

ORIGINAL ARTICLE

DIAGNOSTIC ACCURACY OF FOCUSED ASSESSMENT WITH SONOGRAPHY IN TRAUMA FOR VISCERAL INJURIES IN BLUNT ABDOMINAL TRAUMA PATIENTS KEEPING CT AS GOLD STANDARD**Syeda Komal Siraj, Faiza Akram, Syed Salahuddin Shah*, Waheed Khan, Saima Zeb****

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Background: Blunt abdominal trauma is common and is associated with intra-abdominal injury. Focused assessment with sonography in trauma (FAST) is extremely sensitive and specific test for the diagnosis of visceral injury in such patients with added benefit of quick scan and bedside availability. This study was conducted with an aim to establish the diagnostic accuracy of FAST for diagnosing visceral injuries in blunt abdominal trauma patients. **Methods:** This study involved 247 patients of both genders aged 18–60 years, referred to Department of Diagnostic Radiology with history of blunt abdominal trauma. All these 247 patients underwent FAST and CT abdomen. The results of CT scan were taken as gold standard and those of FAST were judged accordingly as true/false positive/negative. **Results:** Visceral injury was diagnosed in 167 (67.6%) patients on FAST while CT scan confirmed visceral injury in 165 (66.8%) patients. There were 155 true positive, 12 false positive, 10 false negative and 70 true negative cases which yielded 93.94% sensitivity, 85.37% specificity, 91.09% accuracy, 92.81% positive predictive value and 87.50% negative predictive value for FAST in detecting visceral injury. **Conclusion:** FAST is fairly sensitive, specific, and accurate in diagnosing visceral injury among blunt abdominal trauma. Its non-invasive, radiation-free nature, and widespread bedside availability advocate its preferred use in place of CT in diagnosis of visceral injury in blunt abdominal trauma cases.

Keywords: Accuracy, Sonography, Trauma, Abdominal, Visceral, Scan

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INTRODUCTION

Trauma is 3rd commonest cause of death in all ages and is first commonest cause of mortality in people of 5–25 year age. It inflicts huge resources in healthcare system.¹ Prevalence of intra-abdominal injury after blunt trauma has been reported as high as 13%. Commonest causes of blunt abdominal trauma include vehicle accident, fall, assault, and industrial mishaps, liver being the commonest injured organ followed by spleen, gut, retroperitoneal haematoma, and other organs. Males are more frequently involved compared to females.²

Computed Tomography (CT) is gold standard in evaluation of intra-abdominal injury in blunt abdominal trauma patients for parenchymal organ injuries as well as detecting small bowel and mesenteric injuries, and associated hemoperitoneum. It provides an accurate evaluation of visceral injuries, thus helping the surgeons to select the correct initial clinical emergency management.³ But it requires unavoidable time delay, needs patient transfer, and is inappropriate for hemodynamically unstable patients.⁴ Increased rate of mortality and morbidity in trauma patient is mostly due to delay in early diagnosis or misdiagnosis.⁵

Focused assessment with sonography in trauma (FAST) is used in evaluation of trauma patients since past 30 years. Identification of free fluid within the peritoneal cavity, pleural spaces and pericardium can be detected promptly with FAST on patient arrival in Accident and Emergency Department. It is targeted on

dependent intra-peritoneal sites where blood is most likely to collect: the hepatorenal space (i.e., Morrison's pouch), the inferior portion of the intra-peritoneal cavity (including pouch of Douglas) and lienorenal recess. Other advantages of FAST include evaluation of solid organ injury, fractures, pneumothorax, sequential examinations, as well as use in pre-hospital transport and multiple casualty settings as a triage tool.⁶ FAST takes less time, is cost-effective, non-invasive, repeatable and easily accessible. It can also be used for unstable patients in resuscitation area. Moreover, surgeons and emergency physicians with limited experience in ultrasound can also perform FAST after a brief training.⁴ FAST is becoming the common earliest screening investigation in majority of Accident and Emergency Departments worldwide, and is also part of the Advanced Trauma Life Support program for assessment of the hypotensive trauma patient.⁶ The sensitivity and specificity of FAST to detect visceral injuries after blunt abdominal trauma has been reported as 93.5% and 84.4% respectively; CT scan revealed visceral injury in 44%.⁷

Trauma leading to visceral injuries is very common in our population and early diagnosis and early treatment is of extreme importance to reduce the morbidity and mortality. The present study aims to detect the diagnostic accuracy of FAST in the assessment of visceral injuries in blunt abdominal trauma patients keeping CT scan as gold standard.

PATIENTS AND METHODS

The study was conducted after approval from Hospital Ethical and Research Committee. All patients presenting to Emergency Department with suspicion of visceral injury after blunt abdominal trauma were included in the study after written informed consent. The inclusion criteria were patients with clinical suspicion of visceral injury after blunt abdominal trauma who were hemodynamically stable, with age range of 18–60 years. Exclusion criteria were pregnant patients, penetrating trauma and burns, already operated, and hemodynamically unstable patients.

