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Diagnostic Value Of Fast In Blunt Solid-Organ Injuries In Children

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Abstract: Objective. To assess the diagnostic value and clinical effectiveness of the FAST protocol in children with blunt solid-organ injuries (BSOI) compared with conventional ultrasonography.

Materials and Methods. This single-center cohort study analyzed 117 children with hepatic and/or splenic injuries treated at the Republican Research Center of Emergency Medicine (RRCEM), Tashkent, during 2006–2024. Two cohorts were compared: a comparison group (2006–2017; n=61) evaluated with non-contrast ultrasonography, and a FAST group (2017–2024; n=56) in which FAST was integrated into the diagnostic pathway. Assessed variables included AAST injury grade, volume of free intraperitoneal fluid, hemodynamic status, diagnostic sensitivity and specificity, treatment strategy, and clinical outcomes. Statistical analysis used the χ^2 test and Student's t-test; $p<0.05$ was considered significant.

Results. FAST demonstrated high diagnostic performance – sensitivity 83.9% and specificity 96.4% – significantly exceeding that of conventional ultrasonography (68.8% and 75.0%, respectively; $p<0.01$). In the FAST cohort, the rates of laparotomy (32.1% vs 60.7%; $p=0.004$), conversion from laparoscopy to laparotomy (32.0% vs 66.7%; $p=0.033$), and overall open procedures (46.4% vs 86.9%; $p<0.001$) were all significantly lower. Conservative management was feasible in 23.2% of patients versus 0% in the comparison cohort; all conservatively treated children were discharged in satisfactory condition. Mean length of stay was 4.5±2.3 days in conservatively managed patients.

Conclusion. Incorporation of FAST into the evaluation of pediatric BSOI substantially improved diagnostic accuracy, optimized surgical decision-making, reduced unnecessary laparotomies, and expanded organ-preserving conservative care. FAST should be regarded as an essential component of the diagnostic algorithm for pediatric hepatic and splenic trauma.

Keywords: Children; blunt abdominal trauma; FAST protocol; solid organs; surgical strategy.

Introduction: Blunt solid-organ injuries (BSOI) in children rank among the most frequent – and potentially life-threatening – entities in emergency abdominal surgery. International and national studies indicate that hepatic and splenic injuries account for up to 70% of all intra-abdominal organ injuries in children and are associated with substantial risks of massive hemorrhage, multiorgan failure, and mortality [1, 2]. Clinical diagnosis can be challenging in pediatrics due to muted symptomatology, nonspecific laboratory findings, and variable hemodynamic responses.

Conventional imaging – namely, non-contrast ultrasonography (US) and multidetector computed tomography (MDCT) – has clear advantages, yet each

modality presents important limitations. Traditional US demonstrates only moderate sensitivity (approximately 65–70%) and a high false-negative rate when hemoperitoneum volumes are small. MDCT is widely regarded as the diagnostic gold standard, but its use in children is constrained by the need for patient transfer, ionizing radiation exposure, and the requirement for hemodynamic stability [3, 4].

Against this backdrop, the FAST protocol (Focused Assessment with Sonography for Trauma) is of particular interest – a standardized, rapid ultrasound assessment aimed at detecting free fluid in the abdominal and pleural cavities. While adult cohorts report high diagnostic metrics for FAST – sensitivity 85–96% and specificity >98% – pediatric performance is less uniform, with sensitivity declining in the setting of low-volume hemoperitoneum. These observations underscore the need for further pediatric-specific evaluation of FAST and careful definition of its role in clinical pathways [5, 6].

Improving early diagnostic strategies and optimizing management algorithms for pediatric BSOI remain core objectives of contemporary pediatric surgery. Implementing FAST can expedite diagnostic confirmation and, importantly, shift treatment decisions toward organ-preserving and conservative approaches – reducing unnecessary laparotomies and improving patient outcomes.

