



ORIGINAL RESEARCH ARTICLE

MDCT-Based Evaluation of Intra-Abdominal Injuries Among Patients with Blunt Abdominal Trauma

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Abstract

Background: Blunt abdominal trauma is a common presentation in emergency departments, and prompt, accurate identification of solid organ and hollow viscus injury is critical to guiding management. Multidetector computed tomography (MDCT) has become the primary imaging modality for haemodynamically stable patients with suspected intra-abdominal injury.

Objectives: To evaluate the diagnostic accuracy of contrast-enhanced MDCT in detecting intra-abdominal organ injury following blunt trauma, in comparison with focused assessment with sonography for trauma (FAST), using surgical and clinical follow-up findings as the reference standard.

Methods: A cross-sectional study was conducted on 155 haemodynamically stable patients with blunt abdominal trauma who underwent both FAST and contrast-enhanced MDCT. Findings were correlated with surgical or clinical follow-up outcomes to calculate diagnostic accuracy parameters for each modality.

Results: MDCT demonstrated a sensitivity of 96.5% and specificity of 94.1% for detection of intra-abdominal organ injury, compared with 68.2% and 89.3% respectively for FAST. The spleen was the most commonly injured organ (24.5%), followed by the liver (21.9%).

Conclusion: MDCT offers substantially higher sensitivity than FAST for the detection of solid organ injury in blunt abdominal trauma and should remain the investigation of choice in haemodynamically stable patients with clinical suspicion of intra-abdominal injury.

Keywords: Blunt abdominal trauma, multidetector computed tomography, FAST, diagnostic accuracy, radiology.

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1 | INTRODUCTION

Blunt abdominal trauma, most commonly resulting from road traffic accidents, falls,

and assaults, remains a leading cause of morbidity and mortality among trauma patients worldwide.¹ Timely and accurate identification of intra-abdominal organ injury is essential, as delayed

diagnosis of solid organ or hollow viscus injury is associated with increased complications, need for delayed intervention, and mortality.²

Focused assessment with sonography for trauma (FAST) has traditionally served as a rapid, bedside screening tool in the initial assessment of trauma patients, offering the advantage of speed and portability without ionising radiation.³ However, its sensitivity for detecting solid organ injury, particularly in haemodynamically stable patients without significant haemoperitoneum, has been reported to be considerably lower than that of computed tomography.²

Multidetector computed tomography has emerged as the investigation of choice for haemodynamically stable patients with suspected blunt abdominal trauma, offering rapid acquisition, excellent spatial resolution, and the ability to comprehensively assess solid organs, bowel, mesentery, and retroperitoneal structures in a single examination.¹ Despite concerns regarding cumulative radiation exposure associated with CT, particularly in younger patients, its diagnostic superiority in this clinical context has led to its widespread adoption as a central component of modern trauma imaging protocols.⁴

This study was undertaken to evaluate the diagnostic accuracy of contrast-enhanced MDCT in detecting intra-abdominal organ injury following blunt trauma, and to compare its performance with FAST, using surgical findings or clinical follow-up as the reference standard.

2 | REVIEW OF LITERATURE

Comparative studies evaluating CT and ultrasonography in blunt abdominal trauma have consistently

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demonstrated the superior sensitivity of CT for detecting solid organ injury, while acknowledging the continued value of FAST as a rapid initial screening tool in the resuscitation bay, particularly in haemodynamically unstable patients requiring immediate surgical decision-making.⁵ A systematic review and meta-analysis of emergency ultrasonography for blunt abdominal trauma found pooled sensitivity for FAST to be substantially lower than that reported for CT across the included studies, reinforcing the complementary rather than competing roles of the two modalities.⁶

A review examining the overall investigation strategy for blunt abdominal trauma concluded that while FAST remains valuable for rapid triage, CT should be performed in all haemodynamically stable patients with clinical suspicion of intra-abdominal injury, given its markedly superior diagnostic yield.⁷ The American Association for the Surgery of Trauma organ injury scaling system, originally developed for splenic and hepatic injury, has since become the standard grading framework used in CT reporting to guide management decisions between conservative and operative approaches.⁸

