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# Comparison of Diagnostic Accuracy of Focused Assessment with Sonography for Trauma (FAST) vs Computed Tomography for the Diagnosis of Blunt Torso Trauma

Maria Akram<sup>1</sup>, Aiman Shehzad<sup>2</sup>, Shabana Bibi<sup>3</sup>, Hareem Zehra<sup>4</sup>, Zainab Sajjad<sup>5</sup>, Iqra Manzoor<sup>6</sup>, Ghulam Rasool<sup>7</sup>, Rahma Bacha<sup>8</sup>, Syed Yousaf Gilani<sup>9</sup>, Faizan Nadeem<sup>10</sup>, Mehreen Fatima<sup>11</sup>

<sup>1,2,3,4,5</sup> MID, The University of Lahore, Lahore, Pakistan

<sup>6</sup> Lecturer, University of Lahore, Lahore, Pakistan, Email: iqramanzoor36@gmail.com. Ph No:0344-6690892

<sup>7</sup> Retired HOD of Radiology Department, Mayo Hospital, MBBS, DMRD, FCPS.

<sup>8</sup> Asst. Prof. UIRSMIT (University Institute of Radiological Sciences & Medical Imaging Technology), The University of Lahore, Lahore, Pakistan

<sup>9</sup> Lecturer, Research Incharge (UIRSMIT, RRS) The University of Lahore, Pakistan

<sup>10</sup> Consultant Nuclear Medicine, Gulab Devi Hospital Lahore, Pakistan

<sup>11</sup> Assistant Prof. Biostatistics, UIRSMIT, The University of Lahore, Pakistan

Correspondence: Maria Akram, MID, The University of Lahore, Lahore, Pakistan, Email: maria.akram00@gmail.com. Ph No: 0309-4363319

## Abstract

Background: FAST and CT scan are both widely used imaging techniques for diagnosing blunt torso trauma and have their limitations and advantages. Objective: To evaluate the Accuracy of Focused Assessment with Sonography for Trauma (FAST) vs Computed Tomography for diagnosing Blunt Torso Trauma. Methodology: A cross sectional research which was done in Lahore in emergency department of Mayo hospital and Services hospital. Total 125 participants took part in the study who were victims of blunt torso trauma by road traffic accidents damaging mainly spleen, kidneys, liver, retroperitoneum, bladder and pancreas. FAST scan using Toshiba, Nemio model, Convex probe having a frequency of 3.75 MHz was carried out. Pictures were captured with different abdominal views. CT scan using Toshiba, 16 slice Hitachi and Scenaria, 128 slices was also done on the same population after giving contrast material. Results: Mean age of population under study was 37.87±11.678. FAST scan was administered on all patients and then CT scan was administered. Out of 125 scans 77 FAST positive scans were confirmed and 48 negative scans were confirmed by using CT scan. The values of sensitivity, specificity, ppv and npv of FAST scan were calculated to be 100%, 91.67, 100% and 85.42%. Conclusion: Although FAST is also a very valuable tool, some of the critical injuries that need immediate attention for the patient's life may be overlooked so CT scan is considered the best option for diagnostic accuracy of Blunt torso trauma.

