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Systematic Review

FAST versus CT for detecting intra-abdominal injury in hemodynamically stable patients after motor vehicle collisions: a systematic review

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Abstract

Background: In hemodynamically stable patients after motor vehicle collisions (MVCs), rapid detection of intra-abdominal injury (IAI) is important to avoid missed injuries. FAST (Focused Assessment with Sonography for Trauma) is a widely used method for bedside screening, and computed tomography (CT) is the principal for evaluation. We aimed to systematically review the data comparing FAST with CT for detection of IAI in hemodynamically stable patients after MVC related blunt abdominal trauma. **Methods**: our study is A PRISMA based systematic review and our literature search was applied in PubMed, Scopus, and Web of Science. We screened free original studies about FAST in blunt abdominal trauma, with CT and clinical reference standards. A set of 10 original studies were included, cohorts focused on hemodynamically stable blunt trauma and motor vehicle accident populations. Data extraction was done and we extract the study design, population characteristics, hemodynamic status, comparator standard, and diagnostic outcomes. **Results**: The identified studies were heterogeneous in design, trauma mechanism, age group, and outcome definitions. FAST show a value as a rapid bedside triage tool, but limitations were noted in excluding all IAIs, mainly low volume bleeding and gastrointestinal injuries. CT is the most comprehensive modality for injury detection and characterization in stable patients. **Conclusion**: FAST is complementary early assessment tool rather than a standard substitute for CT in hemodynamically stable MVC patients with suspected IAI.

Keywords: Intra-abdominal injury; FAST; CT; Motor vehicle collisions

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Introduction

Blunt abdominal trauma is a major diagnostic challenge in emergency and trauma care because clinically important IAI were present despite subtle examination findings, especially early after injury and in patients with distracting injuries. In trauma workflows, FAST and CT are commonly used as additional imaging tools rather than substitutes, but their roles differ by hemodynamic status and injury pattern (Desai et al. 2021; ACR Appropriateness Criteria 2023/2024). FAST is rapid, repeatable, and free of ionizing radiation, whereas CT provides broader anatomic characterization and grading of injuries that impact operative versus non operative management decisions.

FAST is highly specific for free intraperitoneal fluid but has variable sensitivity for all IAIs, mainly when bleeding volume is low or injuries are hollow viscus in nature (Desai et al. 2021; Stengel et al. 2018). A study cited in a recent educational article reported pooled FAST sensitivity of 78.9% and specificity of 99.2% in adult trauma, while showing heterogeneity related to reference standards (CT, laparotomy, or patient outcomes) and injury spectrum (Desai et al. 2021).

In hemodynamically stable patients, immediate life-saving triage is less urgent than in unstable trauma, yet the diagnostic threshold is low because missed injuries lead to delayed morbidity. A negative FAST alone may miss IAIs, this support the confirmatory CT when clinical suspicion persists (Natarajan et al. 2010). Decision-support approaches have been proposed to reduce unnecessary CT utilization by integrating FAST with physical examination, radiography, and laboratory markers, this reflect the need to balance diagnostic safety, radiation exposure, contrast risks, and resource use (Deunk et al. 2010).

The EAST practice management guidance notes that a negative FAST prompt follow-up CT in patients at high risk for intra abdominal injury, while recent imaging criteria continue to rate CT abdomen and pelvis as a key modality in stable major blunt trauma scenarios (EAST; ACR). This systematic review focuses on FAST versus CT for detecting IAI in hemodynamically stable MVC patients, a subgroup in which diagnostic efficiency and avoidance of missed injury are important.

Methods

We conduct this systematic review according to the PRISMA 2020 statement. The review question was: Among hemodynamically stable patients after MVCs, what is the diagnostic performance and clinical utility of FAST compared with CT for detecting IAI? Because the literature in this area is reported under broader blunt abdominal trauma (BAT) populations, studies of BAT were considered during screening, with focus to MVC specific cohorts where available.

Eligibility criteria

We included original human studies evaluating FAST in BAT and abdominal trauma populations and reporting diagnostic findings in CT and other reference standards operative findings, and clinical follow-up. We include free full-text articles indexed in PubMed and screened for relevance to WOS and Scopus indexing during manuscript preparation. We exclude reviews, editorials, narrative summaries, and non-original reports.

Information sources and search strategy

We searched electronic databases, PubMed, Scopus, and Web of Science, search terms combined controlled vocabulary and keywords related to FAST, focused assessment with sonography for trauma, computed tomography,

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blunt abdominal trauma, motor vehicle collision, and intra abdominal injury. A free full-text filter was applied during feasibility screening. Reference lists of eligible studies were hand-searched. 10 free full text original studies were included for the qualitative analysis.