METHODS

We conducted a single-center cohort study of 117 children (0–18 years) with blunt solid-organ injuries (liver and/or spleen) treated at the Republican Research Center of Emergency Medicine (RRCEM), Tashkent, Uzbekistan, during 2006–2024. Patients were allocated to two cohorts: a comparison group (n=61) evaluated with conventional (non-contrast) ultrasonography (US), and a FAST group (n=56) in which the FAST protocol was implemented.

Eligibility criteria:

Inclusion – children with isolated or combined hepatic and/or splenic injuries confirmed instrumentally or intraoperatively.

Exclusion – penetrating trauma, hollow-viscus injury, isolated pancreatic or renal trauma, and late presentation (>24 h after injury).

The mean age was 12.4 ± 3.6 years (range 0–18); 71.2% were boys and 28.8% girls. Mechanisms of injury were road-traffic incidents (45.9%), falls from height (26.8%), blows from blunt objects (20.3%), and crush/compression injuries (7.0%).

In the FAST cohort, three abdominal windows were assessed: right upper quadrant (RUQ), left upper quadrant (LUQ), and suprapubic; with eFAST, the pleural spaces were additionally examined. Ultrasound systems included Siemens Sonoline Vera Pro and Aloka SSD-680/SSD-630 with 2–12 MHz transducers. Findings were verified either at operation (n=36) or through clinical course during nonoperative management (n=20). For comparison, data from the conventional US cohort (n=61), frequency-matched for age, sex, and clinical profile, were used.

Primary diagnostic endpoints were sensitivity, specificity, and overall accuracy of FAST relative to a composite reference standard (operative findings and/or adjudicated clinical outcome). Therapeutic endpoints included rates of laparotomy, laparoscopy, conversion to laparotomy, and the proportion managed nonoperatively.

Statistical analysis. Between-group differences were assessed using Pearson's χ^2 test and Student's t test. Statistical significance was set at $p<0.05$. Data processing was performed with MS Excel and MedCalc (Belgium).

RESULTS

Across both cohorts, isolated injuries of the liver and spleen predominated, though their distribution differed between groups. In the comparison cohort, isolated splenic injury was more frequent (43.6%), whereas its proportion declined to 35.5% in the FAST cohort. Conversely, the frequency of isolated hepatic injury increased from 32.1% to 38.0%. Combined liver–spleen injuries accounted for 24.2% and 26.5%, respectively.

Table 1 summarizes the sonographic findings and key diagnostic metrics obtained with the FAST protocol.

Table 1. FAST-derived data and ultrasonographic findings in pediatric blunt solid-organ injury, n=56

Parameter		Isolated liver injury (n=24)	Isolated splenic injury (n=22)	Combined liver + spleen (n=10)
RUQ (Morison's pouch)		17	0	9
LUQ (splenorenal recess)		2	20	10
Suprapubic/pelvic window		7	8	9
Organ margins	Smooth	20	17	6

	Irregular	**4**	**5**	**4**
Parenchymal echogenicity	**Hyper**	**2**	**1**	**—**
	Iso	**20**	**18**	**—**
	Hypo	**2**	**3**	**—**
Parenchymal echotexture	**Homogeneous**	**20**	**17**	**—**
	Heterogeneous	**4**	**5**	**—**

RESULTS

Free fluid was identified across all "zones of interest" — RUQ, LUQ, and the suprapubic window. In isolated liver injuries, fluid was most frequently detected in the RUQ (70.8%); in isolated splenic injuries, LUQ positivity predominated (90.9%). For isolated hepatic trauma, fluid also appeared in the LUQ in 8.3% and in the suprapubic window in 29.2% of cases. In isolated splenic trauma, suprapubic involvement was noted in 36.4%. In combined liver–spleen injuries, only one case lacked RUQ fluid, whereas suprapubic fluid was present in 90% of patients.

