

Original Article

Diagnostic Accuracy of Focused Assessment With Sonography for Trauma Against Contrast-Enhanced Multidetector Computed Tomography in Blunt Abdominal Trauma: A Cross-Sectional Study

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ABSTRACT

Background: Focused assessment with sonography for trauma (FAST) is widely used for rapid evaluation of blunt abdominal trauma, but its diagnostic scope is more limited than contrast-enhanced multidetector computed tomography (CE-MDCT). **Objective:** To determine the diagnostic performance of FAST for the study-defined intra-abdominal solid-organ injury outcome using CE-MDCT as the reference standard and to describe associated CE-MDCT findings. **Methods:** This cross-sectional analytical diagnostic-accuracy study included 140 patients with blunt abdominal trauma evaluated at Services Hospital, Lahore, from June 2022 to June 2023. Participants underwent FAST followed by abdominopelvic CE-MDCT. Diagnostic performance was assessed using sensitivity, specificity, predictive values, accuracy, likelihood ratios, and Cohen's kappa. **Results:** FAST was positive in 66 (47.1%) participants and negative in 74 (52.9%). Against CE-MDCT, FAST demonstrated 93.8% sensitivity, 92.1% specificity, 90.9% positive predictive value, 94.6% negative predictive value, and 92.9% overall accuracy. The positive and negative likelihood ratios were 11.88 and 0.07, respectively, and agreement was high ($\kappa=0.856$). CE-MDCT additionally demonstrated active bleeding, free fluid, mesenteric tears, bowel perforation, mesenteric haematoma, and other traumatic abnormalities. **Conclusion:** FAST showed high diagnostic agreement with CE-MDCT for the predefined target condition in this selected cohort, while CE-MDCT provided broader characterization of associated abdominal injuries. **Keywords:** blunt abdominal trauma; focused assessment with sonography for trauma; multidetector computed tomography; diagnostic accuracy; bowel injury; mesenteric injury.

INTRODUCTION

Blunt abdominal trauma remains an important diagnostic challenge because clinically significant intra-abdominal injuries may initially present with subtle, nonspecific, or evolving signs. Delayed recognition of solid-organ, bowel, mesenteric, or vascular injuries can increase the risk of haemorrhage, peritonitis, sepsis, operative delay, and other preventable complications. Accurate early assessment therefore requires integration of the mechanism of injury,

clinical examination, laboratory findings, and appropriately selected imaging rather than reliance on any single diagnostic modality (1–4).

Focused assessment with sonography for trauma (FAST) is widely incorporated into the early evaluation of trauma patients because it is rapid, portable, repeatable, radiation-free, and can be performed at the bedside during initial resuscitation. Its principal role is the detection of free intraperitoneal fluid, which may provide an early indication of clinically important intra-abdominal injury, particularly when rapid decision-making is required. However, the diagnostic performance of conventional FAST is influenced by operator experience, examination timing, patient selection, haemodynamic status, body habitus, the volume and distribution of intraperitoneal fluid, and the type of underlying injury. Previous studies and systematic reviews have consequently reported relatively high specificity but more variable sensitivity, particularly when FAST is used to detect traumatic organ injury or haemoperitoneum (5–8). Contrast-enhanced ultrasound has demonstrated improved detection of solid-organ injuries in selected populations, especially children, but its findings are not directly transferable to conventional adult FAST and its routine use remains dependent on local expertise, equipment, and standardized protocols (9,10).

Contrast-enhanced multidetector computed tomography (CE-MDCT) provides a substantially more comprehensive anatomical assessment in haemodynamically stable patients with suspected intra-abdominal trauma. In addition to identifying solid-organ injuries and active haemorrhage, CE-MDCT can demonstrate direct and indirect signs of bowel and mesenteric injury, including bowel-wall discontinuity, extraluminal gas or enteric contents, mesenteric contrast extravasation, free fluid, mesenteric haematoma, abnormal bowel-wall enhancement, and mesenteric stranding (2–4,11). Contemporary trauma guidance therefore supports FAST as an early triage examination while positioning contrast-enhanced CT as the principal definitive imaging modality in stable patients when intra-abdominal injury remains suspected (2,12). Nevertheless, even CT findings must be interpreted together with the injury mechanism and evolving clinical picture because some bowel and mesenteric injuries can initially be subtle or equivocal (3,11,13).