**Keywords:** Blunt Torso Trauma, Focused Assessment for Sonography with Trauma (FAST), Computed Tomography (CT)

## Introduction

Trauma is one of the most commonly reported causes of death in the younger population<sup>1</sup>. If we talk about the frequency of trauma, the most commonly injured abdominal organs and structures are the spleen, liver, kidneys, small bowel and/or mesentery, bladder, colon and/or rectum, diaphragm, pancreas, and major vessels<sup>2</sup>. The focused assessment of sonography in trauma (FAST) evaluates for free fluid (FF) around the heart and three areas of the abdominal–pelvic cavity<sup>3</sup>. Computer tomography (CT) is a non-destructive method based on X-ray absorption that allows visualization of the material's internal microstructure<sup>4</sup>. Currently the CT scan is considered as the best method for diagnosing intra-abdominal injury after blunt torso trauma<sup>5</sup>. Blunt torso trauma leads to thousands of admissions each year, leading to high expenses for the health care system<sup>6</sup>. The results of blunt abdominal trauma have enhanced over the previous two centuries. The ready accessibility of CT scans also enabled doctors to monitor these patients carefully without unnecessary surgery<sup>7</sup>. Although the ultrasound machines have enhanced resolution, 50% of strong wounds are missed. For more specificity, CT was used in blunt trauma. Ultrasound is mostly considered the best option in the case of initial assessment of blunt abdominal injury<sup>8</sup>. A cross sectional study was done to assess the FAST diagnostic accuracy in patients with blunt torso trauma by using surgical results as the best modality. The study was conducted in a time of six months at the radiology department of a hospital in Multan. The study included 155 patients who were suffering from Blunt abdominal trauma. After the surgery all patients were prepared for FAST scan. The results of the study showed that FAST's sensitivity, specificity, and diagnostic precision were 82.1%, 90.6%, and 83.9%, respectively. It was concluded from the study that FAST was a reliable modality and must be performed in all cases of Blunt torso Trauma<sup>9</sup>. Another study was conducted to find the effectiveness of FAST and CT scan in the diagnosis of Blunt torso trauma. This was a prospective study conducted in a hospital of Faisalabad in a time span of two years between 2016 and end of 2017. The research included patients with blunt abdominal trauma who were stable enough to undergo both USG and CT scans. The results showed that Road accidents are the most prevalent cause of trauma (58.9%), followed by tripping from heights (32.1%). The most commonly injured intra-abdominal organs were liver (73.2%), spleen (51.8%), kidneys (46.4%) and pancreas (12.5%). CT scan was able to identify the existence of hemoperitoneum in 100 percent of patients, while only 83.9 percent of patients were identified by the use of FAST scan. It was concluded from the study that In comparison with FAST, CT scan is a superior imaging instrument to detect Blunt abdominal trauma. However, for CT to be conducted, the patient must be hemodynamically stable<sup>10</sup>. Another research was published for investigation on patients with abdominal injury. The point of this investigation was to assess the part of ultrasound in early finding of intra-abdominal damage following blunt abdominal injury and line up in patients with intra-abdominal damage for identifying late difficulties. 120 patients who introduced to the emergency room were assessed by Focused Assessment in Sonography for Trauma (FAST) and follow-up sonography was done after 12– 24 hrs. This investigation observed FAST to be 93% sensitive and 99% specific. Ultrasonography is viewed as the best methodology in starting assessment of blunt abdominal injury patients as it is noninvasive, easily available, and consuming less time. Ultrasonography is extremely valuable in line up of patients with intra-abdominal injury and reducing the need of CT which is costly, requiring high radiation dose<sup>11</sup>. Another research was conducted which focused on assessing accuracy of diagnosis of emergency FAST in the case of torso injuries. It was a cross sectional descriptive study planned over a period of three months. 197 participants were hired for the study including average age of 27 years and SD =11. The overall ratio of male and female participants was 5:1. The specificity of EFAST was 97 percent, sensitivity was 100 percent, NPV was 100 percent and PPV was 87 percent. Completion time of an EFAST scan was 5 minutes on average. 168 which is 85 percent of the patients were scanned for EFAST. 82 (48%) of the participants were discharged on the same day of hospitalization. However, even after two weeks 7(4%) were still hospitalized. The death rate was 18 (9%). It was concluded from the study that EFAST is a reliable technique for the diagnosis of torso injuries in a restricted resource context<sup>12</sup>. A descriptive observational study was carried out in Saudi Arabia between september 2016 and 2017. The patients (n=105) who were victims of Blunt torso trauma because of motor vehicles accidents were presented for CT and FAST scans for the identification of free fluid. Results showed that FAST sensitivity was calculated to be 76.1 percent. CI: 95%, 64.14-85.69%), 84.2 percent specificity (95% CI, 68.75-93.98%) and 79 percent precision (95% CI, 70.01-86.38%). In most instances of high-grade strong visceral injuries a focused sonography evaluation for trauma identified free fluid. Close to half of the true negative instances had visceral or other injuries of low grade. The study concluded that FAST is a valid tool for the starting assessments of Blunt

torso trauma with elevated sensitivity and specificity. Low grade solid visceral and other types of injuries are not excluded in a negative FAST scan<sup>13</sup>.

## Material and Methods

This was a cross sectional analytical study on the Diagnostic Accuracy of Focused Assessment with Sonography for Trauma (FAST) vs Computed Tomography for the Diagnosis of Blunt Torso Trauma. 125 patients who were victims of Blunt torso trauma. The study was carried out in emergency and accident department of Mayo hospital and Services hospital Lahore. The duration of the study was three months after the topic of study was approved. CT scan Toshiba aquilion, 16 slices and Hitachi scenaria 128 slices and Ultrasonography Toshiba Nemio model, convex probe 3.75 MHz were utilized in the current study. All of the patients were subjected to FAST scan initially in FAST scan position spine with four abdominal views the hepato-renal interface (Morrison's pouch) Angle and the right diaphragm, the spleno-renal interface and left diaphragm, Pelvis in both planes - I. Longitudinal II. Transverse, Pericardial: Subxiphoid or intercostal views of the pericardium and Pleura Bilateral: The fifth view is the pleura (bilaterally). After FAST scan CT was conducted in CT scan patient position spine. Contrast is given in patients with abdominal injuries. Plain CT scan was done in patients with thoracic injuries. Ethical considerations of the study were insured permission was taken from the higher authorities of hospital. All the information and details obtained from the patients was kept confidential. The subjects were explained in detail their rights related to study as well their right to withdraw from the study any time they wanted. Informed consent was signed by the patients or their guardians. All the statistical analysis was done on 20 Statistical package for social sciences.

