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Retrospective Analysis of FAST Examinations in an Emergency Department in Izmir

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Abstract

Introduction: Focused Assessment with Sonography for Trauma (FAST) is a widely used ultrasonographic protocol in emergency departments for rapidly detecting intra-abdominal free fluid in trauma patients. While effective, its limited sensitivity for small fluid collections and certain solid organ injuries underscores the need for complementary imaging modalities like computed tomography (CT). This study evaluates the diagnostic role of FAST, its concordance with CT findings, and its impact on clinical outcomes.

Materials and Methods: This retrospective, single-center study analyzed trauma patients who underwent FAST at a tertiary hospital in İzmir, Turkey, over four years. Only patients with radiologist-reported FAST results were included. Demographics, trauma mechanisms, FAST findings, CT results, and clinical outcomes (surgery, admission, mortality) were collected and analyzed statistically.

Results: Among 428 patients, 8.18% (35) had free fluid detected by FAST, while 10.05% (43) had free fluid identified by CT. Patients with free fluid detected exclusively on CT showed no significant association with mortality (16.7%) or gastrointestinal system (GIS) surgery (2.7%) but had higher ward and Intensive Care Unit (ICU) admission rates (p=0.001). Patients with free fluid detected by both FAST and CT had worse outcomes, including ICU admission (18.2%) and mortality (33.3%). Significant hemogram decreases and new-onset liver function abnormalities were associated with increased GIS surgery and adverse outcomes (p<0.05).

Conclusion: FAST is an essential bedside tool for trauma assessment, but its limitations highlight the importance of integrating CT for comprehensive evaluation. Free fluid identified exclusively on CT emphasizes the need for enhanced monitoring despite no direct impact on mortality or surgery.

Key words: Fast; computed tomography; trauma management; hemoperitoneum.

Introduction

Focused Assessment with Sonography for Trauma (FAST) is a highly reliable ultrasonographic protocol widely utilized in emergency departments to rapidly and non-invasively detect the presence of intra-abdominal free fluid in trauma patients. Particularly in hemodynamically unstable trauma cases, this method accelerates the determination of the need for emergency surgery, earning broad acceptance in emergency medicine due to its ability to deliver quick results and its ease of bedside application (1). By contributing to the diagnostic process in time-critical trauma situations, FAST also supports the efficient utilization of hospital resources (2). However, it is essential to acknowledge certain limitations of the FAST protocol in terms of sensitivity and specificity. Its diagnostic performance may be limited in detecting low-volume hemorrhages or specific solid organ injuries (3.4). In such cases, advanced imaging modalities such as computed tomography (CT) can enhance diagnostic accuracy and facilitate more reliable clinical decision-making (5). Thus, evaluating the accuracy of FAST findings and their impact on clinical decision-making processes is crucial for achieving optimal outcomes in trauma management. Thus, evaluating the accuracy of FAST findings and their impact on clinical decision-making processes is crucial for achieving optimal outcomes in trauma management. By comparing FAST with advanced imaging techniques, such as CT, and correlating these findings with clinical outcomes, this study aims to provide deeper insights into the strengths and limitations of this widely used diagnostic tool. This retrospective analysis investigates the contribution of FAST to the evaluation of trauma patients, its concordance with CT findings, and its role in guiding patient management in emergency settings.

Materials and Methods

Study design and setting

This single-center, retrospective observational study was conducted in the emergency department of a hospital in İzmir, Turkey, which treats

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approximately 320.000 patients annually. The study was initiated after approval from the Izmir Katip Çelebi University Clinical Research Ethics Committee (Decision No: 0431, Date: 21.09.2023). Patients who presented to the emergency department with traumatic causes and underwent FAST were included in the study.

Study population: The study included patients who presented to the emergency department with trauma over the past four years and underwent FAST officially reported by a radiologist. Not only patients with abdominal trauma but also those with extra-abdominal trauma who underwent FAST due to high-energy mechanisms were included. Patients under 18 years of age, those with incomplete data, and those whose outcomes could not be followed were excluded from the study.