When the initial ultrasound examination did not fully characterize the injury pattern, repeat scanning was performed within the first 3 hours of the therapeutic window — at 3-hour intervals in hemodynamically stable children and hourly in unstable patients.

FAST accuracy was verified intraoperatively in 36 patients (64.3%) and by clinical follow-up during nonoperative management in 20 (35.7%). Free intraperitoneal fluid was confirmed in all operated children. In 10 cases, the sonographic estimate of hemoperitoneum volume differed from operative findings: underestimation by 300–800 mL occurred in 6 children, indicating ongoing hemorrhage and contributing to delayed operative control, whereas overestimation by ~200 mL occurred in 4 children. For volume estimation, an institutional sonographic conversion was applied: each millimeter of free-fluid depth measured in the RUQ or LUQ corresponded to approximately 50 mL of intraperitoneal fluid.

Among the 36 operated patients, free fluid was confirmed in 36/36 (100%); in 32/36 (88.9%) the volume exceeded 500 mL, and in 2/36 (11.1%) it did not exceed 200 mL. The largest volumes (1,500–2,000 mL) were recorded in combined injuries.

Diagnostic performance metrics for FAST were calculated as follows: sensitivity = TP/(TP+FN) and specificity = TN/(TN+FP), where TP, TN, FP, and FN denote true-positive, true-negative, false-positive, and false-negative results, respectively. Pooled sensitivity and specificity estimates for FAST are summarized in Table 2.

Table 2. Diagnostic performance of FAST in children with blunt solid-organ injuries

Metric	Value
Sensitivity	
True positive diagnoses (TP)	47
False negative diagnoses (FN)	9
Total patients with SOI	56
Sensitivity	47/56 = **83.9%**
Specificity	
False positive diagnoses (FP)	11
True negative diagnoses (TN)	54
Total patients without SOI*	65
Specificity	54/65 = **96.4%**

***Note – *refers to children admitted with abdominal pain but without a history of solid-organ injury.**

As shown in Table 2, FAST ultrasonography demonstrated high sensitivity and specificity (83.9% and 96.4%, respectively) in detecting blunt solid-organ injuries (BSOI). While there was no need to calculate specificity separately for each injured organ or their combinations, we believe that determining sensitivity for isolated hepatic trauma, splenic trauma, and combined injuries provides important differentiation.

Analysis of FAST sensitivity in children admitted with traumatic liver injury, splenic injury, or combined injuries is summarized in Table 3.

Table 3. Sensitivity of FAST ultrasonography in pediatric blunt solid-organ injuries

Sensitivity analysis	Hepatic injury	Splenic injury	Combined injury
True positive diagnoses (TP)	20	19	9

False negative diagnoses (FN)	4	3	1
Total patients with SOI	24	22	10
Sensitivity	20/24	19/22	9/10
%	**83.3%**	**86.4%**	**90.0%**

The findings confirm the high diagnostic performance of FAST in blunt solid-organ trauma. Sensitivity for isolated hepatic injuries was 83.3%, for splenic trauma 86.4%, and for combined injuries 90.0%, underscoring its particular strength in detecting multiple organ involvement.

For objective comparison of FAST with conventional ultrasonography, we used a retrospective cohort of 61 patients with blunt solid-organ injuries. These patients were comparable to the FAST group in terms of age, sex, mechanism of injury, time to admission, and clinical course, thereby minimizing systematic bias and ensuring validity of the comparison (Table 4).

Table 4. Diagnostic value of conventional ultrasonography in children with blunt solid-organ injuries

Sensitivity analysis	**Value**
True positive diagnoses (TP)	42
False negative diagnoses (FN)	19
Total patients with SOI	61
Sensitivity	42/61 = **68.8%**
Specificity analysis	**Value**
False positive diagnoses (FP)	18
True negative diagnoses (TN)	54
Total patients without SOI*	72
Specificity	54/72 = **75.0%**

***Note – *refers to children admitted with abdominal pain but without a history of solid-organ injury.**

Comparative analysis demonstrated that FAST significantly outperformed conventional ultrasonography across key diagnostic parameters: sensitivity was higher by 15.1% ($p<0.01$), while specificity exceeded that of standard US by 21.4% ($p<0.001$). Thus, integration of FAST into clinical practice has markedly improved the reliability of early diagnosis of blunt solid-organ injuries in children, particularly in the setting of emergency surgery.