Study selection and data extraction

We do a two stage screening title and abstract then full text. Extracted variables were study design, setting, population characteristics, adult, BAT/MVC, hemodynamic status, FAST operator, reference standard, CT, surgery, follow-up, and diagnostic outcomes, sensitivity, specificity, predictive values, likelihood ratios, or management outcomes. Due to heterogeneity in trauma populations, outcome definitions, and reference standards, narrative synthesis was planned as the primary approach.

Results

We include 10 original free full text studies about FAST in blunt abdominal trauma pathways. The included studies were heterogeneous in design, prospective and retrospective cohorts; diagnostic accuracy studies, population, mechanism definition, MVC-specific vs mixed BAT, and outcomes, diagnostic test characteristics vs prognostic outcomes. Waheed et al. (2018) evaluated FAST accuracy in BAT caused by motor vehicle accidents, and Dammers et al. (2017) addressed FAST use in hemodynamically stable BAT patients.

FAST generally reported as a rapid bedside tool with clinical value for early triage and risk stratification, but with recognized limitations for excluding all intra abdominal injuries mainly when injuries do not produce free intraperitoneal fluid or when hollow viscus injury is present. This limitation is emphasized in the study by Mohammadi and Ghasemi-Rad (2012), which highlighted the role of repeated ultrasonography when initial FAST is negative but clinical suspicion persists.

Studies differed in the comparator standard, some used CT as the primary criterion standard for solid organ injury or IAI assessment, and others used composite standards, CT, surgery, and clinical observation, which affect pooled estimates if meta-analysis is attempted. The Dammers study supports that in stable BAT patients, FAST carry prognostic and triage information beyond pure diagnostic classification, which suggest that FAST and CT function as supportive to each other rather than mutually exclusive modalities.

Several studies included mixed blunt trauma mechanisms and some were pediatric only, the final review prespecify whether these cohorts are retained, excluded, or analyzed separately. The preliminary set is best interpreted as a screening-derived candidate pool for the final qualitative synthesis. If strict MVC only and hemodynamically stable adult-only criteria are enforced, the number of eligible studies decrease substantially. This anticipated narrowing should be documented in the final PRISMA flow with explicit exclusion reasons.

Discussion

Our review addresses an important question, whether FAST is a reliable substitute for CT in hemodynamically stable patients after blunt abdominal trauma. The broader trauma literature suggests that this is not a simple comparison. FAST is useful as an early screening and triage tool, whereas CT is the more comprehensive modality for defining injury extent, identifying occult injuries, and informing definitive management in stable patients (Stengel et al. 2015; Stengel et al. 2018).