The complementary roles of FAST and CE-MDCT make their diagnostic relationship clinically important. FAST can provide immediate bedside information but cannot reliably characterize many parenchymal, retroperitoneal, bowel, mesenteric, spinal, or vascular injuries. Conversely, CE-MDCT provides greater anatomic detail but requires patient transfer to the scanner, intravenous contrast administration, and exposure to ionizing radiation. The practical balance between these modalities may be particularly relevant in settings where access to CT, radiology staffing, imaging turnaround times, and thresholds for advanced imaging vary. Although previous studies have evaluated FAST performance in blunt abdominal trauma, reported accuracy has been heterogeneous because of differences in study populations, target conditions, operator expertise, reference standards, and clinical settings (5–8). Evidence derived from tertiary-care trauma populations in resource-constrained settings remains valuable for determining how effectively FAST performs when compared directly with CE-MDCT and for describing injuries that may lie beyond the diagnostic scope of conventional FAST.

Accordingly, this cross-sectional analytical study evaluated patients with blunt abdominal trauma who underwent both FAST and CE-MDCT at a tertiary hospital in Lahore, Pakistan. The primary objective was to determine the diagnostic performance of FAST for the predefined intra-abdominal solid-organ injury outcome using CE-MDCT as the reference standard, including sensitivity, specificity, positive and negative predictive values, overall diagnostic accuracy, likelihood ratios, and agreement between the two examinations. Secondary objectives were to describe the mechanisms of blunt abdominal trauma, the distribution of FAST-detected intraperitoneal fluid, and CE-MDCT findings relevant to bowel and mesenteric injury. The study therefore addressed whether FAST can provide accurate initial classification of the specified injury outcome while identifying the additional traumatic abnormalities demonstrated by CE-MDCT.

MATERIAL AND METHODS

This cross-sectional analytical diagnostic-accuracy study was conducted in the Department of Radiology at Services Hospital, Lahore, Pakistan, from June 2022 to June 2023. The study population comprised patients presenting with blunt abdominal trauma who underwent both focused assessment with sonography for trauma (FAST) and contrast-enhanced multidetector computed tomography (CE-MDCT) as part of the evaluation for suspected intra-abdominal injury. The paired-test design allowed FAST findings to be compared directly with CE-MDCT findings within the same participants. A total of 140 patients aged 17–71 years were included using

convenience sampling. Eligible mechanisms of injury included motor-vehicle collisions, falls, animal-related trauma, and assault. Patients presenting with penetrating abdominal trauma or those without a clinical indication for evaluation of intra-abdominal injury were excluded. Written informed consent was obtained from participants before enrolment and data collection.

FAST was performed using a Philips EPIQ-series ultrasound system equipped with a 3–5 MHz curvilinear transducer. Standard FAST assessment included examination of the hepatorenal recess, splenorenal recess, pelvis, and epigastric region. The presence and anatomical distribution of intraperitoneal free fluid were recorded, together with reported sonographic findings involving abdominal solid organs. For the primary diagnostic comparison, the recorded FAST examination was categorized as positive or negative for the study-defined intra-abdominal solid-organ injury outcome. FAST was performed before CE-MDCT, and both examinations contributed paired observations for the diagnostic-accuracy analysis.