Early prospective work evaluating emergent abdominal sonography after blunt trauma established the role of FAST as a rapid triage tool but highlighted its limited ability to detect injuries in the absence of free intraperitoneal fluid.⁹ With the increasing availability of transarterial embolization as an adjunct to non-operative management, accurate CT-based grading of hepatic injury has assumed even greater clinical importance in guiding the choice between observation, embolization, and surgery.¹⁰ Detailed radiological descriptions of the CT appearance of blunt liver trauma have further refined the recognition of injury patterns, including subcapsular haematoma, laceration, and active contrast extravasation.¹¹

Similarly, CT-based criteria for the management of blunt splenic injury—particularly the identification of active contrast extravasation as a predictor of failure of non-operative management—have been well described and are now incorporated into most institutional trauma protocols.¹² The use of multidetector CT specifically for the detection of active haemorrhage has been shown to have high accuracy,

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allowing early identification of patients who may benefit from angioembolization.¹³

Bowel and mesenteric injuries, though less common than solid organ injury, are recognised as a diagnostically challenging subset given their sometimes subtle CT appearance, and dedicated descriptions of helical CT findings in such injuries have improved recognition rates.¹⁴ The role of screening CT in detecting clinically significant bowel and mesenteric injury has been further validated in subsequent series, supporting a low threshold for CT in patients with concerning mechanism of injury even in the absence of overt peritonism.¹⁵ Historical series examining missed injuries in abdominal trauma have underscored the clinical consequences of diagnostic delay, further reinforcing the importance of a sensitive initial imaging strategy.¹⁶

More recent work has explored the role of whole-body CT imaging in multisystem trauma patients without obvious signs of injury, demonstrating a substantial yield of clinically significant occult injuries that would otherwise have been missed on selective imaging alone.¹⁷ Efforts to develop standardised diagnostic algorithms incorporating clinical, laboratory, and FAST findings to guide selective use of abdominal CT have aimed to balance diagnostic yield against unnecessary radiation exposure.¹⁸ Limitations of FAST have also been specifically documented in patients with abdominal injury but without significant haemoperitoneum, a scenario in which the sensitivity of ultrasonography is known to fall considerably.¹⁹ Additional work has highlighted the importance of recognising physiological free pelvic fluid in women of reproductive age as a potential confounder on FAST examination, underscoring the need for careful interpretation in this subgroup.²⁰

3 | MATERIALS AND METHODS

3.1 | Study Design and Setting

This was a hospital-based, cross-sectional observational study conducted in the Department of Radiodiagnosis in collaboration with the Department of Surgery of a tertiary care trauma centre over a period of twelve months.

3.2 | Study Population

A total of 155 haemodynamically stable adult patients presenting with a history of blunt abdominal trauma who underwent both FAST and contrast-enhanced MDCT of the abdomen were included in the study after obtaining informed consent.

3.3 | Sample Size

The sample size was calculated based on an expected sensitivity of CT of approximately 95% from prior literature, with 95% confidence and an absolute precision of 5%, yielding a minimum required sample size of approximately 146 patients. A total of 155 patients were enrolled to account for possible incomplete data.

3.4 | Inclusion Criteria

Haemodynamically stable adult patients with a history of blunt abdominal trauma and clinical suspicion of intra-abdominal injury who underwent both FAST and contrast-enhanced CT were included.

3.5 | Exclusion Criteria

Haemodynamically unstable patients requiring immediate surgical exploration without imaging, patients with penetrating abdominal trauma, and those unwilling to provide consent were excluded from the study.

3.6 | Imaging Protocol

FAST was performed at initial presentation by the emergency/trauma team, followed by contrast-enhanced MDCT of the abdomen and pelvis performed on a 128-slice scanner in the portal venous phase, with additional arterial phase imaging where active haemorrhage was suspected. CT images were reviewed by an experienced radiologist blinded to the FAST findings, and organ injuries were graded according to the American Association for the Surgery of Trauma (AAST) organ injury scale.