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Fig 1: PRISMA flow chart

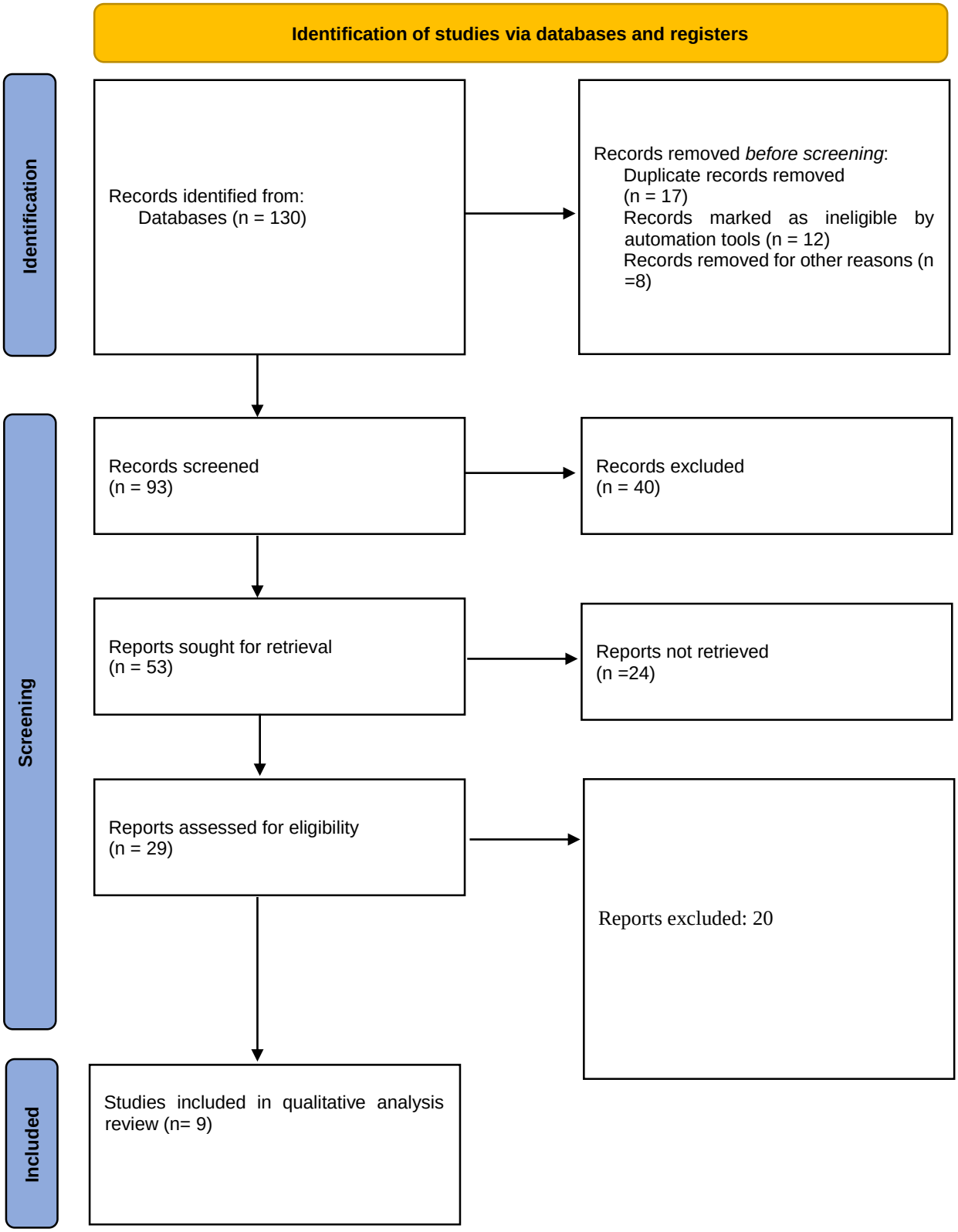

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Table 1: Risk of bias

Study	Tool	Patient selection	FAST	Reference standard	Flow and timing	Overall RoB	Reason
Kirkpatrick et al. 2005	QUADAS-2	H	L	L	H	H	Verification bias acknowledged; only half underwent CT and "true negatives" not all be verified.
Tsui et al. 2008	QUADAS-2	L	L	H	H	H	Differential verification, positives compared with CT/laparotomy; negatives often observed without CT unless deterioration pain; unstable positives went directly to OR.
Kendall et al. 2009	QUADAS-2	H	H	L	L	H	Convenience sample limited to patients who received CT. CT read by attending radiologists blinded to secondary ultrasound.
Kendall et al. 2011	ROBINS-I	Moderate	—	—	Moderate	Moderate	Retrospective cohort of BAT patients in an ED observation pathway; CT performed at team discretion.
Mohammadi & Ghasemi-Rad 2012	QUADAS-2 (adapted)	H	H	H	H	H	Case-identified GI-injury cohort with intraoperative comparison; CT used only in a subset; not representative of all BAT patients undergoing FAST.
Ghafouri et al. 2016	QUADAS-2	L	L	H	H	H	FAST operators blinded, but reference standard is mixed, with CT not performed in all.
Dammers et al. 2017	QUADAS-2	H		L	H	H	Retrospective cohort; only a small proportion of negative FASTs verified by CT.
Waheed et al. 2018	QUADAS-2	H	L	L	L	H	Included only adults with MVC blunt abdominal injury who had FAST and CT within defined time windows; excluded unstable patients, risk

Study	Tool	Patient selection	FAST	Reference standard	Flow and timing	Overall RoB	Reason
							of selection bias. CT was the gold standard and radiologists were blinded to FAST.
Ben-Ishay et al. 2015	QUADAS-2	L	L	H	H	H	Consecutive trauma registry cohort, but CT performed in only 40%

Table 2: Characteristics of the included studies

Study	Study type	Population focus	Mechanism	Hemodynamic focus	Relevance
Kirkpatrick et al., 2005	Prospective original study	BAT	Mixed blunt trauma	Not exclusively stable	FAST performance; CT/operative comparators likely used
Tsui et al., 2008	Original BAT study	regional ED BAT	Mixed BAT	Mixed	Moderate
Kendall et al., 2009	Original prospective cohort	BAT	Mixed BAT	Mixed	CT criterion standard context for organ injury
Kendall et al., 2011	Original cohort	BAT observation pathway	Mixed BAT	Hemodynamically normal/low-risk pathway	management/observation context
Mohammadi & Ghasemi-Rad, 2012	Original study	BAT	Mixed BAT	Mixed	FAST limitations; repeated US vs CT pathway relevance
Ben-Ishay et al., 2015	Original study	Pediatric BAT	Mixed BAT	Mixed	
Ghafouri et al., 2016	Diagnostic accuracy original study	BAT	Mixed BAT	Mixed	High for FAST accuracy, not MVC-only
Dammers et al., 2017	Retrospective cohort	BAT	Mixed blunt abdominal injury	Hemodynamically stable	High
Waheed et al., 2018	Diagnostic accuracy original study	BAT due to MVCs	Motor vehicle accidents		high