Detailed history was taken from the patients followed by clinical examination, FAST, and CT. All scan were performed under a single standard technique and were reported/reviewed under supervision of a single competent radiologist. Data were recorded on a pre-designed proforma, entered on and analyzed using SPSS-20, and 2x2 tables were generated to calculate sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of FAST against CT scan as the gold standard.

RESULTS

Mean age of the patients was 34.1±11.7 years. There were 186 (75.3%) male and 61 (24.7%) female patients with a male to female ratio of 3:1. Road traffic accident was the most frequent cause and was observed in 59.1% patients followed by fall from height (32.4%) and assault (8.5%).

Visceral injury was diagnosed in 167 patients on FAST while CT scan confirmed visceral injury in 165 patients (Table-1). No statistically significant differences were observed in the frequency of CT confirmed visceral injury in several subgroups based on patient's age ($p=0.898$), gender ($p=0.814$) and mode of injury ($p=0.619$) (Table-2).

When cross-tabulated diagnosis of visceral injury on FAST with that of CT scan, there were 155 true positive, 12 false positive, 10 false negative and 70 true

negative cases (Table-3). The sensitivity, specificity, accuracy, positive predictive value and negative predictive value for FAST in detecting visceral injury are tabulated as Table-4. Similar tabulation was done based on age, gender and mode of injury (Table-5, 6).

Table-1: Diagnosis of visceral injury on FAST and abdominal CT scan (n=247)

Modality	Visceral Injury	Frequency	Percent (%)
FAST	Yes	167	67.6
	No	80	32.4
CT Scan	Yes	165	66.8
	No	82	33.2

Table-2: Stratification of visceral injury confirmed on CT scan across various subgroups (n=247)

Subgroups	n	Visceral injury [n (%)]	p
Age			
18–39 years	176	118 (67.0%)	0.898
40–60 years	71	47 (66.2%)	
Gender			
Male	186	125 (67.2%)	0.814
Female	61	40 (65.6%)	
Mode of Injury			
RTA	146	97 (66.4%)	0.619
Fall from height	80	52 (65.0%)	
Assault	21	16 (76.2%)	

Chi-square test, Observed difference was statistically insignificant

Table-3: Cross-tabulation of FAST and CT scan for diagnostic performance in visceral injury after blunt trauma abdomen (n=132)

FAST	CT Scan		Total
	Visceral injury	No	
Visceral injury	155 ^a	12 ^c	167
No	10 ^b	70 ^d	80

^aTrue Positive= 155, ^bFalse Negative= 10, ^cFalse Positive= 12, ^dTrue Negative= 70

Table-4: Diagnostic performance of FAST in visceral injury after blunt abdominal trauma

Statistical Parameter	Formula	Value
Sensitivity	$\frac{a}{a+b}$	93.94%
Specificity	$\frac{d}{c+d}$	85.37%
Accuracy	$\frac{a+d}{a+b+c+d}$	91.09%
Positive Predictive Value	$\frac{a}{a+c}$	92.81%
Negative Predictive Value	$\frac{d}{b+d}$	87.50%

Table-5: Cross-tabulation of FAST and CT scan for diagnostic performance in visceral injury after blunt trauma abdomen across age groups (n=247)

Age group	FAST	CT Scan		Total	Diagnostic Performance
		Visceral Injury	No		
18–39 years (n=176)	Visceral Injury	111	8	119	SN=94.07%, SP=86.21%, PPV=93.28%, NPV=87.72%, AC=91.48%, PR=67.05%
	No	7	50	57	
40–60 years (n=71)	Visceral Injury	44	4	48	SN=93.62%, SP=83.33%, PPV=91.67%, NPV=86.96%, AC=90.14%, PR=66.20%
	No	3	20	23	

SN= Sensitivity, SP= Specificity, AC= Accuracy, PPV= Positive Predictive Value, NPV= Negative Predictive Value, PR= Prevalence

Table-6: Cross-tabulation of FAST and CT scan for diagnostic performance in visceral injury after blunt trauma abdomen across gender groups (n=247)

Gender	FAST	CT Scan		Total	Diagnostic Performance
		Visceral Injury	No		
Male (n=186)	Visceral Injury	118	9	127	SN=94.40%, SP=85.25%, PPV=92.91%, NPV=88.14%, AC=91.40%, PR=67.20%
	No	7	52	59	
Female (n=61)	Visceral Injury	37	3	40	SN=92.50%, SP=85.71%, PPV=92.50%, NPV=85.71%, AC=90.16%, PR=65.57%
	No	3	18	21	

SN= Sensitivity, SP= Specificity, AC= Accuracy, PPV= Positive Predictive Value, NPV= Negative Predictive Value, PR= Prevalence