Data collection: In this retrospective study, the recorded data of patients who underwent the FAST protocol in the emergency department over the past four years were reviewed. Data collected for patients who underwent the FAST protocol included demographic information at the time of presentation (age, gender, and time of admission), presenting complaints, and trauma mechanisms. Additionally, FAST findings, officially performed and reported by radiologists, were analyzed for the presence and anatomical location of intraperitoneal free fluid, solid organ injuries, the need for abdominal computed tomography (CT), and the concordance between FAST and CT findings. Furthermore, the clinical course of patients following their presentation to the emergency department was evaluated, including surgical requirements, admission to the intensive care unit or other departments, and outcomes (discharge, admission and mortality). All data were recorded on a standardized data collection form to prepare them for statistical analysis.

Ethical approval: The study was initiated after approval from the Izmir Katip Çelebi University Clinical Research Ethics Committee (Decision No: 0431, Date: 21.09.2023).

Statistical analysis: The data were analyzed using IBM SPSS Statistics Standard Concurrent User V 26 (IBM Corp., Armonk, New York, USA). Descriptive statistics were presented as the number of units (n), percentages (%), minimum, maximum, mean ± standard deviation values. The normal distribution of numerical variables was assessed using the Shapiro-Wilk normality test. For comparisons between two groups, the independent samples t-test was used for normally distributed data, while the Mann-Whitney U test was employed for non-normally distributed data. For variables with more than two categories, one-way analysis of variance (ANOVA) was applied if the data were normally distributed, and the Kruskal-Wallis H test was used for non-normally distributed data. When the ANOVA results were significant, the Dunn-Bonferroni test was utilized for multiple comparisons. Relationships between categorical variables were assessed using the Pearson chi-square test. A p-value of <0.05 was considered statistically significant.

Table 1: Descriptive statistics of patients

	İstatistikler
Gender	
Female	119 (27.8%)
Male	309 (72.2%)
Age (years)	44.17±20.54
Systolic BP (mmHg)	124.18±18.69
Diastolic BP (mmHg)	76.49±11.61
Heart rate (beats per minute)	87.68±14.57
MAP (mmHg)	92.36±12.84
Shock Index	0.73±0.21
Trauma Mechanism	
Traffic Accident	191 (44.63%)
Fall	150 (35.05%)
Sharp Injury	18 (4.21%)
Gunshot Injury	5 (1.17%)
Assault	33 (7.71%)
Other	31 (7.24%)
Significant Hemogram Decrease	
Absent	386 (90.19%)
Present	42 (9.81%)
New-Onset Renal Function Abnormality	
Absent	415 (96.96%)
Present	13 (3.04%)
New-Onset Liver Function Abnormality	
Absent	377 (88.08%)
Present	51 (11.92%)
FAST – Free Fluid	
Absent	393 (91.82%)
Present	35 (8.18%)
CT - Free Fluid	
Absent	385 (89.95%)
Present	43 (10.05%)
Need for Gastrointestinal Surgery	
Absent	413 (96.5%)
Present	15 (3.5%)
Outcome	
Discharge	187 (43.69%)
Ward Admission	186 (43.46%)
ICU Admission	55 (12.85%)
Mortality	
Absent	422 (98.6%)
Present	6 (1.4%)

BP: blood pressure, **MAP:** mean arterial pressure, **FAST:** focused assessment with sonography for trauma, **CT:** computed tomography, **n:** number of individuals, **%:** Percentage values are presented.