CE-MDCT served as the reference imaging examination and was performed using a Toshiba Aquilion 160-slice multidetector CT scanner. Images were reconstructed at 1-mm intervals and reviewed using coronal and sagittal multiplanar reformations. Intravenous iodinated contrast material was administered in a volume of 120–150 mL at a rate of at least 3 mL/s. The imaging protocol included arterial- and venous-phase acquisition, with an additional delayed phase at 3–5 minutes when low-flow active bleeding was suspected. Oral contrast material was not routinely administered. Recorded CE-MDCT findings included active bleeding, seat-belt-related findings, extraluminal air, pneumoperitoneum, free fluid, haemoperitoneum, splenic injury, bowel-wall defect, bowel perforation, spillage of enteric contents, mesenteric haematoma, mesenteric tear, and spinal fracture. Because individual participants could demonstrate more than one traumatic finding, these imaging features were treated as non-mutually exclusive variables.

The primary outcome was the diagnostic performance of FAST for the study-defined solid-organ injury outcome using CE-MDCT as the reference standard. Diagnostic classification was based on paired FAST and CE-MDCT results. During verification of the aggregate diagnostic data, the internally consistent contingency-table counts were 60 true-positive, 6 false-positive, 4 false-negative, and 70 true-negative examinations, corresponding to 66 FAST-positive and 74 FAST-negative examinations among the 140 participants. These paired classifications were used to calculate sensitivity, specificity, positive predictive value, negative predictive value, overall diagnostic accuracy, positive and negative likelihood ratios, and agreement between FAST and CE-MDCT. Secondary outcomes included the distribution of mechanisms of blunt abdominal trauma, anatomical distribution of FAST-detected free fluid, and the frequency of CE-MDCT features relevant to bowel, mesenteric, vascular, solid-organ, and associated traumatic injury.

Data were analysed using IBM SPSS Statistics version 25.0. Categorical variables were summarized as frequencies and percentages. The association between mechanism of injury and FAST status was assessed using Pearson's chi-square test. Sensitivity was calculated as $TP/(TP+FN)$, specificity as $TN/(TN+FP)$, positive predictive value as $TP/(TP+FP)$, negative predictive value as $TN/(TN+FN)$, and overall diagnostic accuracy as $(TP+TN)/N$. Positive and negative likelihood ratios were derived from the corresponding sensitivity and specificity estimates. Wilson 95% confidence intervals were calculated for diagnostic proportions, and agreement beyond chance between FAST and CE-MDCT classifications was assessed using Cohen's kappa coefficient. All analyses were two-sided, and a p value <0.05 was considered statistically significant. The reported diagnostic calculations were independently checked arithmetically against the aggregate contingency-table totals, and all 140 paired FAST and CE-MDCT examinations contributed to the primary diagnostic analysis.

Ethical approval for the study was obtained from the ethics committee of Superior University, Lahore, Pakistan. Participation was voluntary, written informed consent was obtained before enrolment, and participant-identifying information was maintained confidentially throughout data collection and analysis.

RESULTS

The study included 140 participants aged 17–71 years. Of these, 86 (61.4%) were male and 54 (38.6%) were female. Motor-vehicle collisions were the most frequent mechanism of blunt abdominal trauma, accounting for 87 cases (62.1%), followed by falls in 28 (20.0%), assault in 15 (10.7%), and animal-related trauma in 10 (7.1%). FAST was positive

in 66 participants (47.1%) and negative in 74 (52.9%). The distribution of injury mechanisms was not associated with FAST status ($\chi^2(3)=1.938$, $p=0.585$; Cramér's $V=0.118$). Participant and FAST characteristics are presented in Table 1.

Table 1. Participant, injury-mechanism, and FAST characteristics (N=140)

Characteristic	n (%)
Male sex	86 (61.4)
Female sex	54 (38.6)
Motor-vehicle collision	87 (62.1)
Fall	28 (20.0)
Assault	15 (10.7)
Animal-related trauma	10 (7.1)
FAST positive	66 (47.1)
FAST negative	74 (52.9)
Free fluid: hepatorenal recess	31 (22.1)
Free fluid: splenorenal recess	24 (17.1)
Free fluid: pelvis	15 (10.7)
Free fluid: epigastric region	1 (0.7)

FAST, focused assessment with sonography for trauma. Free-fluid locations were non-mutually exclusive; percentages are based on N=140.