A similar pattern was observed when analyzing sensitivity according to the injured organ, as presented in Table 5.

Table 5. Sensitivity of conventional ultrasonography in pediatric blunt solid-organ injuries

Sensitivity analysis	**Hepatic injury**	**Splenic injury**	**Combined injury**
True positive diagnoses (TP)	17	16	8
False negative diagnoses (FN)	9	8	3
Total patients with SOI	26	24	11
Sensitivity	17/26	16/24	8/11
%	**65.3%**	**66.7%**	**72.7%**

Thus, the use of FAST significantly improves the initial diagnostic accuracy in pediatric blunt solid-organ injuries (BSOI).

Comparative analysis and surgical strategy outcomes depending on the applied ultrasound method

Comparative evaluation of treatment approaches revealed marked differences between the cohort assessed with standard ultrasonographic screening (n=61) and the cohort examined using the FAST protocol (n=56), as summarized in Table 6.

Table 6. Comparative analysis of treatment strategies depending on the diagnostic method

Treatment strategy	**Comparison group (*n*=61)**	**FAST group (*n*=56)**	**χ^2**	***p***
Conservative management	0 (0.0%)	13 (23.2%)	16.4	<0.001
Laparotomy	37 (60.7%)	18 (32.1%)	8.41	0.004
Laparoscopy	24 (39.3%)	25 (44.6%)	0.15	0.695

Conversion (from laparoscopies)	16 (66.7%)	8 (32.0%)	4.58	0.033
Total open procedures (laparotomy + conversion)	53 (86.9%)	26 (46.4%)	19.9	<0.001

In the comparison group, all patients underwent emergency surgery. Laparotomy was performed in 37 children (60.7%) due to massive hemoperitoneum and hemodynamic instability. Laparoscopic procedures were carried out in 24 patients (39.3%); however, only 10 were completed minimally invasively (laparoscopic suturing of hepatic lacerations or argon plasma coagulation of splenic injuries). In the majority (66.7%), conversion to laparotomy was required because of unidentified bleeding sources or profuse hemorrhage exceeding 2,000 mL. Ultimately, definitive hemostasis was achieved by open surgery in 53 children (86.9%), including hepatic repair (n=16), combined liver–spleen trauma (n=8), and splenectomy (n=29).

In the FAST group, the use of this protocol allowed for a more individualized strategy. An active-observational approach with conservative management was implemented in 13 patients (23.2%); all had stable hemodynamics and moderate volumes of free fluid (≤500 mL). These children were discharged without surgery, with a mean hospital stay of 4.5±2.3 days. Laparotomy was required in 18 patients (32.1%), mainly in the setting of massive hemoperitoneum. Laparoscopic procedures accounted for 44.6% (25 children), most commonly consisting of hepatic suturing or argon plasma coagulation of splenic tears using hemostatic agents. The rate of conversions was significantly reduced to 32.0% (8 cases), which was less than half of that observed in the comparison group (p=0.033). Overall, open hemostasis was necessary in 26 patients (46.4%), including hepatic repair (n=8), combined liver–spleen trauma (n=14), and splenectomy (n=4).

Thus, implementation of the FAST protocol allowed:

- Expansion of conservative management opportunities (23.2% vs 0% in the comparison group).
- Reduction of conversion rates by more than twofold (from 66.7% to 32.0%; χ^2=4.58; p=0.033).
- Nearly halving the proportion of open procedures (from 86.9% to 46.4%; χ^2=19.9; p<0.001).