Results

The descriptive statistics of the study population are shown in Table 1. Among the 428 patients included, 72.2% (309 patients) were male, and 27.8% (119 patients) were female. The mean age was 44.17±20.54 years. Hemodynamic parameters included a mean systolic blood pressure of 124.18±18.69 mmHg, diastolic blood pressure of 76.49±11.61 mmHg, and heart rate of 87.68±14.57 beats per minute. The mean arterial pressure was 92.36±12.84 mmHg, and the shock index was 0.73±0.21. Trauma mechanisms included traffic accidents in 44.63% (191 patients), falls in 35.05% (150 patients), sharp injuries in 4.21% (18 patients), gunshot injuries in 1.17% (5 patients), assaults in 7.71% (33 patients), and other causes in 7.24% (31 patients). A significant hemogram decrease was observed 9.81% (42 patients). New-onset renal function abnormalities were detected in 3.04% (13 patients), and liver function abnormalities were noted in 11.92% (51 patients). FAST examinations revealed free fluid in 8.18% (35 patients). Computed tomography identified free fluid in 10.05% (43 patients). The need for gastrointestinal surgery was documented in 3.5% (15 patients). Clinical outcomes included discharge in 43.69% (187 patients), ward admission in 43.46% (186 patients), and Intensive Care Unit (ICU) admission in 12.85% (55 patients). Mortality occurred in 1.4% (6 patients). The analysis of FAST examinations is detailed in Table 2. Among the 35 patients with detected free fluid, perihepatic fluid was observed in 19 patients (4.44%), perisplenic fluid in 12 patients (2.8%), pelvic fluid in 20 patients (4.67%), lumbar fluid in 6 patients (1.4%), and pericardial fluid in 1 patient (0.23%). Solid organ injuries were identified in 15

Table 2: Analysis of Fast examinations

	Statistics
Perihepatic Fluid	
Absent	409 (95.56%)
Present	19 (4.44%)
Perisplenic Fluid	
Absent	416 (97.2%)
Present	12 (2.8%)
Pelvic Fluid	
Absent	408 (95.33%)
Present	20 (4.67%)
Lumbar Fluid	
Absent	422 (98.6%)
Present	6 (1.4%)
Pericardial Fluid	
Absent	427 (99.77%)
Present	1 (0.23%)
Solid Organ Injury	
Absent	413 (96.5%)
Present	15 (3.5%)
Liver Injury	
Absent	420 (98.13%)
Grade 1	3 (0.7%)
Grade 2	3 (0.7%)
Grade 3	2 (0.47%)
Spleen Injury	
Absent	425 (99.3%)
Grade 1	2 (0.47%)
Grade 2	1 (0.23%)
Grade 3	0 (0.0%)
Kidney Injury	
Absent	422 (98.6%)
Grade 1	2 (0.47%)
Grade 2	3 (0.7%)
Grade 3	1 (0.23%)

FAST: focused assessment with sonography for trauma, **CT:** computed tomography, ***n*:** number of individuals, **%:** Percentage values are presented.

patients (3.5%). Of the solid organ injuries, liver injuries were classified as Grade 1 in 3 patients (0.7%), Grade 2 in 3 patients (0.7%), and Grade 3 in 2 patients (0.47%). Spleen injuries were categorized as Grade 1 in 2 patients (0.47%) and Grade 2 in 1 patient (0.23%), with no Grade 3 spleen injuries noted. Kidney injuries were recorded as Grade 1 in 2 patients (0.47%), Grade

Table 3: Relationship of MAP and shock index to GIS surgery requirement, outcome and mortality

Need for Gastrointestinal Surgery					
	Absent	**Present**		**Test Statistics**	**p value**
MAP	92.63±12.76	84.87±13.38		2.313	0.021‡
Shock Index	0.72±0.21	0.87±0.19			
Outcome					
	Discharged	**Ward Admission**	**ICU Admission**	**Test Statistics**	**p value**
MAP	94.72±8.12	91.57±11.38	87.04±24.15	8.514	0.001£
Shock Index	0.68±0.11	0.71±0.15	0.95±0.4	43.698	0.001£
Mortality					
	Absent	**Present**		**Test Statistics**	**p value**
MAP	92.53±12.58	80.67±24.34		2.257	0.025‡
Shock Index	0.72±0.19	1.17±0.56			

MAP: mean arterial pressure, **ICU:** intensive care unit. **‡:** Independent samples t-test. Numerical variables are presented as mean±standard deviation. **£:** One-way ANOVA.