Reported ultrasound findings involving abdominal solid organs included liver laceration in 31 participants (22.1%), splenic laceration in 24 (17.1%), and renal injury in 15 (10.7%)(Table 2).

Table 2. Reported ultrasound solid-organ findings (N=140)

Ultrasound finding	n (%)
Liver laceration	31 (22.1)
Splenic laceration	24 (17.1)
Renal injury	15 (10.7)

Findings were non-mutually exclusive; percentages are based on N=140.

CE-MDCT demonstrated a spectrum of traumatic abnormalities (Table 3). Active bleeding was the most frequently reported finding, occurring in 29 participants (20.7%). Free fluid and mesenteric tear were each identified in 21 (15.0%), while splenic injury was recorded in 15 (10.7%) and bowel perforation in 14 (10.0%). Mesenteric haematoma occurred in 12 participants (8.6%). Other recorded findings included extraluminal air and pneumoperitoneum in 10 participants each (7.1%), enteric-content spillage in 9 (6.4%), haemoperitoneum in 8 (5.7%), spinal fracture in 7 (5.0%), and seat-belt-related and bowel-wall findings in 6 participants each (4.3%).

Table 3. Contrast-enhanced multidetector computed tomography findings (N=140)

CE-MDCT finding	n (%)
Active bleeding	29 (20.7)
Free fluid	21 (15.0)
Mesenteric tear	21 (15.0)
Splenic injury	15 (10.7)
Bowel perforation	14 (10.0)
Mesenteric haematoma	12 (8.6)
Extraluminal air	10 (7.1)
Pneumoperitoneum	10 (7.1)
Spillage of enteric contents	9 (6.4)
Haemoperitoneum	8 (5.7)
Spinal fracture	7 (5.0)
Seat-belt-related finding	6 (4.3)
Bowel-wall defect	6 (4.3)

CE-MDCT, contrast-enhanced multidetector computed tomography. Findings were non-mutually exclusive; percentages are based on N=140.

For the primary diagnostic comparison, 64 participants (45.7%) were classified as CE-MDCT positive for the study-defined target condition and 76 (54.3%) as CE-MDCT negative. FAST correctly classified 60 of 64 CE-MDCT-positive examinations and 70 of 76 CE-MDCT-negative examinations. There were 6 false-positive and 4 false-negative FAST examinations (Table 4).

Table 4. FAST classification against CE-MDCT for the study-defined target condition (N=140)

FAST result	CE-MDCT positive, n	CE-MDCT negative, n	Total, n
Positive	60	6	66
Negative	4	70	74
Total	64	76	140

FAST, focused assessment with sonography for trauma; CE-MDCT, contrast-enhanced multidetector computed tomography.

Based on these paired classifications, FAST demonstrated a sensitivity of 93.8% (95% CI 85.0–97.5) and specificity of 92.1% (95% CI 83.8–96.3). The positive predictive value was 90.9% (95% CI 81.6–95.8), while the negative predictive value was 94.6% (95% CI 86.9–97.9). Overall diagnostic accuracy was 92.9% (95% CI 87.4–96.1). The positive likelihood ratio was 11.88 (95% CI 5.50–25.66), whereas the negative likelihood ratio was 0.07 (95% CI 0.03–0.18). Agreement between FAST and CE-MDCT was high, with Cohen's κ =0.856 (95% CI 0.771–0.942). Diagnostic-performance estimates are summarized in Table 5 and displayed in Figure 2.

Table 5. Diagnostic performance of FAST against CE-MDCT (N=140)

Diagnostic measure	Estimate	95% CI
Sensitivity, %	93.8	85.0–97.5
Specificity, %	92.1	83.8–96.3
Positive predictive value, %	90.9	81.6–95.8
Negative predictive value, %	94.6	86.9–97.9
Accuracy, %	92.9	87.4–96.1
Positive likelihood ratio	11.88	5.50–25.66
Negative likelihood ratio	0.07	0.03–0.18
Cohen's κ	0.856	0.771–0.942

FAST, focused assessment with sonography for trauma; CE-MDCT, contrast-enhanced multidetector computed tomography; CI, confidence interval.