These findings confirm that FAST enables more accurate differentiation of injury severity and reduces surgical invasiveness without compromising clinical outcomes.

DISCUSSION

The findings of this study demonstrate that implementation of the FAST protocol significantly improved diagnostic accuracy and reduced the rate of unnecessary laparotomies in children with blunt solid-organ injuries (BSOI). These results are consistent with global trends, though certain aspects appear specific to the pediatric population.

According to Scaife et al., FAST sensitivity in children rarely exceeds 50%, indicating limited reliability of the method. In contrast, sensitivity in our study reached 83.9%, which can be explained by the use of serial examinations and the availability of trained specialists [7]. Ben Ishay et al. reported a sensitivity of 77% and specificity of 70%, emphasizing that a negative FAST does not exclude injury. Our findings corroborate this conclusion, as false negatives were observed primarily in cases with small-volume hemoperitoneum [8]. Schonfeld et al. also noted that a negative FAST cannot serve as the sole criterion to rule out solid-organ trauma. We reached a similar conclusion and incorporated dynamic reassessment as an obligatory component of the diagnostic pathway [9]. Streck et al. proposed the PECARN clinical rule to reduce unnecessary CT imaging in children. Likewise, in our study, the use of FAST reduced the number of CT scans performed, thereby lowering radiation exposure [10]. Pearce et al. demonstrated that repeated CT examinations increase the risk of malignancy in children, making FAST an especially valuable tool in pediatric practice [11]. Houda II and Murray et al. highlighted that the sensitivity of conventional ultrasound ranges from 56% to 97% depending on injury location. In our material, FAST clearly outperformed conventional US, particularly in cases of combined hepatic and splenic trauma [12, 13].

Suthers et al. and Levy et al. reported that when combined with clinical examination, FAST sensitivity may approach 100%. In our practice, dynamic use of FAST in conjunction with clinical evaluation substantially reduced diagnostic errors [14, 15]. According to Negus et al., children often display an enhanced vasoconstrictor response, which may limit the reliability of some instrumental methods. This highlights FAST as a more suitable modality for primary assessment [16].

Armstrong et al. and Pegoraro et al. suggested contrast-enhanced ultrasound (CEUS) as an alternative to CT in pediatric patients. However, CEUS requires specialized equipment and is not always available in emergency settings, whereas FAST can be performed

universally [17, 18].

Finally, Coccolini et al. emphasized that absolute indications for immediate laparotomy include hemodynamic instability and the presence of free intraperitoneal blood. Our findings confirm that FAST enables rapid stratification of such patients and timely referral for surgical management [19].

CONCLUSION

The use of the FAST protocol in children with blunt hepatic and splenic trauma demonstrated high diagnostic performance (sensitivity 83.9%, specificity 96.4%), which substantially reduced the rate of unnecessary laparotomies, decreased the number of laparoscopic conversions, and expanded the feasibility of conservative management. The method has proven its clinical significance and should be regarded as an essential component of the diagnostic algorithm and therapeutic decision-making process in pediatric blunt solid-organ abdominal injuries.