Table 4: Comparison of free fluid detected via CT and FAST in relation to GIS surgery requirement, outcomes, and mortality

					Free Fluid in CT		Test Statistics	p value
					Absent	**Present**		
Need for GIS Surgery	Absent	Free Fluid in FAST	Absent	n	369	15	124.071	0.001&
				%	89.3%	3.6%		
			Present	n	11	18		
				%	2.7%	4.4%		
	Present		Absent	n	4	5	1.25	0.264&
				%	26.7%	33.3%		
			Present	n	1	5		
				%	6.7%	33.3%		
Outcome	Discharged	Free Fluid in FAST	Absent	n	183	1	0.016	0.898&
				%	97.9%	0.5%		
			Present	n	3	0		
				%	1.6%	0.0%		
	Ward Admission		Absent	n	157	10	61.362	0.001&
				%	84.4%	5.4%		
			Present	n	6	13		
				%	3.2%	7.0%		
	ICU Admission		Absent	n	33	9	13.521	0.001&
				%	60.0%	16.4%		
			Present	n	3	10		
				%	5.5%	18.2%		
Mortality	Absent	Free Fluid in FAST	Absent	n	370	19	122.377	0.001&
				%	87.7%	4.5%		
			Present	n	12	21		
				%	2.8%	5.0%		
	Present		Absent	n	3	1	3.000	0.083&
				%	50.0%	16.7%		
			Present	n	0	2		
				%	0.0%	33.3%		

GIS: gastrointestinal system, **ICU:** intensive care unit**, FAST:** focused assessment with sonography for trauma, **CT:** computed tomography, Numerical variables ***n*:** represents the number of individuals, % indicates percentage values. **&:** Chi-square analysis

Table 5: Relationship between trauma mechanism, significant hemogram decrease, new-onset renal dysfunction and new-onset liver function test abnormality with GIS surgery requirement, outcome and mortality

			Need for GIS Surgery		Test Statistics	p value	Outcome			Test Statistics	P value	Mortality		Test Statistis	p value
			Absent	Present			Discharged	Ward Admission	ICU Admission			Absent	Present		
Trauma Mechanism	Traffic Accident	n	182	9	36.39	0.001&	79	81	31	27.099	0.003&	188	3	3.272	0.658&
		%	42.50%	2.10%			18.50%	18.90%	7.20%			43.90%	0.70%		
	Fall	n	150	0			60	70	20			148	2		
		%	35.00%	0.00%			14.00%	16.40%	4.70%			34.60%	0.50%		
	Sharp Injury	n	15	3			8	10	0			17	1		
		%	3.50%	0.70%			1.90%	2.30%	0.00%			4.00%	0.20%		
	Gunshot Injury	n	3	2			0	3	2			5	0		
		%	0.70%	0.50%			0.00%	0.70%	0.50%			1.20%	0.00%		
	Assault	n	33	0			25	8	0			33	0		
		%	7.70%	0.00%			5.80%	1.90%	0.00%			7.70%	0.00%		
	Other	n	30	1			15	14	2			31	0		
		%	7.00%	0.20%			3.50%	3.30%	0.50%			7.20%	0.00%		
Significant Hemogram Decrease	Absent	n	375	11	4.989	0.026&	180	166	40	26.915	0.001&	382	4	3.804	0.051&
		%	87.60%	2.60%			42.10%	38.80%	9.30%			89.30%	0.90%		
	Present	n	38	4			7	20	15			40	2		
		%	8.90%	0.90%			1.60%	4.70%	3.50%			9.30%	0.50%		
New-Onset Renal Function Abnormality	Absent	n	401	14	0.695	0.404&	183	180	52	1.626	0.444&	411	4	18.965	0.001&
		%	93.70%	3.30%			42.80%	42.10%	12.10%			96.00%	0.90%		
	Present	n	12	1			4	6	3			11	2		
		%	2.80%	0.20%			0.90%	1.40%	0.70%			2.60%	0.50%		
New-Onset Liver Function Abnormality	Absent	n	368	9	11.681	0.001&	180	162	35	43.392	0.001&	374	3	8.409	0.004&
		%	86.00%	2.10%			42.10%	37.90%	8.20%			87.40%	0.70%		
	Present	n	45	6			7	24	20			48	3		
		%	10.50%	1.40%			1.60%	5.60%	4.70%			11.20%	0.70%		

GIS: gastrointestinal system, **ICU:** intensive care unit, Numerical variables *n*: represents the number of individuals, % indicates percentage values. **&:** Chi-square analysis