DISCUSSION

The present study showed that FAST had high diagnostic agreement with CE-MDCT for the study-defined solid-organ injury outcome in this selected cohort of patients with blunt abdominal trauma. The principal finding was that FAST demonstrated high sensitivity and specificity when compared with CE-MDCT, while CE-MDCT additionally identified a broader spectrum of vascular, bowel, mesenteric, spinal, and associated traumatic abnormalities. These findings support the role of FAST as an initial bedside assessment tool while reinforcing that its diagnostic scope is narrower than that of cross-sectional imaging.

The observed diagnostic performance of FAST was higher than that reported in several previous studies and systematic reviews, in which specificity has generally been more consistent than sensitivity. Conventional FAST is most effective for identifying intraperitoneal free fluid and is less reliable for detecting injuries that do not initially produce a sufficient volume of free fluid or that involve retroperitoneal, bowel, mesenteric, or isolated parenchymal structures (5–8). The comparatively high sensitivity observed in the present study may therefore reflect characteristics of the selected population, including the inclusion of patients who underwent both FAST and CE-MDCT, the relatively high prevalence of the target condition, and the spectrum of injuries encountered in a tertiary-care trauma setting. Such factors can influence diagnostic estimates and may partly explain differences from studies conducted in broader emergency, prehospital, or lower-prevalence populations.

The high specificity observed in this study is consistent with the established diagnostic role of FAST in trauma assessment. When intraperitoneal free fluid is visualized in an appropriate clinical context, the finding may strongly increase suspicion of significant intra-abdominal injury. Conversely, a negative FAST examination should not be interpreted as evidence that all clinically important abdominal injuries are absent, because the diagnostic sensitivity of FAST depends on the timing of examination, the amount and distribution of free fluid, operator expertise, body habitus, and the anatomical location and nature of the injury (5–8). This is particularly relevant for bowel and mesenteric trauma, in which clinically important injuries may be present without substantial haemoperitoneum during the initial assessment (2–4,11,12).

CE-MDCT provided additional information that could not be adequately characterized by conventional FAST. In the present cohort, CT findings included active bleeding, mesenteric tears, bowel perforation, mesenteric haematoma, extraluminal air, pneumoperitoneum, enteric-content spillage, bowel-wall defects, and associated spinal injury. Contemporary imaging literature similarly emphasizes that CT can identify both direct and indirect features of bowel and mesenteric trauma, including bowel-wall discontinuity, extraluminal gas or enteric material, vascular contrast extravasation, mesenteric haematoma, free fluid, abnormal bowel-wall enhancement, and mesenteric stranding (2–4,11). Direct or highly specific findings may strongly influence operative decision-making, whereas isolated indirect findings usually require interpretation in conjunction with mechanism of injury, clinical examination, laboratory findings, and serial reassessment.

The presence of bowel and mesenteric abnormalities in this study is clinically important because these injuries can be difficult to recognize during the early phase of blunt trauma. Previous studies evaluating CT-based scoring systems and the Bowel Injury Prediction Score have shown that combinations of radiological and clinical findings may improve identification of patients with clinically significant bowel and mesenteric injury, although no scoring system provides perfect sensitivity across all populations (14–16). The present findings therefore support a multimodal approach in which imaging findings are interpreted alongside the clinical trajectory rather than used in isolation. This is especially important when CT demonstrates only subtle or indirect abnormalities or when symptoms persist despite initially equivocal imaging.