3.7 | Reference Standard

Surgical findings (where laparotomy was performed) or clinical and radiological follow-up over a minimum of 48 hours (in patients managed conservatively) were used as the reference standard for confirming the presence or absence of intra-abdominal organ injury.

3.8 | Statistical Analysis

Data were analysed using descriptive statistics. Sensitivity, specificity, positive and negative predictive values, and diagnostic accuracy were calculated for both CT and FAST against the reference standard. Results were tabulated and represented graphically using multiple chart formats to illustrate different aspects of the data.

4 | RESULTS

Of the 155 patients studied, 94 (60.6%) were male and 61 (39.4%) were female. The age and gender-wise distribution is summarised in Table 1 and illustrated in Figure 1.

The 26–35 year age group accounted for the largest proportion of cases (32.9%), consistent with the higher incidence of road traffic accidents among younger economically active adults.

The spleen was the most commonly injured solid organ (24.5%), followed closely by the liver (21.9%), consistent with their relatively exposed anatomical position and vulnerability to direct impact and deceleration forces.

As shown in Table 3 and Figure 3, MDCT markedly outperformed FAST across all diagnostic parameters, most notably in sensitivity (96.5% vs 68.2%), reflecting the limited ability of FAST to detect solid organ injury in the absence of significant free intraperitoneal fluid.

As illustrated in Figure 4, the majority of both splenic and hepatic injuries were of lower grade (Grades I–III), with a progressive decline in frequency at higher grades (IV–V), consistent with the expected severity distribution in a predominantly stable trauma cohort

selected for imaging rather than immediate laparotomy.

Figure 5 summarises the diagnostic algorithm followed in this study, integrating FAST as an initial triage tool with subsequent CT confirmation and AAST-based grading to guide further management.

5 | DISCUSSION

The present study demonstrates that MDCT offers markedly superior sensitivity compared with FAST for the detection of intra-abdominal organ injury following blunt trauma, a finding consistent with earlier comparative series and systematic reviews.^{5,6} The sensitivity of FAST observed in this study (68.2%) is comparable to pooled estimates reported in prior meta-analyses, reaffirming the well-recognised limitation of ultrasonography in detecting solid organ injury in the absence of significant haemoperitoneum.^{6,19}

The predominance of splenic and hepatic injury observed in this study is consistent with their established position as the most commonly injured solid organs in blunt abdominal trauma, reflecting both their relatively fixed anatomical position and rich vascular supply.^{11,12} The grade distribution observed, with a predominance of lower-grade injuries, likely reflects the study's inclusion criteria of haemodynamically stable patients, as higher-grade injuries are more frequently associated with haemodynamic instability necessitating immediate surgical intervention without prior imaging.⁸

The findings of this study support the continued central role of FAST as a rapid initial triage tool, particularly valuable in haemodynamically unstable patients where immediate identification of significant haemoperitoneum can expedite the decision for emergency laparotomy.⁹ However, in haemodynamically stable patients, the substantially higher sensitivity of CT supports its use as the definitive investigation, particularly given the clinical consequences of missed injury described in earlier series.¹⁶

The role of CT in guiding non-operative management has become increasingly important with the growing use of transarterial embolization for high-

TABLE 1: Age and Gender-wise Distribution of Study Subjects (n = 155)

Age Group (years)	Male (n)	Female (n)	Total (n)	Percentage (%)
16–25	25	17	42	27.1
26–35	31	20	51	32.9
36–45	20	13	33	21.3
46–55	12	7	19	12.3
56 and above	6	4	10	6.4
Total	94	61	155	100.0

Figure 1: Age-wise Distribution of Study Subjects (n=155)