2 in 3 patients (0.7%), and Grade 3 in 1 patient (0.23%). The relationship between mean arterial pressure (MAP) and the shock index with gastrointestinal system (GIS) surgery requirement, clinical outcomes, and mortality is detailed in Table 3. Patients requiring GIS surgery had a significantly lower MAP (84.87±13.38 mmHg) compared to those who did not require surgery (92.63±12.76 mmHg). The shock index was elevated in patients requiring surgery (0.87±0.19) compared to those who did not (0.72±0.21; p=0.021). In terms of outcomes, patients discharged from the emergency department had a mean MAP of 94.72±8.12 mmHg, while those admitted to the ward had a MAP of 91.57±11.38 mmHg, and those admitted to the ICU had the lowest MAP at 87.04±24.15 mmHg (p=0.001) as seen in Table 3. Similarly, the shock index progressively increased across these groups, with values of 0.68±0.11, 0.71±0.15, and 0.95±0.4, respectively (p=0.001). Regarding mortality, patients who survived had a mean MAP of 92.53±12.58 mmHg, whereas those who died had a significantly lower MAP of 80.67±24.34 mmHg. The shock index was notably higher in patients who died (1.17±0.56) compared to survivors (0.72±0.19; p=0.025) (Table 3). The comparison of free fluid detected via computed tomography (CT) and focused assessment with sonography for trauma (FAST) in relation to gastrointestinal system (GIS) surgery requirement, outcomes, and mortality is presented in Table 4. Among patients with GIS surgery, 4.4% had free fluid detected via both CT and FAST, while 3.6% of those with free fluid detected only via CT did not require surgery (p=0.001). For patients without GIS surgery, 33.3% had free fluid detected by both CT and FAST, compared to 26.7% with free fluid detected only via CT (p=0.264). Regarding outcomes, 97.9% of patients discharged from the emergency department had no free fluid detected via either CT or FAST, with no significant association observed (p=0.898). Ward admissions were noted in 7.0% of patients with free fluid detected by both CT and FAST and in 5.4% of those with free fluid detected only via CT (p=0.001). ICU admissions occurred in 18.2% of patients with free fluid detected by both CT and FAST and in 16.4% with free fluid detected only via CT (p=0.001). Mortality was reported in 33.3% of patients with free fluid detected via both CT and FAST and in 16.7% of those with free fluid detected only by CT (p=0.083). Among survivors, 5.0% had free fluid detected by both modalities, while 4.5% had free fluid detected only via CT (p=0.001). The relationship between trauma mechanism, significant hemogram decrease, new-onset renal dysfunction, and new-onset liver function test abnormality with gastrointestinal system (GIS) surgery requirement, outcomes, and mortality is shown in Table 5. Trauma mechanisms demonstrated a significant association with GIS surgery (p=0.001) and outcomes (p=0.003). Patients with significant hemogram decrease were more likely to require GIS surgery (p=0.026) and had a higher rate of ICU admissions (p=0.001). New-onset liver function abnormalities were significantly associated with GIS surgery (p=0.001), outcomes (p=0.001), and mortality (p=0.004). Conversely, new-onset renal function abnormalities showed a significant association only with mortality (p=0.001). These findings highlight the critical impact of specific laboratory and clinical parameters on surgical needs and patient outcomes.

