Blunt Head Trauma: Protocol for a Prospective Multi-center Observational Cohort Study. *JMIR Res Protoc.* 2022 Nov 24;11(11) :e43027.

[7] Rippey JC, Royse AG. Ultrasound in trauma. *Best Pract Res Clin Anaesthesiol.* 2009 Sep;23(3):343-62.

[8] Rose JS. Ultrasound in abdominal trauma. *Emerg Med Clin North Am.* 2004; 22(3): 581-99.

[9] Ben-Ishay O, Daoud M, Peled Z, Brauner E, Bahouth H, Kluger Y. Focused abdominal sonography for trauma in the clinical evaluation of patients with BAT. *World J Emerg Surg.* 2015 Jul 1;10:27.

[10] McGahan JP, Horton S, Gerscovich EO, Gillen M, Richards JR, Cronan MS, et al. Appearance of solid organ injury with contrast-enhanced sonography in BAT: preliminary experience. *AJR Am J Roent genol.* 2006 Sep;187(3):658-66.

[11] Mohammad A, Hefny AF, Abu-Zidan FM. Focused Assessment Sonography for Trauma (FAST) training: a systematic review. *World J Surg.* 2014;38(5):1009-18.

[12] O'Dowd V, Kiernan C, Lowery A, Khan W, Barry K. Seatbelt injury causing small bowel devascularisation: case series and review of the literature. *Emerg Med Int.* 2011;2011:675341.

[13] Moore C, Liu R. Not so FAST—let's not abandon the pediatric focused assessment with sonography in trauma yet. *J Thorac Dis.* 2018 Jan;10(1):1-3.

[14] Marx JA, Hockberger RS, Walls RM, et al., eds. *Rosen's Emergency Medicine: Concepts and Clinical Practice.* 8th ed. St. Louis, MO: Elsevier; 2014. p. 855-871.

[15] Fox JC, Boysen M, Gharahbaghian L, Cusick S, Ahmed SS, Anderson CL, et al. Test characteristics of focused assessment of sonography for trauma for clinically significant abdominal free fluid in pediatric BAT. *Acad Emerg Med.* 2011 May;18(5): 477-82.

[16] Negus S, Danin J, Fisher R, Johnson K, Landes C, Somers J, et al. Paediatric trauma imaging: why do we need separate guidance? *Clin Radiol.* 2014 Dec;69(12): 1209-13.

[17] Hershkovitz Y, Zoarets I, Stepansky A, Kozer E, Shapira Z, Klin B, et al. Computed tomography is not justified in every pediatric blunt trauma patient with a suspicious mechanism of injury. *Am J Emerg Med.* 2014 Jul;32(7):697-9.

[18] Allen CJ, Tashiro J, Sola JE. Role of FAST or Abdominal Ultrasound to Limit CT Imaging in Evaluation of the Pediatric Abdominal Trauma Patient. *Curr Surg Rep.* 2014;2(6):1–5.

[19] van Schuppen J, Olthof DC, Wilde JC, Beenen LF, van Rijn RR, Goslings JC. Diagnostic accuracy of a step-up imaging strategy in pediatric patients with BAT. *Eur J Radiol.* 2014 Jan;83(1):206-11.

[20] Pak LM, Coit DG, Eaton AA, Allen PJ, D'Angelica MI, DeMatteo RP, et al. Percutaneous Peritoneal Lavage for the Rapid Staging of Gastric and Pancreatic Cancer. *Ann Surg Oncol.* 2017 May;24(5):1174-1179.

[21] Tintinalli JE, Stapczynski JS, Ma OJ, et al., eds. *Tintinalli's Emergency Medicine: A Comprehensive Study Guide.* 8th ed. New York, NY: McGraw-Hill; 2012:1620-1621.