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Initial Fast Scan Finding in Hemodynamically Stable Patient with Blunt Abdominal Trauma

Rekan Mohammed Ali* Kamal Ahmed saeed Sadeek Hama Aziz Salih*****

Abstract

Background and objectives: Abdominal trauma can cause severe injuries to various internal organs. Focused assessment with sonography for trauma is an ultrasound technique for free intraperitoneal fluid detection in blunt abdominal trauma patients. This study aimed to investigate the importance of FAST scan as an initial imaging modality and early detection of free fluid in hemodynamically stable blunt abdominal trauma patients presenting to the emergency department.

Methods: This was a prospective cross-sectional study conducted in the emergency department of Shar Hospital, Sulaymaniyah, Iraq, from April 2022 to March 2023. The study involved 103 hemodynamically stable patients presented with blunt abdominal trauma. Patient demographics, vital signs, symptoms, and FAST results were recorded and analyzed.

Results: The study included 71 males and 32 females, with a mean age of 31.64 ± 15.04 years. Vehicle collisions accounted for 65% of the cases. Abdominal pain was the most common symptom (68%). Only seven patients (6.8%) had a positive FAST test; free fluid was found around the liver, renal, and in pelvic regions. A positive FAST was significantly associated with blunt trauma to the abdomen ($p = 0.001$) and related to the site of injury ($p < 0.001$). Patients with positive FAST had higher heart rates ($p=0.005$) and shorter time of injury before arrival to the hospital ($p=0.002$) than those with negative FAST.

Conclusions: In hemodynamically stable patients with blunt abdominal trauma, initial FAST detected free peritoneal fluid in a small percentage of cases. Patients with a positive FAST presented earlier and had higher heart rates.

Keywords: Blunt abdominal trauma, Diagnostic accuracy, Focused assessment with sonography for trauma (FAST), Free fluid

*M.B.Ch.B, emergency medicine candidate at KHCMS, Shar Hospital, Sulaimani-Iraq, medicine-md@yahoo.com.
*Corresponding author
**M.B.Ch.B, C.A.B.S, general surgery specialist, Sulaimani teaching hospital, Sulaimani-Iiraq. kamalsaeed62@yahoo.com
*** M.B.Ch.B, D.G.S, K.B.H.C.M.S fellowship EM, MRCEM, Emergency medicine specialist, Sulaimani teaching hospital, Sulaimani-Iiraq, sadeeksalih@gmail.com

Introduction

Trauma is widespread, leading to life-threatening injuries and causing the death of 5.1 million people (9% of all deaths) globally according to a study done in 2008. Trauma accounted for 17% of the disease burden among adults aged between 15-59 in 2004.[1,2] Abdominal trauma, which refers to any injury sustained to the abdominal region, is the third most common type of injury among individuals under 40 years old.[2] This type of injury can result from blunt trauma, such as in car accidents, or penetrating trauma, such as gunshot wounds or stabbings. Abdominal trauma is associated with a high rate of morbidity and mortality, especially if it involves damage to vital organs such as the liver, spleen, or intestines. The kidneys are well protected by the surrounding fatty capsule, organs and bones.[3] But a forceful impact to the abdomen can still result in kidney injury.[3] Blunt abdominal trauma may damage the bladder. The hollow bladder is in the lower abdomen and pelvis. The pelvic bones protect it, but a powerful blow to the lower abdomen may still injure the bladder.[4] Medical attention and treatment are essential to prevent serious complications and increase the chances of recovery.[5,] [6]Timely identification and intervention can reduce the mortality rate associated with abdominal trauma by as much as 50%.[7] This is especially in children. The use of imaging techniques is essential in detecting such trauma early on. However, due to the unique physical characteristics of children and the various ways in which trauma can occur, it can be challenging to identify the extent and severity of injuries through imaging alone. Additionally, children may respond differently to trauma than adults, with the ability to maintain normal blood pressure despite significant blood loss, which can initially mask the severity of the trauma during physical examination and vital sign monitoring.[8-10]Immediate referral of a victim to a trauma center and timely diagnosis and treatment are crucial for improving patient outcomes, especially in cases of suspected blunt abdominal trauma. Delayed diagnosis and treatment can lead to serious complications and even death. [11]The optimal imaging approach for analyzing Blunt Abdominal Trauma (BAT) is still the scope of ongoing research, and there is no universally agreed-upon protocol. Regardless, the Focused Assessment with Sonography for Trauma (FAST) can be a proper initial screening process for seeing BAT. However, it is essential to recognize that FAST has limitations, particularly when detecting parenchymal lacerations, where its sensitivity falls in the 30% to 60% range.[12] While FAST can be an adequate screening tool, it should be considered one of many diagnostic methods. A better comprehensive imaging approach may be necessary for an accurate diagnosis and treatment of BAT. Further research is required to develop a more precise and complete imaging protocol for BAT.[12-14] The sensitivity for free fluid is high, near 99%.[13]Computed Tomography (CT) is a favorably practical instrument for noticing abdominal injuries, delivering an elevated level of sensitivity and specificity in seeing hemoperitoneum and active bleeding, as well as parenchymal and hollow visceral organ laceration. In addition, its reliability in diagnosing such injuries has been demonstrated through research, making it an essential diagnostic tool in assessing suspected abdominal trauma.[15,] [16]One significant limitation of CT scanning is the potential for radiation exposure. Due to their smaller size, greater sensitivity to radiation, and longer life expectancy compared to adults, children are at a higher risk of developing radiation-induced cancer from each radiation dose they receive. This places them at a disproportionate risk compared to adults.[17, 18] Reducing unnecessary delays in trauma care. Patients will be assigned to