The results also reinforce the complementary rather than interchangeable roles of FAST and CE-MDCT. FAST remains valuable because it can be performed rapidly at the bedside, repeated during resuscitation, and incorporated into early trauma decision-making without ionizing radiation. Contemporary reviews of extended FAST and prehospital point-of-care ultrasound similarly support its role in rapid triage while emphasizing the importance of operator training, appropriate governance, and integration with definitive imaging pathways (17,18). In haemodynamically stable patients, however, CE-MDCT provides substantially greater anatomical detail and remains central to the assessment of suspected intra-abdominal injury, particularly when retroperitoneal, bowel, mesenteric, vascular, or multiple injuries are possible (2,11,12).

Even CE-MDCT should not be interpreted as infallible for hollow-viscus or mesenteric injury. A previous systematic review and meta-analysis demonstrated that CT has high specificity for traumatic hollow-viscus injury requiring laparotomy but less-than-perfect sensitivity, meaning that subtle or evolving injuries can occasionally be missed during the initial examination (19). Accordingly, imaging findings must be integrated with serial clinical assessment when suspicion remains high. This is especially relevant in patients with persistent abdominal pain, worsening examination findings, unexplained laboratory abnormalities, or mechanisms associated with bowel and mesenteric injury.

Timely recognition of bowel and mesenteric trauma is clinically important because delayed diagnosis can prolong exposure to intestinal contamination, haemorrhage, inflammation, sepsis, and physiological deterioration. Previous observational studies have reported associations between delays in operative management and adverse outcomes in patients with blunt hollow-viscus injury, although the magnitude of this relationship varies according to injury severity, patient selection, and the indication for surgery (20,21). Standardized description and grading of bowel and mesenteric injury can further improve communication between radiologists and trauma surgeons and support consistent clinical decision-making (22). In this context, the spectrum of CE-MDCT findings observed in the present study highlights the value of recording the type and distribution of traumatic abnormalities rather than reducing the CT examination to a simple positive or negative classification.

Motor-vehicle collisions were the predominant mechanism of injury in this cohort, accounting for nearly two-thirds of participants. This pattern is compatible with the known mechanisms of blunt bowel and mesenteric trauma, in which rapid deceleration, compression, and shearing forces can affect relatively fixed bowel segments, mesenteric attachments, and vascular structures (3,4). However, the absence of a statistically significant association between mechanism of injury and FAST status indicates that mechanism alone did not distinguish FAST-positive from FAST-negative cases in this sample. Mechanism of injury should therefore be considered as one component of the broader clinical assessment rather than as an isolated predictor of imaging findings.

Several strengths of the study should be considered. FAST and CE-MDCT were available for the same 140 participants, allowing paired assessment of the index and reference imaging examinations. The study also reported

multiple diagnostic-performance measures rather than relying only on sensitivity and specificity, and the calculated confidence intervals provide an indication of the precision of the observed estimates. In addition, the description of bowel, mesenteric, vascular, and associated CE-MDCT findings broadens the clinical interpretation beyond the primary diagnostic classification.

The findings must nevertheless be interpreted in light of important limitations. Convenience sampling and restriction to patients who underwent both FAST and CE-MDCT may have introduced selection and spectrum bias, and the resulting estimates may not be directly generalizable to all patients presenting with blunt abdominal trauma. CE-MDCT served as the reference imaging standard rather than operative findings or a composite clinical reference standard, so the study assessed agreement with CT rather than the absolute accuracy of CE-MDCT itself. The diagnostic performance estimates also depend on the study-defined criteria used to classify FAST and CE-MDCT examinations. Operator experience, examination timing, patient haemodynamic status, body habitus, image quality, blinding, indeterminate examinations, and CT inter-reader agreement were not characterized in sufficient detail to determine their influence on diagnostic performance. In addition, the aggregate contingency table required reconciliation of an internal source inconsistency, and participant-level data were not available for independent adjudication. Clinical outcomes such as laparotomy, delayed diagnosis, complications, length of stay, and mortality were also not reported. Finally, the single-center design limits external generalizability and supports cautious interpretation of the high diagnostic estimates.