DISCUSSION

Blunt abdominal trauma is among the commonest causes of injuries and is mainly caused due to automobile accidents. The rapid rise in number of automobiles and its aftermath has caused rapid rise in victims to blunt abdominal trauma. Motor vehicle accidents cause 75 to 80% of blunt abdominal trauma.¹ Other causes of blunt abdominal trauma include fall from height, being hit with blunt objects, sport trauma, industrial accidents and bomb blasts.^{1,2} Blunt abdominal trauma is usually not apparent thus often missed unless meticulously and repeatedly looked for. Delay in diagnosis and inadequate treatment of the abdominal injuries causes increased mortality.¹ Even in the presence of the best techniques and advancements in diagnostic and supportive care, the morbidity and mortality rates are still high. The reason for increased mortality and morbidity can be interval between trauma and hospitalization, inappropriate and lack of adequate surgical treatment, delayed diagnosis, postsurgical complications and accompanying trauma specially to head, thorax and pelvis.²

The early assessment of unstable trauma patients must be rapid and unequivocal to accurately guide the diagnostic and therapeutic interventions in accordingly.¹⁻³ CT scan is the gold standard in assessment of intra-abdominal injury in blunt abdominal trauma patients but it demands unavoidable time delay, needs patient transfer, and is inappropriate for hemodynamically unstable patients.³ Plain radiography of the chest and pelvis and FAST produce early results that has direct influence on further management. The FAST targets to determine any abnormal abdominal fluid collection within the peritoneal, pericardial, and other potential spaces. In hemodynamically unstable trauma patients, any free fluid suggests FAST-positivity and is assumed to represent hemorrhage.⁴⁻⁷ Recent studies claimed that FAST was an extremely sensitive and specific test for the diagnosis of visceral injury with added benefit of quick scan and bedside availability.⁷ However, the available evidence contains controversy.

In the present study, the mean age of the patients was 34.1±11.7 years—the most productive time of life. Similar mean age has been reported by Mohsin *et al*⁸ among blunt abdominal trauma patients presenting at Liaquat National Hospital, Karachi. Latif *et al*⁹ from Combined Military Hospital, Lahore, and Janjua *et al*¹⁰ from Pakistan Institute of Medical Sciences, Islamabad also reported similar results. A relatively lower mean age of 30.5±11.2 years has been reported by Bano *et al*¹¹ among patients presenting at Civil Hospital Karachi while much higher mean age of 39.4±12.1 years has been reported by Mushtaq *et al*¹² from Nishtar Hospital Multan. Waheed *et al*¹³ reported comparable mean age among such patients in KSA.

There was a male predominance among our patients. This is in line with Janjua *et al*¹⁰, Latif *et al*⁹, and Mohammadi *et al*¹⁴ from Iran. This younger age and male predominance can be attributable to mode of injury (RTA, 59.0% cases) which frequently involves young males.²

Road traffic accident was the most frequent cause in our patients followed by fall from height, and assault. Latif *et al*⁹ from CMH Lahore, Bano *et al*¹¹ from Civil Hospital Karachi, and Musiitwa *et al*¹⁵ from Uganda reported similar frequencies of RTA, fall from height and assault among such patients.

In the present study, visceral injury was diagnosed in 66.8% of patients with blunt abdominal trauma on CT scan. Our observation is similar with that of Gul *et al*¹⁶ who reported visceral injury among 68.0% of blunt abdominal trauma patients presenting at DHQ Hospital, Mirpur, A.J.K. Mohsin *et al*⁸ have reported the frequency of visceral injury to be 74.0% among such patients at Liaquat National Hospital, Karachi. Comparable frequency of visceral injury as 63.6% and 63.8% has been reported by Janjua *et al*¹⁰ in local population and Waheed *et al*¹³ in KSA respectively. FAST was found to have 93.94% sensitivity, 85.37% specificity, 91.09% accuracy, 92.81% positive predictive value, and 87.50% negative predictive value in detecting visceral injury. Our results are in agreement to those of Hamid *et al*⁷, Mohsin *et al*⁸, and Latif *et al*⁹ who observed similar sensitivity of FAST in patients with blunt abdominal trauma. Much lower sensitivity of 36.6% has been reported by Kanai *et al*¹⁷ in Iran while much lower specificity of 67.0% has been reported by Nnamonu *et al*¹⁸ in Nigeria. A possible explanation for this conflict among studies can be the hardware and operator dependent nature of ultrasound.

The present study further adds to the already available evidence on the topic. The results of the present study are in line with the other studies already published in local population and establish the role of FAST in the emergency evaluation of victims of blunt abdominal trauma. Owing to non-invasive and radiation free nature of ultrasound along with widespread and bedside availability FAST appears to be superior to CT scan which exposes the patients to radiations, requires patients transfer causing unavoidable delay, and is not available at many district setups.

The strengths of our study are large sample size of 247 patients and that we stratified the data to address effect modifiers. A very strong limitation to the present study is that it was a single centre experience and considering the hardware and operator dependent nature of ultrasound which is generally agreed to be a source of inter-observer variability. There is need for a multi-centre trial to further establish the role of FAST in the diagnostic evaluation of patients presenting in emergency with blunt abdominal trauma.

CONCLUSION

FAST was found to be 93.9% sensitive, 85.4% specific and 91.1% accurate in diagnosing visceral injury among patients with blunt abdominal trauma. Its non-invasive, radiation-free nature, and easy bedside availability advocate its preferred use in place of CT in diagnosis of visceral injury in blunt abdominal trauma cases.

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