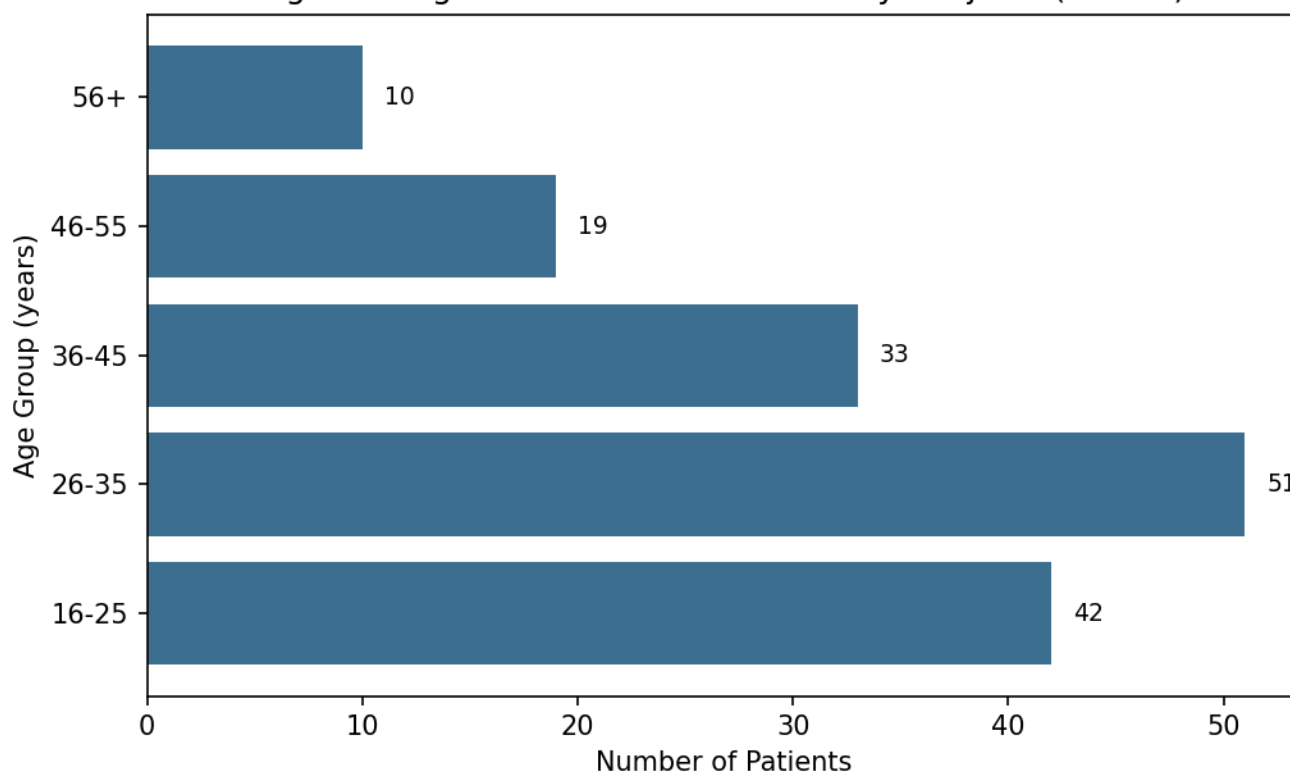


FIGURE 1:

TABLE 2: Distribution of Solid Organ Injury on CT (Figure 2)

Organ Injured	Number (n)	Percentage (%)
Splenic injury	38	24.5
Hepatic injury	34	21.9
Renal injury	21	13.5
Mesenteric / bowel injury	14	9.0
Pancreatic injury	7	4.5
No visceral injury identified	41	26.4

Figure 2: Distribution of Solid Organ Injury on CT (n=155)