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observation, radiological (transarterial embolization [TAE]), or surgical intervention based on CT scan results. This step-up approach was hypothesized to reduce missing clinically important injuries without introducing unneeded risk factors (such as radiation or an intervention). This study aimed to investigate the importance of FAST scan as an initial imaging modality and early detection of free fluid in hemodynamically stable blunt abdominal trauma patients presenting to the emergency department.

Patients and methods

The current study design was prospective cross-sectional study in which hemodynamically stable patients presented with Blunt Abnormal Trauma (BAT) to the emergency department at Shar hospital in Sulaymani, Iraq. The study was carried out during the 1st of April 2022 until the 31st of March 2023. The researchers evaluated and compared the positive and negative outcomes from the BAT cases with normal vital signs.There was no age limit among participants, all the hemodynamically stable BAT cases were included. The exclusion criteria were victims of BAT with hemodynamical instability. Preexisting peritoneal fluid, penetrating abdominal trauma cases and pregnant women were excluded in the study. The researchers collected BAT cases who presented to Shar hospital. FAST scan was done quickly and reliably by emergency physicians or non-radiologists. The findings were recorded on a designed questionnaire. Bedside Focused assessment with sonography for Trauma (FAST) was performed to detect free intraperitoneal fluid in 4 major areas (pericardial, hepatorenal, splenorenal, pelvic) in patient with blunt abdominal trauma. Only hemodynamically stable patients who presented with BAT were collected. Cases with unstable vital signs were avoided. This study was submitted to the Ethics and Scientific committees Program at Kurdistan Higher Council of Medical Specialties. Verbal consent was obtained from each patient after explaining the aim and scope of the study. The data were recorded on a specially designed questionnaire, collected and entered in the computer and then analyzed using appropriate data system which is called Statistical Package for Social Sciences (SPSS) version 28 and the results were compared between patients with different variables, with a statistical significance level of ≤ 0.05. The results presented as rates, ratio, frequencies, percentages in tables and figures and analyzed using t-test, and Chi square tests.

Results

We enrolled 103 participants in our study, Table (1) shows that the majority (68.9%) of cases were male, and 31.1% of them were female. Most (65%) of patients were victims of motor vehicle collision injury, and almost one quarter (24.3%) of them fell from height. The majority (68%) of patients complained of abdominal pain; whereas, 24% of patients had abdominal abrasions. Only 1% of cases complained of both abdominal pain and abrasions. Around 24% of patients experienced abdominal tenderness. The most common injured parts (41.7%) were musculoskeletal, followed by the head (15.5%), and the chest (9.7%). The FAST scan result was negative for peritoneal fluid in the majority (93.2%) of cases. Only 4.9% of hepatorenal and 1.9% of pelvis were common injured area.

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Table (1): Gender, signs and symptoms of abdominal injury, involved areas and FAST exam of participants.