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Table 3: result extraction framework

Study	FAST comparator and reference standard	Primary outcome type	Key extractable metrics
Kirkpatrick 2005	CT, surgery/clinical outcomes	Diagnostic accuracy	TP, FP, FN, TN; sensitivity/specificity
Tsui 2008	CT/operative/clinical follow-up	FAST performance in BAT	Sensitivity, specificity, PPV, NPV
Kendall 2009	CT criterion standard	Solid organ injury detection	Test characteristics by injury type
Kendall 2011	Observation + imaging outcomes	Clinical pathway/risk outcome	Rates of delayed IAI diagnosis, observation outcomes
Mohammadi 2012	CT + repeated US pathway	FAST limitation / repeated US utility	Initial FAST negatives, delayed positivity
Ben-Ishay 2015	CT/clinical outcomes	Pediatric BAT FAST utility	Pediatric subgroup metrics
Ghafouri 2016	CT/operative/clinical outcomes	Diagnostic accuracy	Sensitivity/specificity/PPV/NPV
Dammers 2017	Clinical hemorrhage outcomes + imaging pathway	Prognostic/triage value in stable BAT	Likelihood ratios, intervention/mortality association
Waheed 2018	CT/surgical findings	Diagnostic accuracy in MVC BAT	Sensitivity/specificity/PPV/NPV/accuracy

Diagnostic performance depends on the target condition being tested, FAST is optimized for detecting free fluid and hemoperitoneum, not every form of IAI. Studies that define the outcome as any intra-abdominal injury including bowel, mesenteric, or retroperitoneal injuries report lower sensitivity than studies focused on clinically significant hemoperitoneum. This explain why FAST maintain high specificity in studies while sensitivity differ (Desai et al. 2021). The problem is magnified in stable patients, in whom smaller volume bleeding and delayed radiographic evolution are more common; thus, a negative initial FAST cannot exclude injury in all cases (Natarajan et al. 2010; Engles et al. 2019).

Our review question is complicated by the common inclusion of mixed blunt trauma mechanisms in published studies, MVCs are a major subset of blunt trauma, but injury biomechanics, restraint use, associated thoracic and pelvic trauma, and pretest probability differ from falls or assaults. This introduces indirectness when extrapolating pooled BAT data to MVC only populations. The same challenge applies to age group mixing adult and pediatric cohorts, differences in operator experience, and variability in the reference standard, all of which contribute to heterogeneity and limit direct pooling (Stengel et al. 2015; Stengel et al. 2018).

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Our findings support an imaging strategy in stable trauma rather than replacement of CT by FAST. This interpretation is aligned with guideline oriented recommendations, the EAST guidance advises follow-up CT after negative FAST in high-risk patients, and ACR appropriateness criteria prioritize CT in multiple stable blunt-trauma imaging scenarios (EAST; ACR). Deunk et al. (2010) also show that selective CT pathways built using FAST with clinical and laboratory variables, indicate that the most efficient approach is FAST-integrated CT selection rather than universal CT or FAST-only strategies.

An additional consideration is injury subtype, WSES guidance on bowel injury highlights that modern trauma care relies on E-FAST and CT, yet even CT has limitations for bowel injury diagnosis, no single test is perfect in all stable blunt trauma presentations (Smyth et al. 2022). Serial examinations, repeat imaging, and clinical observation were important safeguards against missed injury. FAST is a rapid, high-specificity bedside test that accelerate triage and identify patients requiring urgent escalation, but not as a stand-alone test for IAI in hemodynamically stable MVC patients. CT is central when suspicion persists, in cases where FAST is negative, or detailed injury characterization is needed for management planning (Natarajan et al. 2010; EAST; ACR).

Conclusion

In hemodynamically stable patients after motor vehicle collisions, FAST is useful for rapid bedside screening and early triage, but it should not be considered a definitive test for excluding intra-abdominal injury. FAST performance is impacted by injury type, bleeding volume, operator factors, and study design heterogeneity, while CT provides better anatomic detail and more reliable exclusion of injuries relevant to management decisions. The most appropriate approach is a strategy in which FAST supports initial assessment and CT is used when FAST is negative and suspicion persists, or when definitive injury characterization is required.

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