REFERENCES

1. Calder BW, Vogel AM, Zhang J, et al. Focused assessment with sonography for trauma in children after blunt abdominal trauma: A multi-institutional analysis. J Trauma Acute Care Surg. 2017;83(2):218–24. doi:10.1097/TA.0000000000001546
2. Coccolini F, Coimbra R, Ordonez C, et al. Liver trauma: WSES 2020 guidelines. World J Emerg Surg. 2020;15:24. doi:10.1186/s13017-020-00302-7
3. Long MK, Vohra MK, Bonnette A, et al. Focused assessment with sonography for trauma in predicting early surgical intervention in hemodynamically unstable children with blunt abdominal trauma. JACEP Open. 2022;3(1):e12650. doi:10.1002/emp2.12650
4. Sharma G, Chatterjee N, Kaushik A, Saxena S. Clinicoradiological predictors of severity of traumatic intra-abdominal injury in pediatric patients: A retrospective study. Cureus. 2021;13(9):e17936. doi:10.7759/cureus.17936
5. Bahrami-Motlagh H, Hajijoo F, Mirghorbani M, et al. Test characteristics of focused assessment with sonography for trauma (FAST), repeated FAST, and clinical exam in prediction of intra-abdominal injury in children with blunt trauma. Pediatr Surg Int. 2020;36(10):1227–34. doi:10.1007/s00383-020-04733-w
6. Ozgen SUZ, Altun D. Pediatric abdominal trauma. In: Garbuzenko DV, editor. Abdominal trauma – New solutions to old problems. IntechOpen; 2023. doi:10.5772/intechopen.108677
7. Scaife ER, Rollins MD, Barnhart DC, et al. The role of focused abdominal sonography for trauma (FAST) in pediatric trauma evaluation. J Pediatr Surg. 2013;48(6):1377–83. doi:10.1016/j.jpedsurg.2013.03.038
8. Ben Ishay O, Daoud M, Peled Z, et al. Focused abdominal sonography for trauma in the clinical evaluation of children with blunt abdominal trauma. World J Emerg Surg. 2015;10:27. doi:10.1186/s13017-015-0021-x
9. Schonfeld D, Lee LK. Blunt abdominal trauma in children. Curr Opin Pediatr. 2012;24(3):314–8. doi:10.1097/MOP.0b013e328352de97
10. Streck CJ, Vogel AM, Zhang J, et al. Identifying children at very low risk for blunt intra-abdominal injury in whom CT of the abdomen can be avoided safely. J Am Coll Surg. 2017;224(4):449–58. doi:10.1016/j.jamcollsurg.2016.12.041
11. Pearce MS, Salotti JA, Little MP, et al. Radiation exposure from CT scans in childhood and subsequent risk of leukaemia and brain tumours: A retrospective cohort study. Lancet. 2012;380(9840):499–505. doi:10.1016/S0140-6736(12)60815-0
12. Houda IIWE. Pediatric trauma. In: Tintinalli JE, Stapczynski JS, Cline DM, et al, editors. Emergency medicine: A comprehensive study guide. 7th ed. New York: McGraw-Hill Companies; 2010.
13. Murray BL, Cordle RJ. Pediatric trauma. In: Marx JA, Hockberger RS, Walls RM, editors. Rosen's Emergency Medicine: Concepts and Clinical Practice. 8th ed. Philadelphia: Elsevier Saunders; 2014.
14. Suthers SE, Albrecht R, Foley D, et al. Surgeon-directed ultrasound for trauma is a predictor of intra-abdominal injury in children. Am Surg. 2004;70(2):164–8. PMID:15011921
15. Levy JA, Noble VE. Bedside ultrasound in pediatric emergency medicine. Pediatrics. 2008;121(5):e140–6. doi:10.1542/peds.2007-1816
16. Negus S, Danin J, Fisher R, et al. Paediatric trauma imaging: Why do we need separate guidance? Clin Radiol. 2014;69(12):1209–13. doi:10.1016/j.crad.2014.07.001
17. Armstrong LB, Mooney DP, Paltiel H, et al. Contrast enhanced ultrasound for the evaluation of blunt pediatric abdominal trauma. J Pediatr Surg. 2018;53(3):548–52. doi:10.1016/j.jpedsurg.2017.03.042
18. Pegoraro F, Giusti G, Giacalone M, Parri N. Contrast-enhanced ultrasound in pediatric blunt

abdominal trauma: A systematic review. J Ultrasound. 2022;25(4):419–27. doi:10.1007/s40477-021-00623-6

19. Coccolini F, Moore EE, Kluger Y, et al. Kidney and uro-trauma: WSES-AAST guidelines. World J Emerg Surg. 2019;14:54. doi:10.1186/s13017-019-0274-x