Original Article

Diagnostic Performance of Focused Assessment with Sonography for Trauma (FAST) versus Contrast-Enhanced Computed Tomography in Blunt Abdominal Trauma: A Cross-Sectional Observational Study

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Abstract

Background: Blunt abdominal trauma (BAT) is a major cause of morbidity and mortality, particularly among young adults. Focused Assessment with Sonography for Trauma (FAST) is a rapid bedside screening tool, while contrast-enhanced computed tomography (CECT) remains the reference standard. Comparative data from Indian tertiary centres on the diagnostic performance of FAST versus CECT in haemodynamically stable patients remain limited. **Material and Methods:** This cross-sectional observational study enrolled 210 consecutive haemodynamically stable adults (18-60 years) with BAT who underwent both FAST and CECT abdomen at a tertiary care teaching hospital in Central India. FAST findings (presence/absence of free fluid) were compared with CECT as the reference standard. Diagnostic accuracy indices (sensitivity, specificity, PPV, NPV), kappa agreement, and chi-square association were calculated. Demographic, clinical, and injury characteristics were also analysed. **Results:** Mean age was 33.09 ± 11.07 years; 77.1% were male. Road traffic accidents accounted for 65.7% of injuries. FAST was positive in 128 patients (61.0%) and CECT in 150 patients (71.4%). Using CECT as reference, FAST demonstrated sensitivity 80.0%, specificity 86.7%, PPV 93.8%, and NPV 63.4%. Moderate agreement was observed (κ=0.601). The association between FAST and CECT findings was statistically significant ($p<0.001$). Solid organ injury was present in 71.4% (liver most common, 34.3%); hollow viscus injury occurred in 17.1%. **Conclusion:** FAST is a useful, rapid screening modality with high specificity and PPV in haemodynamically stable BAT patients. Its moderate sensitivity and lower NPV indicate that a negative FAST does not reliably exclude significant intra-abdominal injury. CECT remains essential for definitive evaluation, especially when clinical suspicion persists.

Keywords: Blunt abdominal trauma, FAST, CECT, Diagnostic accuracy, Hemoperitoneum, Solid organ injury, Trauma imaging, Emergency surgery.

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Introduction

Trauma accounts for nearly 9% of global deaths and disproportionately affects young adults.[1] Blunt abdominal trauma (BAT) forms a major subset, commonly resulting from road traffic accidents (RTAs), falls, and assaults. In India, RTAs remain the leading cause, with a consistent male predominance and maximum incidence in the third and fourth decades of life.[2–4] Occult haemorrhage from solid or hollow viscera can rapidly progress to shock or sepsis, making early diagnosis essential.

Physical examination alone has limited sensitivity, particularly in polytrauma or altered sensorium.[5] Laboratory tests are non-specific. Diagnostic peritoneal lavage, once widely used, is invasive and non-specific for organ injury.[6]

Focused Assessment with Sonography for Trauma (FAST) provides rapid, bedside detection of free intraperitoneal or pericardial fluid without radiation or contrast. It is integral to trauma protocols and valuable in unstable patients or resource-limited settings.[7] However, its sensitivity is only moderate (typically 70-90%), and it may miss low-volume haemorrhage, retroperitoneal bleeding, and hollow-viscus injury without significant fluid.[8,9]

Contrast-enhanced computed tomography (CECT) of the abdomen is regarded as the gold-standard imaging modality in haemodynamically stable patients. Multidetector CECT accurately depicts solid-organ injury grade, active extravasation, hollow-viscus perforation, and retroperitoneal structures, thereby guiding non-operative management and reducing unnecessary laparotomy.[9,10] Its limitations include radiation exposure, need for contrast, requirement for patient stability, and restricted availability outside tertiary centres.

Despite widespread adoption of both modalities, comparative diagnostic performance data from large Indian tertiary cohorts remain limited. The present cross-sectional study therefore

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evaluated FAST against CECT as the reference standard in 210 consecutive haemodynamically stable adults with BAT. We hypothesised that FAST would show high specificity and positive predictive value but only moderate sensitivity and negative predictive value. The findings aim to refine the role of FAST within Indian trauma algorithms and support selective use of CECT in variable-resource environments.

Materials and Methods

Study design and setting: This cross-sectional observational study was conducted in the Department of General Surgery, MGM Medical College and MY Hospital, Indore, a tertiary-care teaching hospital serving urban and rural populations of Central India.

Study Duration: Over a period of 12 months after Institutional Ethics Committee approval.