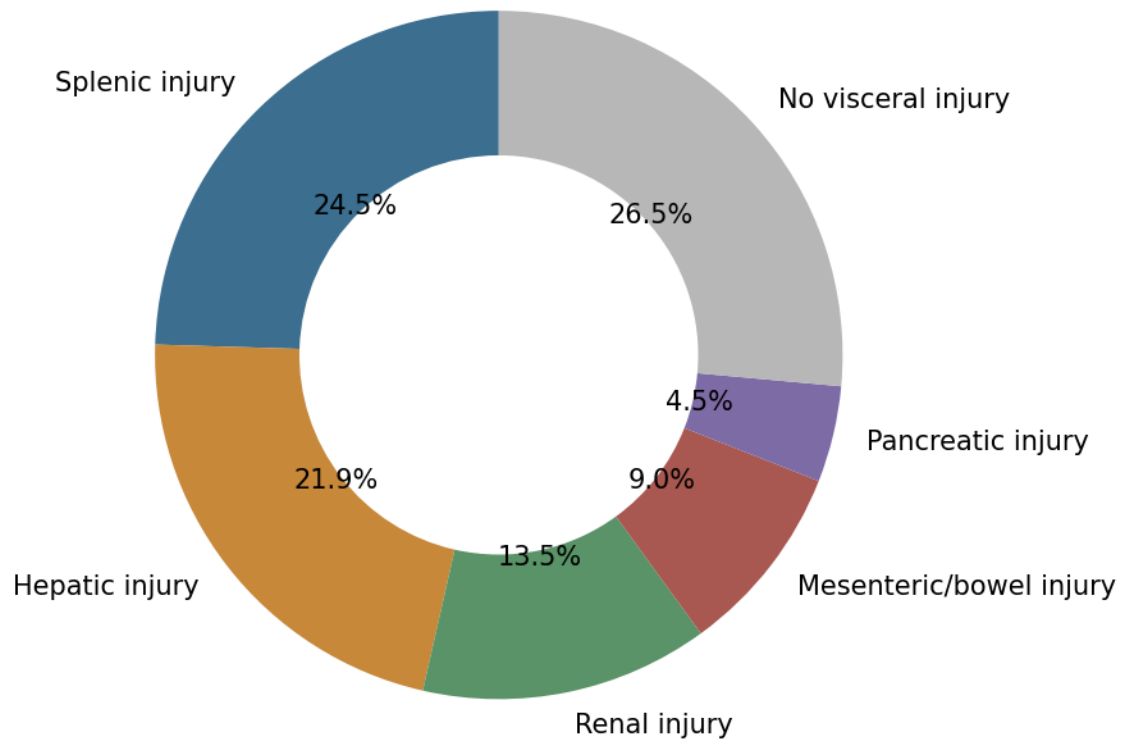


FIGURE 2:

TABLE 3: Diagnostic Accuracy of CT versus FAST (Figure 3)

Diagnostic Parameter	CT	FAST (USG)	Reference Standard
Sensitivity	96.5%	68.2%	—
Specificity	94.1%	89.3%	—
Positive Predictive Value	95.7%	82.4%	—
Negative Predictive Value	95.2%	78.6%	—
Diagnostic Accuracy	95.5%	79.4%	Surgery / clinical follow-up

TABLE 4: AAST Injury Grade Distribution (Figure 4)

AAST Injury Grade	Splenic Injury (n)	Hepatic Injury (n)	Total (n)
Grade I	10	9	19
Grade II	12	11	23
Grade III	9	8	17
Grade IV	5	4	9
Grade V	2	2	4