Discussion

This study provides valuable insights into the diagnostic utility and clinical implications of FAST examinations in trauma patients, highlighting its strengths and limitations. FAST is widely recognized as an essential bedside tool in emergency departments for rapidly identifying intraperitoneal free fluid, particularly in hemodynamically unstable patients (6). However, consistent with previous research, our findings demonstrate that the sensitivity of FAST is limited in detecting small or localized fluid collections and certain solid organ injuries, necessitating the use of advanced imaging modalities like CT to enhance diagnostic accuracy (7.8). Notably, a subgroup of patients with free fluid detected exclusively on CT demonstrated no statistically significant association with gastrointestinal surgery (2.7%) or mortality (16.7%), yet exhibited significantly higher ward and ICU admission rates. This aligns with Kornblith et al., who emphasized the incremental utility of FAST when combined with physical examination but acknowledged its reduced sensitivity in children and adults with subtle injuries (9). The higher resolution of CT imaging allows for detection of fluid collections or injuries that may correlate with evolving clinical instability not captured by FAST. Richards et al. also highlighted that CT identified free fluid in up to 20% of cases missed by FAST, underscoring the critical role of CT in complementing ultrasonographic findings (2.10). Patients with free fluid identified by both FAST and CT presented with worse clinical outcomes, including ICU admission (18.2%) and mortality (33.3%), further reinforcing the additive value of FAST in detecting clinically significant fluid collections. These results are consistent with findings from Schnüriger et al., who reported that FAST reliably detects high-grade solid organ injuries but often misses lower-grade injuries, necessitating CT for comprehensive assessment (3). In addition to imaging findings, our study identified significant correlations between laboratory parameters and adverse outcomes. Patients with significant hemogram decreases were more likely to require GIS surgery and had higher rates of ICU admission, reflecting the impact of ongoing hemorrhage on clinical severity. Almansoor et al. similarly highlighted the prognostic value of declining hemoglobin levels in predicting surgical intervention and poor outcomes (11). New-onset liver function abnormalities were associated with higher rates of GIS surgery and mortality, further supporting their role as critical markers in trauma assessment. Conversely, new-onset renal dysfunction showed a significant association only with mortality, highlighting its prognostic importance. Mechanisms of trauma also played a significant role in determining outcomes. High-risk mechanisms, such as traffic accidents and sharp injuries, were significantly associated with GIS surgery and adverse outcomes compared to other trauma mechanisms. This observation underscores the importance of integrating trauma mechanism data into clinical decision-making, as emphasized by Rose et al., who derived decision rules based on injury patterns and FAST findings to guide surgical interventions (3.12). The findings of this study and prior literature collectively emphasize that while FAST remains indispensable in the acute trauma setting, its limitations necessitate a multimodal diagnostic approach (13.14). Future research should explore emerging imaging modalities, such as contrast-enhanced ultrasound, which may bridge the sensitivity gap between FAST and CT while maintaining practicality in emergency settings (15). Moreover, prospective studies with larger cohorts are warranted to validate these findings and optimize trauma care pathways.

Study limitations: This study has several limitations that should be acknowledged. First, its retrospective design inherently introduces potential biases, such as incomplete data recording and reliance on existing documentation, which may have affected the comprehensiveness of the findings. Second, the study was conducted at a single center, which may limit the generalizability of the results to other settings or populations with differing trauma profiles or resources. Third, the study included only patients whose official FAST reports were performed by radiologists, meaning that only those stable enough for transfer to a radiology unit were enrolled. This excludes unstable patients who could not be transferred, potentially introducing a selection bias. Lastly, while this study focused on the diagnostic utility of FAST and its comparison with CT, it did not assess the influence of operator experience, which is known to impact the sensitivity and specificity of FAST examinations. Future studies should address these limitations by employing prospective designs, including multiple centers, and incorporating standardized protocols to enhance the reliability and applicability of the results.

Conclusion

This study highlights the diagnostic value and limitations of the FAST protocol in trauma care. While FAST remains a cornerstone for the rapid identification of intraperitoneal free fluid in hemodynamically unstable patients, its limited sensitivity in detecting small or localized fluid collections underscores the importance of complementary imaging modalities like CT. Importantly, our findings demonstrate that patients with free fluid detected exclusively on CT, but not on FAST, did not show a significant impact on mortality or the need for gastrointestinal surgery. However, higher rates of ward and ICU admissions in this subgroup emphasize the clinical importance of detecting subtle fluid collections. FAST is invaluable for bedside assessment, but integrating CT is essential for comprehensive evaluation, particularly when FAST findings are negative but suspicion remains. Future research should explore advanced imaging technologies to further improve trauma management and outcomes.

Ethical approval: The study was initiated after approval from the Izmir Katip Çelebi University Clinical Research Ethics Committee (Decision No: 0431, Date: 21.09.2023).

Conflict of interest: The authors declare no competing interests.

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Writing - Review and Revision (AY, FET), Critical Review (AY, MAT, FET).

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