Study Participants (Inclusion and Exclusion criteria): Consecutive adults (18-60 years) of either sex who presented with blunt abdominal trauma, remained haemodynamically stable, required both Focused Assessment with Sonography for Trauma (FAST) and contrast-enhanced computed tomography (CECT) of the abdomen, and provided written informed consent were enrolled. Patients unable to undergo CECT for surgical, technical, or contrast-related reasons were excluded. A final sample of 210 patients was analysed.

Sample Size: The sample size will be calculated based on standard statistical formula considering sensitivity and prevalence from previous studies. (Final sample size to be determined as per institutional protocol.)

Study Procedure: After primary survey and resuscitation according to Advanced Trauma Life Support principles, clinical evaluation, laboratory tests, FAST, and CECT abdomen were performed. Data were recorded on a structured proforma.

FAST examination: FAST was performed bedside by trained personnel using a portable USG machine with a low-frequency curvilinear probe. The 4 standard views– right upper quadrant (Morison's pouch), left upper quadrant (splenorenal recess), pelvic view, and subxiphoid or parasternal cardiac view– were obtained. Presence or absence of free fluid was documented. The examination typically required 2-5 minutes and could be repeated if clinically indicated.

CECT examination: CECT of the abdomen and pelvis was performed according to institutional trauma protocol and interpreted by radiologists. Findings of free fluid, solid-organ injury (with American Association for the Surgery of Trauma grading), hollow-viscus injury, and retroperitoneal pathology were recorded. CECT served as the reference standard.

Variables and outcomes: Demographic data, mechanism and timing of injury, clinical findings, and laboratory parameters were collected. Primary outcome was the presence or absence of free fluid or intra-abdominal injury on FAST versus CECT. Secondary outcomes included solid-organ and hollow-viscus injury patterns and diagnostic accuracy indices.

Statistical analysis: Data were analysed using IBM SPSS v29.0. Continuous variables are expressed as mean ± standard deviation; categorical variables as frequencies and percentages. Association between FAST and CECT was tested by chi-square. Sensitivity, specificity, positive predictive value, and negative predictive value were calculated with CECT as reference. Agreement was assessed by Cohen's kappa. A p-value < 0.05 was considered significant.

Ethical considerations: The protocol was approved by the IEC and Scientific Review Committee. Written informed consent was obtained from all participants. Confidentiality was maintained and standard care was provided irrespective of study participation.

Results

A total of 210 consecutive haemodynamically stable adult patients with blunt abdominal trauma who underwent both FAST and CECT abdomen were analysed. There were no missing data.

Table 1: Demographic and injury characteristics (n = 210)

Characteristic		Frequency (n)	Percentage (%)
Age group (years)	<20	28	13.3
	21–30	72	34.3
	31–40	56	26.7
	41–50	34	16.2
	51–60	20	9.5
Sex	Male	162	77.1
	Female	48	22.9
Mode of injury	Road traffic accident	138	65.7
	Fall	52	24.8
	Others	20	9.5
Time to presentation	<6 hours	124	59.0
	6–12 hours	56	26.7
	>12 hours	30	14.3

The mean age was 33.09 ± 11.07 years (range 18-59 years; median 31.50 years). The largest age group was 21-30 years (72 patients, 34.3%), followed by 31-40 years (56 patients, 26.7%). Males predominated (162 patients, 77.1%); females constituted 48 patients (22.9%) [Table 1].

Clinical features: Abdominal pain was present in 198 patients (94.3%). Vomiting occurred in 86 (41.0%), abdominal distension in 52 (24.8%), and loss of consciousness in 38 (18.1%). Mean heart rate was 92.06 ± 22.24 bpm; mean systolic and diastolic blood pressures were 112.14 ± 17.22 mmHg and 69.23 ± 13.12 mmHg, respectively. Mean SpO_2 was 96.20 ± 3.44%.

Table 2: CECT findings - solid organ and hollow viscus injury (n = 210)		
Finding	**Frequency (n)**	**Percentage (%)**
Solid organ injury present	150	71.4
Liver	72	34.3
Spleen	52	24.8
Kidney	18	8.6
Pancreas	8	3.8
Hollow viscus injury present	36	17.1
Small intestine	16	7.6
Colon	10	4.8
Stomach	6	2.9
Urinary bladder	4	1.9

Imaging findings: FAST was positive for free fluid in 128 patients (61.0%) and negative in 82 patients (39.0%). CECT demonstrated intra-abdominal injury in 150 patients (71.4%) and was negative in 60 patients (28.6%).