Figure 3: Diagnostic Performance of CT vs FAST in Blunt Abdominal Trauma

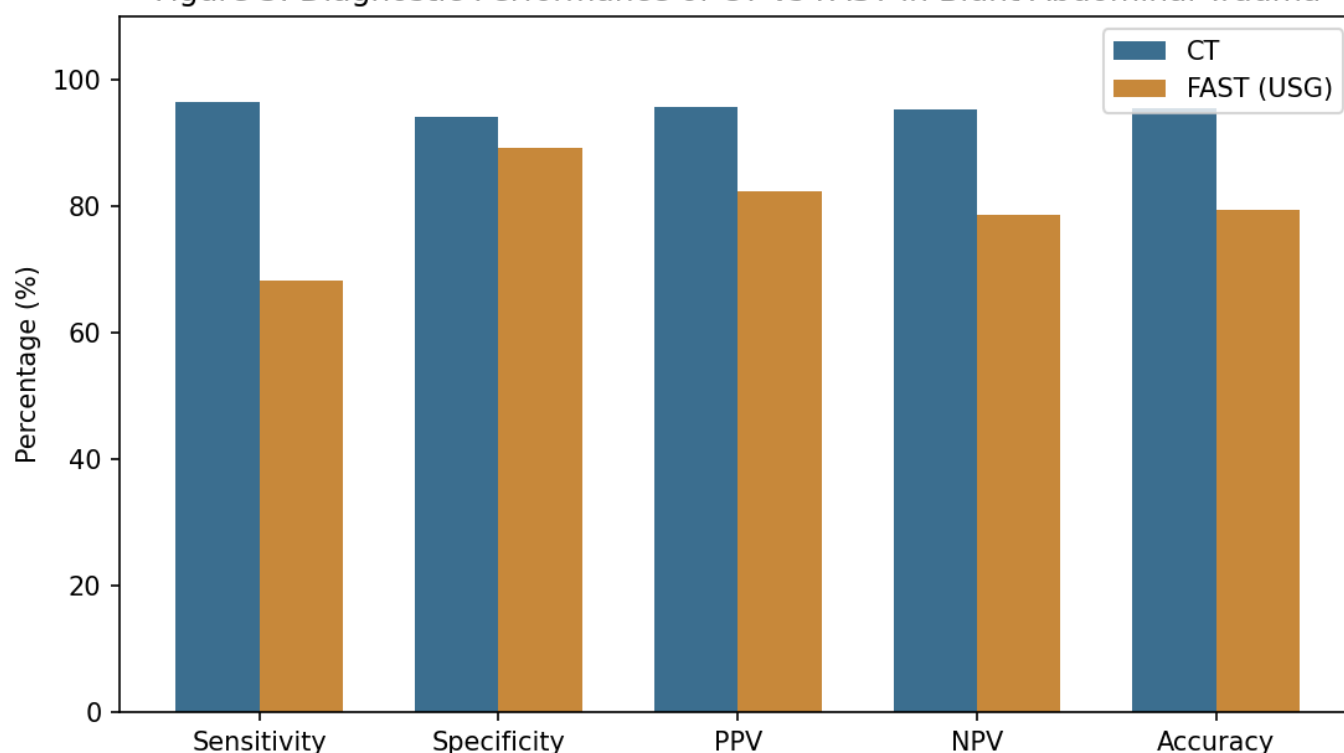


FIGURE 3:

grade solid organ injury, as accurate CT-based grading and identification of active contrast extravasation directly inform the choice between observation, embolization, and surgery.^{10,13} The findings of this study, showing a predominance of lower-grade injury amenable to conservative management, are consistent with the broader trend toward non-operative management of blunt solid organ injury in haemodynamically stable patients.

Radiation exposure remains an important consideration in the use of CT for trauma imaging, particularly in younger patients and in the context of potential repeat imaging during follow-up.⁴ This underscores the importance of judicious, protocol-driven use of CT guided by validated selection criteria, such as those proposed in diagnostic algorithms integrating clinical and FAST findings, to avoid unnecessary radiation exposure in patients at low likelihood of significant injury.¹⁸

6 | SUMMARY

This cross-sectional study of 155 patients with blunt abdominal trauma found that MDCT demonstrated substantially higher sensitivity (96.5%) and specificity (94.1%) than FAST (68.2% and 89.3% respectively) for the detection of intra-abdominal organ injury. The spleen and liver were the most commonly injured organs, and the majority of injuries were of lower AAST grade.

7 | LIMITATIONS

This study has several limitations that merit consideration. First, its single-centre design and reliance on a single reporting radiologist for CT interpretation may limit generalisability. Second, the exclusion of haemodynamically unstable patients proceeding directly to surgery without imaging may have introduced selection bias toward less severe injury patterns. Third, clinical follow-up rather than surgical confirmation was used as the reference standard