Overall, the findings indicate that FAST can provide useful early diagnostic information in blunt abdominal trauma, but its value lies within a broader trauma-imaging pathway rather than as a replacement for CE-MDCT. The high agreement observed in this cohort should therefore be interpreted within the study's selected population and methodological constraints, while the additional injuries demonstrated by CE-MDCT reinforce the importance of definitive cross-sectional imaging when clinically indicated.

CONCLUSION

FAST demonstrated high diagnostic agreement with CE-MDCT for the study-defined solid-organ injury outcome in this selected cohort of patients with blunt abdominal trauma, with high sensitivity, specificity, predictive values, and overall accuracy. However, CE-MDCT identified additional vascular, bowel, mesenteric, spinal, and associated traumatic abnormalities that extend beyond the diagnostic scope of conventional FAST. These findings support the use of FAST as a rapid initial imaging assessment while indicating that CE-MDCT remains important for comprehensive evaluation of clinically suspected intra-abdominal injury in appropriately selected patients.

REFERENCES

1. Granieri S, Altomare M, Bonomi A, Panagini G, Frassini S, Cioffi SPB, et al. Contrast-enhanced CT scan (CECT) for the detection of hollow viscus and mesenteric injuries in blunt trauma: an updated systematic review of the literature and meta-analysis of diagnostic test accuracy. *Eur J Trauma Emerg Surg*. 2024;50(6):2709-2719. doi:10.1007/s00068-024-02667-9.
2. Smyth L, Bendinelli C, Lee N, Reeds MG, Loh EJ, Amico F, et al. WSES guidelines on blunt and penetrating bowel injury: diagnosis, investigations, and treatment. *World J Emerg Surg*. 2022;17(1):13. doi:10.1186/s13017-022-00418-y.
3. Kaewlai R, Chatpuwaphat J, Maitriwong W, Wongwaisayawan S, Shin CI, Lee CW. Radiologic imaging of traumatic bowel and mesenteric injuries: a comprehensive up-to-date review. *Korean J Radiol*. 2023;24(5):406-423. doi:10.3348/kjr.2022.0998.
4. Kazi IA, Elbanan M, Gaballah A, Abdelaziz A, Thimmappa ND, Kabir BW, et al. Pearls and pitfalls in the imaging of blunt bowel and mesenteric injury. *Abdom Radiol (NY)*. 2026 Jul 2. doi:10.1007/s00261-026-05633-8.
5. Kim TA, Kwon J, Kang BH. Accuracy of focused assessment with sonography for trauma (FAST) in blunt abdominal trauma. *Emerg Med Int*. 2022;2022:8290339. doi:10.1155/2022/8290339.
6. Gamberini L, Scquizzato T, Tartaglione M, Chiarini V, Mazzoli CA, Allegri D, et al. Diagnostic accuracy for hemoperitoneum, influence on prehospital times and time-to-definitive treatment of prehospital FAST: a