Variables	Categories	Frequency	Percent
Age, mean±SD	31.64±15.040		
Gender	male	71	68.9
	female	32	31.1
Mechanism of injury	motor cycle accident	11	10.7
	motor vehicle collision	67	65
	fall from height	25	24.3
Presenting symptom of arrival	abdominal pain	70	68
	abdominal abrasion	24	23.3
	abdominal pain and abrasion	1	1
	Abdominal bruise	2	1.9
Abdominal tenderness	present	25	24.3
Involved part	chest	10	9.7
	head	16	15.5
	musculoskeletal	43	41.7
	head and musculoskeletal	9	8.7
FAST exam	positive	7	6.8
	negative	96	93.2
Involved area	none	96	93.2
	pelvis	2	1.9
	hepatorenal	5	4.9
Total		103	100%

Table (2) shows that mean age of patients was 31.64 ± 15.04 years, average systolic blood pressure was 121.43 ± 11.23mmHg, mean diastolic blood pressure was 71.84 ± 8.46mmHg, average pulse rate was 90.38 ± 11.09 bpm, mean respiratory rate was 16.21 ± 1.52 breaths per minute, mean SPO2 was 96.5 ± 1.46%. Lastly, mean time of injury before arrival of cases was 34.9 ± 20.61 minutes.

Table (2): Mean age, blood pressure, pulse and respiratory rate, SPO2 and time of injury of patients.

Variables	Range	Minimum	Maximum	Mean	Std. Deviation
systolic blood pressure	55	100	155	121.43	11.237
diastolic blood pressure	40	60	100	71.84	8.460
pulse rate	63	67	130	90.38	11.092
respiratory rate	6	14	20	16.21	1.525
SPO2	6	93	99	96.50	1.461
time of injury before arrival (minutes)	105	15	120	34.90	20.615

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Table (3) shows that, there was a no statistically significant association between FAST exam and gender, mechanism of injury and presenting symptom on arrival (p-value > 0.05). There was a significant statistical association between FAST exam and abdominal tenderness, majority (85.7%) of patients diagnosed with positive FAST had abdominal tenderness while only (19.8%) of negative group had abdominal tenderness (p-value = 0.001).

Table (3): Association between FAST exam and gender, mechanism, presenting symptom and abdominal tenderness.

Variable	Categories	FAST exam		p-value
		positive	negative	
gender	male	5 (71.4%)	66 (68.8%)	0.882
	female	2 (28.6%)	30 (31.3%)	
mechanism of injury	motor cycle accident	1 (14.3%)	10 (10.4%)	0.377
	motor vehicle collision	3 (42.9%)	64 (66.7%)	
	fall from height	3 (42.9%)	22 (22.9%)	
presenting symptom of arrival	abdominal pain	7 (100%)	63 (65.6%)	0.414
	abdominal abrasion	0 (0%)	24 (25%)	
	none	0 (0%)	6 (6.3%)	
	abdominal pain and abrasion	0 (0%)	1 (1%)	
	abdominal bruise	0 (0%)	2 (2.1%)	
abdominal tenderness	present	6 (85.7%)	19 (19.8%)	0.001
	absent	1 (14.3%)	77 (80.2%)	
Total		7	96	
		100%	100%	

Table (4) shows that, there was no statistically significant association between FAST exam and associated injury and the involved part (p-value >0.05). There was a significant statistical association between FAST exam and involved area, in which more than one quarter (28.6%) of patients diagnosed with positive FAST had trauma to the pelvis, while none (0%) of negative group had pelvic injury. Most (71.4%) of positive group had injuries to the hepatorenal area while none (0%) of negative group had hepatorenal injury (p-value was < 0.001)

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Table (4): Association between FAST exam and associated injury, involved part or area

Variable	Categories	FAST exam		p-value
		positive	negative	
associated injury	present	5 (71.4%)	73 (76%)	0.676
	absent	2 (28.6%)	23 (24%)	
involved part	none	2 (28.6%)	23 (24%)	0.703
	chest	1 (14.3%)	9 (9.4%)	
	head	0 (0%)	16 (16.7%)	
	musculoskeletal	3 (42.9%)	40 (41.7%)	
	head and musculoskeletal	1 (14.3%)	8 (8.3%)	
involved area	none	0 (0%)	96 (100%)	< 0.001
	pelvis	2 (28.6%)	0 (0%)	
	hepatorenal	5 (71.4%)	0 (0%)	
Total		7	96	
		100%	100%	

The outcomes in Table (5) reveal that there was no statistically significant difference between FAST exam and systolic blood pressure, diastolic blood pressure and respiratory rate (p-value was > 0.05). There was a statistically significant difference between FAST exam and age, pulse rate, SPO2, time of injury before arrival. Patients with negative FAST scan were older in age, had a lower mean pulse rate, higher SPO_2 level, and a shorter time of injury before arrival (p-value < 0.05)

Table (5): Difference in positive and negative FAST exam results regarding vital signs, age of patients and time of injury.