Figure 4: AAST Organ Injury Grade Distribution

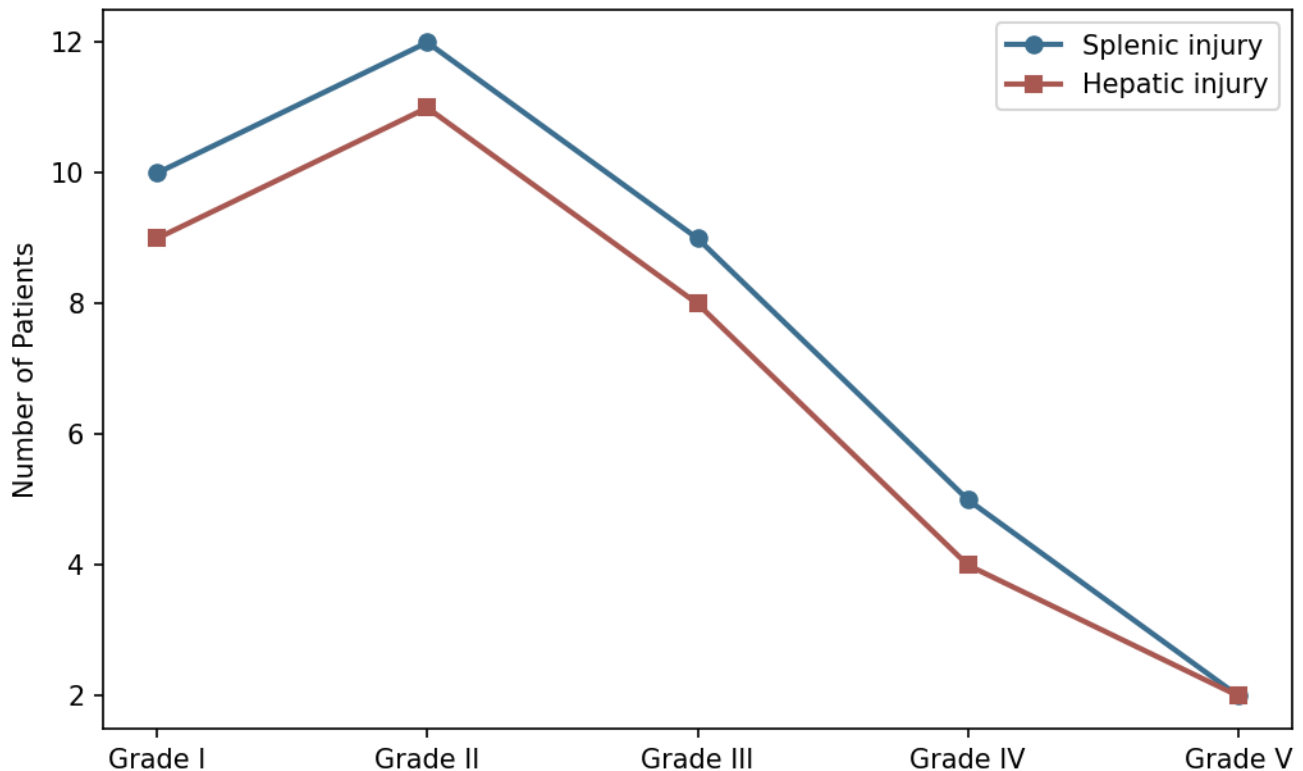


FIGURE 4:

in a proportion of conservatively managed patients, which may be subject to some degree of misclassification. Finally, this study did not formally assess inter-observer variability in CT interpretation or AAST grading.

8 | RECOMMENDATIONS

Based on the findings of this study, FAST should continue to be used as a rapid initial triage tool in the assessment of blunt abdominal trauma, particularly in haemodynamically unstable patients, while contrast-enhanced MDCT should remain the definitive investigation of choice in haemodynamically stable patients with clinical suspicion of intra-abdominal injury. Institutional protocols should incorporate validated diagnostic algorithms to guide selective CT use, balancing diagnostic yield against radiation exposure, particularly in younger patients. Larger, multi-centric studies with standardised reporting protocols would help further refine selection

criteria for imaging in this patient population.

9 | CONCLUSION

MDCT offers substantially higher diagnostic accuracy than FAST for the detection of solid organ injury in blunt abdominal trauma and should remain the primary imaging modality in haemodynamically stable patients with clinical suspicion of intra-abdominal injury, with FAST retaining a complementary role in rapid initial triage.