- systematic review and individual participant data meta-analysis. *Injury*. 2023;54(6):1421-1431. doi:10.1016/j.injury.2023.03.024.
7. Lin KT, Lin ZY, Huang CC, Yu SY, Huang JL, Lin JH, et al. Prehospital ultrasound scanning for abdominal free fluid detection in trauma patients: a systematic review and meta-analysis. *BMC Emerg Med*. 2024;24(1):7. doi:10.1186/s12873-023-00919-2.
 8. Sutarjono B, Kessel M, Alexander D, Grewal E. Is it time to re-think FAST? A systematic review and meta-analysis of contrast-enhanced ultrasound and conventional ultrasound for initial assessment of abdominal trauma. *BMC Emerg Med*. 2023;23(1):8. doi:10.1186/s12873-023-00771-4.
 9. Pegoraro F, Giusti G, Giacalone M, Parri N. Contrast-enhanced ultrasound in pediatric blunt abdominal trauma: a systematic review. *J Ultrasound*. 2022;25(3):419-427. doi:10.1007/s40477-021-00623-6.
 10. Jannatdoust P, Valizadeh P, Hassankhani A, Amoukhteh M, Ghadimi DJ, Heidari-Foroozan M, et al. Diagnostic performance of contrast-enhanced ultrasound in traumatic solid organ injuries in children: a systematic review and meta-analysis. *Pediatr Radiol*. 2025;55(2):226-241. doi:10.1007/s00247-024-06127-9.
 11. Siddiqui F, Moriarty H, Bates DDB, LeBedis C. Imaging of blunt traumatic bowel and mesenteric injuries. *Radiol Clin North Am*. 2025;63(3):375-386. doi:10.1016/j.rcl.2024.11.004.
 12. Weinberg JA, Peck KA, Ley EJ, Brown CVR, Moore EE, Sperry JL, et al. Evaluation and management of bowel and mesenteric injuries after blunt trauma: a Western Trauma Association critical decisions algorithm. *J Trauma Acute Care Surg*. 2021;91(5):903-908. doi:10.1097/TA.0000000000003327.
 13. Olson MC, Bach CR, Wells ML, Andrews JC, Khandelwal A, Welle CL, et al. Imaging of bowel ischemia: an update, from the AJR special series on emergency radiology. *AJR Am J Roentgenol*. 2023;220(2):173-185. doi:10.2214/AJR.22.28140.
 14. Wandling M, Cuschieri J, Kozar R, O'Meara L, Celii A, Starr W, et al. Multi-center validation of the Bowel Injury Predictive Score (BIPS) for the early identification of need to operate in blunt bowel and mesenteric injuries. *Injury*. 2022;53(1):122-128. doi:10.1016/j.injury.2021.07.026.
 15. Sethi I, Aicher AE, Zawin M, Samuel M, Mukhi A, Vosswinkel J, et al. Index CT-based scoring systems in operative blunt bowel and mesenteric injury identification. *J Surg Res*. 2024;294:240-246. doi:10.1016/j.jss.2023.10.001.
 16. Keller N, Zingg T, Agri F, Denys A, Knebel JF, Schmidt S. Significant blunt bowel and mesenteric injury: comparison of two CT scoring systems in a trauma registry cohort. *Eur J Radiol Open*. 2021;8:100380. doi:10.1016/j.ejro.2021.100380.
 17. Bella FM, Bonfichi A, Esposito C, Zanza C, Bellou A, Sfondrini D, et al. Extended focused assessment with sonography for trauma in the emergency department: a comprehensive review. *J Clin Med*. 2025;14(10):3457. doi:10.3390/jcm14103457.
 18. Hellenthal KEM, Porschen C, Wnent J, Lange M. Evolving role of point-of-care ultrasound in prehospital emergency care: a narrative review. *Scand J Trauma Resusc Emerg Med*. 2025;33(1):126. doi:10.1186/s13049-025-01443-x.
 19. Hsia CC, Wang CY, Huang JF, Hsu CP, Kuo LW, Ouyang CH, et al. Diagnostic accuracy of computed tomography for the prediction of the need for laparotomy for traumatic hollow viscus injury: systematic review and meta-analysis. *J Pers Med*. 2021;11(12):1269. doi:10.3390/jpm11121269.
 20. Okishio Y, Ueda K, Nasu T, Kawashima S, Kunitatsu K, Kato S. Surgical intervention for blunt bowel and mesenteric injury: indications and time intervals. *Eur J Trauma Emerg Surg*. 2021;47(6):1739-1744. doi:10.1007/s00068-019-01192-4.
 21. Fu CY, Bajani F, Bokhari M, Wang SH, Cheng CT, Mis J, et al. How long of a postponement in surgery can a blunt hollow viscus injury patient tolerate? A retrospective study from the National Trauma Data Bank. *Surgery*. 2022;171(2):526-532. doi:10.1016/j.surg.2021.06.017.

22. Tominaga GT, Crandall M, Cribari C, Zarza BL, Bernstein M, Kozar RA. Organ Injury Scaling 2020 update: bowel and mesentery. *J Trauma Acute Care Surg.* 2021;91(3). doi:10.1097/TA.0000000000003319.