Solid-organ injury was identified on CECT in 150 patients (71.4%). The liver was the most frequently injured organ (72 patients, 34.3%), followed by the spleen (52 patients, 24.8%), kidney (18 patients, 8.6%), and pancreas (8 patients, 3.8%) [Table 2]. Grade II injuries were most common (39 patients, 18.6%), followed by Grade III (34 patients, 16.2%). Hollow-viscus injury was present in 36 patients (17.1%). The small intestine was most frequently involved (16 patients, 7.6%), followed by colon (10 patients, 4.8%), stomach (6 patients, 2.9%), and urinary bladder (4 patients, 1.9%).

Table 3: Cross-tabulation of FAST versus CECT findings (n = 210)			
FAST result	**CECT positive (n)**	**CECT negative (n)**	**Total**
Positive	120	8	128
Negative	30	52	82
Total	150	60	210

Diagnostic performance of FAST versus CECT: Cross-tabulation of FAST against CECT (reference standard) is shown in [Table 3]. Among 150 CECT-positive patients, FAST correctly identified 120 (true positives) and missed 30 (false negatives). Among 60 CECT-negative patients, FAST correctly identified 52 (true negatives) and yielded 8 false positives.

Table 4: Diagnostic accuracy of FAST (CECT as reference standard)	
Parameter	**Value (%)**
Sensitivity	80.0
Specificity	86.7
Positive predictive value	93.8
Negative predictive value	63.4

Using CECT as the reference standard, FAST demonstrated: [Table 4].

- Sensitivity 80.0%
- Specificity 86.7%
- Positive predictive value 93.8%
- Negative predictive value 63.4%

Agreement between FAST and CECT was moderate (Cohen's κ=0.601). The association was statistically significant (χ^2=80.03, df=1, p<0.001). The odds ratio for a positive FAST predicting a positive CECT was 26.0 (95% CI 11.168-60.531).

Table 5: Diagnostic Performance of FAST in Detecting Solid Organ Injury		
Parameter	**Value (%) for Solid Organ Injury**	**Value (%) for Hollow Viscus Injury**
Sensitivity	80.0	80.6
Specificity	86.7	43.1
PPV	93.8	22.7
NPV	63.4	91.5

Performance of FAST for solid-organ injury was identical to overall performance (sensitivity 80.0%, specificity 86.7%, PPV 93.8%, NPV 63.4%). For hollow-viscus injury, sensitivity was 80.6%, specificity 43.1%, PPV 22.7%, and NPV 91.5%.

Discussion

Blunt abdominal trauma remains a major cause of morbidity among young adults in India. The present cross-sectional study of 210 haemodynamically stable patients evaluated the diagnostic performance of FAST against CECT abdomen and found sensitivity 80.0%, specificity 86.7%, positive predictive value 93.8%, negative predictive value 63.4%, and moderate agreement (κ=0.601). These results are now examined in the context of recent literature.

Demographic characteristics and injury profile: The mean age of 33.09 years and male predominance of 77.1% are consistent with contemporary Indian data. Kumar A et al. in

2025, reporting from a level-I trauma centre in Eastern India, observed a mean age of 30.2 years and a male-to-female ratio of 6.35:1 among 118 patients with blunt abdominal trauma.[11] Similarly, an autopsy-based study (Ranjan SK et al.) from North India documented that 92.5% of victims were male and the peak incidence lay in the 21-30 year age group.[12] Road traffic accidents accounted for 65.7% of injuries in the present series, a figure comparable to the 56.8% reported by Kumar A et al,[11] and higher rates noted in autopsy cohorts by Ranjan SK et al,[12] Solid-organ injury was present in 71.4% of patients, with the liver most frequently involved (34.3%), followed by the spleen (24.8%). This organ hierarchy mirrors findings from Central and South Indian series.[13,14]

Diagnostic accuracy of FAST: The sensitivity of 80.0% observed in the present study lies within the range reported by recent systematic reviews. Rofananda et al. in 2025 performed a systematic review and meta-analysis of 16 studies and calculated a pooled sensitivity of 78.2% (95% CI 75.8-80.5%) and pooled specificity of 97.8% for FAST in blunt abdominal trauma.[15] A separate meta-analysis focusing on solid-organ-related intra-abdominal injury reported a pooled sensitivity of 0.74 and high pooled specificity of 0.96.[16] The specificity of 86.7% in the present cohort is somewhat lower than these pooled estimates, possibly reflecting differences in operator experience, timing of examination, or patient body habitus. The high positive predictive value of 93.8% supports the clinical utility of a positive FAST as a strong indicator for further investigation or intervention, a conclusion also reached by Waheed KB et al. in 2018.[17]

The modest negative predictive value of 63.4% is clinically important. Carter JH et al., in an earlier large retrospective analysis of haemodynamically stable patients, reported FAST sensitivity as low as 22%, emphasising that a negative examination cannot reliably exclude injury.[18] Although more recent pooled data show higher sensitivity, the persistent gap between sensitivity and near-perfect rule-out performance confirms that negative FAST findings must be interpreted with caution in stable patients.