(1–20)

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Figure 5: Diagnostic Algorithm for Blunt Abdominal Trauma

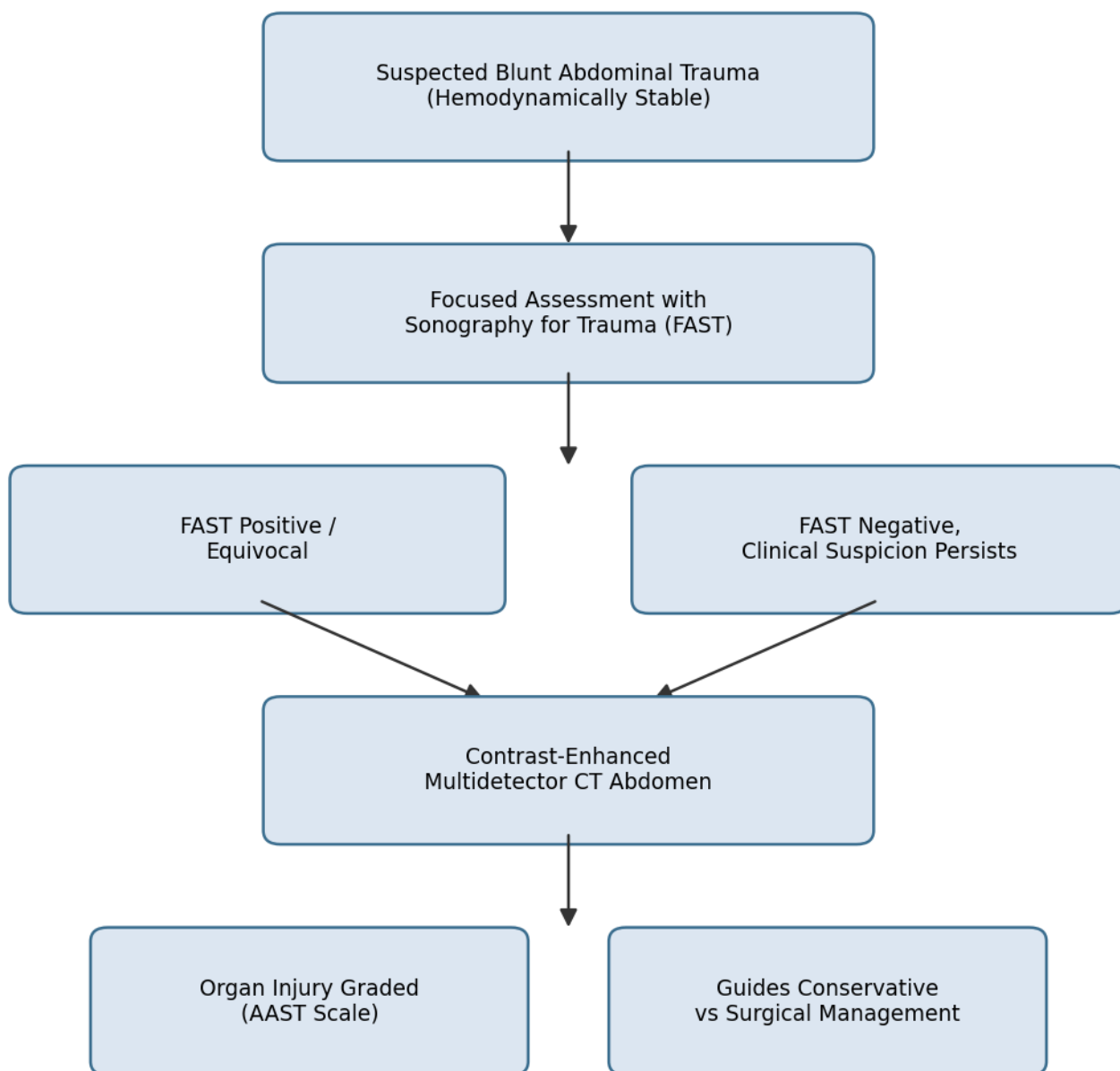


FIGURE 5:

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