Variables	FAST exam	Mean	Standard deviation	p– value	t– test
Age (years)	positive	19.00	12.610	0.021	Significant
	negative	32.56	14.839		
Systolic blood pressure	positive	117.14	6.986	0.298	Non-significant
	negative	121.74	11.447		
Diastolic blood pressure	positive	70.00	5.774	0.553	Non-sign ificant
	negative	71.98	8.629		
Pulse rate	positive	101.71	18.455	0.005	Highly significant
	negative	89.55	10.022		
Respiratory rate	positive	16.71	1.380	0.371	Non-significant
	negative	16.18	1.536		
SPO2	positive	95.43	1.618	0.041	Significant
	negative	96.58	1.427		
Time of injury before arrival (minutes)	positive	57.86	44.894	0.002	Highly significant
	negative	33.23	16.952		

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Discussion

The present study showed that the majority of patients with blunt abdominal trauma were male (68.9%), which is consistent with the systematic review by Singh et al.in which they found that 75 % of patients with abdominal injury were male.[19] The study of Richards et al.[21] also reported a male predominance of 72%. The higher rates among men are likely due to greater risk-taking among the male gender as opposed to female gender. In this study, 65% of the cases were involved in motor vehicle collisions. This is consistent with a retrospective study by Hsiao et al. who found that motor vehicle accidents caused 61.4% of uncomplicated abdominal trauma.[20] In a study by Olufajo et al. it's reported that traffic accidents were the leading cause of abdominal trauma in up to 79.3% of their cases.[22] In high-speed collisions, abdominal injuries caused by rapid deceleration can be significant. Abdominal pain was the most common symptom at presentation reported in 68% of our patients. This is consistent with the findings of Richard et al., where 69% of trauma patients reported abdominal pain.[21] Smith et al.[23] and Bhoi et al.[24] also reported abdominal pain in 62.2% and 93% of the trauma cases, respectively. Abdominal tenderness was present in 24.3% of trauma patients, this is comparable to Smith et al.'s study (22%) but significantly less than Richard et al.'s study (48%).[21,23] We found that chest, head, and musculoskeletal injuries were frequently associated with abdominal trauma. Similarly, Olufajo et al., also reported injuries to the thorax (47.7%), spine (21.3%), and limbs (37.7%) in addition to BAT among their cases.[22] This emphasizes the importance of looking for concomitant injuries when evaluating patients with abdominal trauma.In the current analysis, only 6.8% of patients had a positive FAST test. Other studies reported higher rates, such as 34.2% in the study by Richards et al.[21] and 22.4% by Bhoi et al.[24] This discrepancy may be attributed to the exclusion of hemodynamically unstable patients in this study. We found a significant association between a positive FAST scan and abdominal tenderness. Richards et al. also noted that the abdomen was more tender in patients with positive FAST scan.[21] This is expected given that intra-abdominal fluid accumulation leading to a positive FAST will also be reflected in abdominal pain.We have shown that trauma to the pelvic and hepatic area predicts a positive evaluation of FAST. A study by Jorgensen et al.[25] shows FAST scan was found to have the highest sensitivity (80%) when there's fluid accumulation in the pelvic floor. Our positive FAST patients had a significantly higher heart rate than those with a negative study. Decreased blood pressure may reflect blood loss due to intra-abdominal bleeding. The study by Bhoi et al.[24] also showed higher heart rates in their FAST-positive groups. Patients with a positive FAST test had a longer time from injury to hospital admission in this study. This may indicate a greater severity of injury, prompting immediate intervention. In a study by Hsiao et al. patients with positive FAST results reported a shorter time from injury to presentation.[20] The small sample size is A significant limitation of our study. More extensive studies are needed to confirm these findings. Furthermore, our data are from a single-center therefore, a multicenter design is required for broader generalized results.

Conclusions

Focused assessment with sonography for trauma (FAST) examination is an important initial imaging modality for blunt abdominal injuries even in hemodynamically stable patient. Only 6.8%, had positive findings on FAST scan. There was a significant association between abdominal tenderness and a positive FAST scan. Moreover, Patients with a positive FAST scan had significantly higher heart rates and longer time between injury and arrival to the hospital.

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Conflict of interest

The Authors declare no conflict of interest.

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