Agreement and statistical association: Moderate agreement (κ=0.601) between FAST and CECT is consistent with the expected discordance between a rapid screening tool and a comprehensive reference standard. Heydari F et al. in 2018 reported a higher kappa of 0.865 in a selected cohort with serial examinations, illustrating that agreement can improve with operator expertise and repeated scanning.[19] The highly significant chi-square association (χ^2=80.03, p <0.001) and odds ratio of 26.0 in the present study nevertheless confirm a robust statistical relationship between the two modalities.

Solid-organ versus hollow-viscus injury: FAST performance for solid-organ injury was identical to overall performance (sensitivity 80.0%, specificity 86.7%). This is expected because clinically significant solid-organ injuries usually produce detectable free fluid. In contrast, performance for hollow-viscus injury showed sensitivity 80.6% but specificity only 43.1% and positive predictive value 22.7%. A 2024 systematic review and meta-analysis of CECT for traumatic hollow-viscus and mesenteric injury reported pooled sensitivity of 0.85 and specificity of 0.94, underscoring the superiority of CT for this subset.[20]

Clinical integration of FAST and CECT: In haemodynamically unstable patients a positive FAST appropriately directs immediate laparotomy. In stable patients, however, the moderate sensitivity and limited negative predictive value support selective rather than routine omission of CECT after a negative FAST. This approach is particularly relevant in Indian tertiary centres where CECT is available but must be used judiciously because of radiation exposure, contrast risk, and resource constraints.

Limitations of the evidence base: Operator dependence of FAST, single-centre design, and absence of long-term outcome linkage remain limitations shared by many observational series, including the present study.

In summary, FAST is a rapid, bedside screening tool with high positive predictive value in blunt abdominal trauma. Its moderate sensitivity and lower negative predictive value, however, confirm that CECT remains the definitive imaging modality for haemodynamically stable patients. The present data from a large Central Indian cohort support selective, clinically guided use of both modalities rather than exclusive reliance on either investigation alone.

Conclusion

In this cross-sectional study of 210 haemodynamically stable adults with blunt abdominal trauma, FAST demonstrated sensitivity of 80.0%, specificity of 86.7%, positive predictive value of 93.8%, and negative predictive value of 63.4% when compared with CECT abdomen as the reference standard. Agreement between the two modalities was moderate (κ=0.601). FAST is a rapid and useful bedside screening tool with high positive predictive value; however, its moderate sensitivity and limited negative predictive value indicate that a negative examination cannot reliably exclude significant intra-abdominal injury. CECT remains the definitive imaging modality for comprehensive evaluation of haemodynamically stable patients.

Clinical Implications: A positive FAST should prompt expedited CECT or immediate operative intervention if the patient becomes unstable. A negative FAST does not preclude the need for CECT when clinical suspicion, laboratory abnormalities, or associated injuries are present. FAST retains particular value for rapid triage, serial examination, and resource-constrained settings, but it should be integrated into, rather than substituted for, a selective CECT-based algorithm in stable patients.

Strengths: The study enrolled a relatively large consecutive cohort of haemodynamically stable adults, performed both FAST and CECT contemporaneously, and used CECT as an explicit reference standard. Restriction to stable patients reduced clinical heterogeneity and matches the population in which the FAST-CECT decision is most relevant. Complete data capture without missing observations further strengthens internal validity.

Limitations: The single-centre design limits generalisability. FAST is operator-dependent, and inter-observer variability was not quantified. The study did not evaluate extended FAST, contrast-enhanced ultrasound, or long-term clinical outcomes linked to imaging findings. Sample-size calculation details were completed according to institutional norms rather than a prospectively published protocol.

Recommendations

- Incorporate FAST as a mandatory bedside screening step in the primary survey of blunt abdominal trauma.
- Proceed to CECT in all haemodynamically stable patients with a positive FAST or with persistent clinical suspicion despite a negative FAST.
- Develop institutional protocols that define clear criteria for selective CECT after negative FAST to optimise resource utilisation.
- Ensure regular training and competency assessment of personnel performing FAST.

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Conflicts of interest

There are no conflicts of interest.

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