## Results

Our study included 125 participants and all of them were victims of blunt torso trauma by road accidents, falls and hits. The study included ninety six male (76.8%) participants and twenty nine female (23.2%) participants. The sample consisted of minimum six years of age and maximum fifty-nine years old. Most of the participants who participated in the study were around 37 years with mean age of  $37.87 \pm 11.678$  (table no 2). As evident from the study most of the participants who were involved in the study had no visceral injury ( $n=42$ ) 33.6%, followed by ( $n=32$ ) 25.6% patients with spleen injury, ( $n=29$ ) 23.2% patients who were victims of liver injury, ( $n=8$ ) 6.4% with bladder injury, kidney, lungs, large bowel and injury of pancreas respectively as depicted by the (table no 1). The number of positive and negative FAST scans confirmed by the CT scan are also shown in (table no 2). Cross tabulation was conducted to understand the correlation between CT scan and FAST scan results. It is evident from the table that 48 negative FAST scans were confirmed by CT scan with a percentage of 38.4% and 77 positive FAST scans were confirmed with a percentage of 61.6% by the utilization of CT scan after FAST scan on similar population. Various views in which the FAST scans were carried out are mentioned. It is evident from the findings that the highest number of FAST scans were carried out showed no free fluid with ( $n=48$ ) 38.4%, followed by interaperitoneal view ( $n=43$ ) 34.4%, Hepatorenal ( $n=13$ ) 10.4%, pelvic views of scan were ( $n=8$ ) 6.4%. There were four FAST scans in perihepatic direction, pleural space direction and the Retroperitoneal direction. ( $n=2$ ) were carried in pleural and splenorenal view. Lowest FAST scans ( $n=1$ ) were carried out in peritoneal and RIF view (table no 3) it also displays the different views in which CT scans were conducted on the sample population. It can be seen that most of the scans showed no visceral injury ( $n=40$ ) 32% followed by Laceration view ( $n=32$ ) 25.6%, ( $n=29$ ) 23.2% scans of hematoma view, ( $n=8$ ) 6.4% of Hemorrhage, ( $n=7$ ) 5.6% contusion and the remaining eight scans were carried out on one or two participants of capsular tear, pleural effusion, density fluid, perinephric fluid, pulmonary laceration and rupture. Overall various organs of the participants were affected when they faced blunt torso injury. The results represented that following values of FAST scan were achieved sensitivity was high 100%. Specificity was calculated to be 91.67 %, positive predictive value was found to be 85.42 % and negative predictive value was calculated 100% (table no 4).

Table 1: Frequencies and percentages of the organs injured of the sample under study

Organs Effected	f	%
Bladder	8	6.4
Kidneys	6	4.8
Liver	29	23.2
Lungs	6	4.8
Pancreas	1	.8
No	42	33.6
Spleen	32	25.6
Large Intestine	1	.8

Note. f=frequency, %=percentages

Table 2

Cross tabulation of positive and negative FAST scans within the positive and negative scans of CT scan

		CT P/N Positive
FAST P/N scan	Negative count within CT P/N	48 38.4 %
	Positive Count within CT P/N	77 61.6 %
Total	Count within CT P/N	125 100 %

Note. FAST=Focused assessment sonographic trauma, CT=Computed tomography, P/N=Positive/Negative

Table 3

Frequencies and percentages of the demographic characteristics of sample

Variable	f	%
<b>FAST</b>		
Hepatorenal	13	10.4
Intraperitoneal	43	34.4
Perihepatic	3	2.4
Pleural space	1	2.5
Retroperitoneal	3	13.3
Spleno renal space	2	1.6
No FF seen	48	38.4
RIF	1	.8
Pleural	2	1.6
Pelvic	8	6.4
Peritoneal	1	.8
<b>CT</b>		
No visceral injury	40	32.0
Pulmonary laceration	1	.8
Capsular tear	2	1.6
Contusion	7	5.6
Density fluid	1	.8
Hematoma	29	23.2

Hemorrhage	8	6.4
Laceration	32	25.6
Perinephric fluid	1	.8
Pleural effusion	2	1.6
Rupture	1	.8

Note. FAST=Focused assessment sonographic trauma, CT=Computed tomography, f=frequency, %=percentage

Table 4

Sensitivity	100%
Specificity	91.67%
NPV	100%
PPV	85.42%

Note. %=percentage, NPV=Negative predictive value, positive predictive value

## Discussion

In present study CT scan and FAST were utilized for the assessment of Blunt torso trauma in 125 victims. Most of the participants in current study were males including 76.8 percent of males which is consistent with the previous studies as more men get involved in outdoor activities, road accidents and other blunt injuries because not many females get inadvertent wounds these factors combined leads to more males who are victims of blunt torso trauma<sup>14</sup>. Moreover, it is observed that instead of abdominal contrast CT scans, the use of FAST inspection has increased and its function as only imaging tool for blunt torso trauma has also increased. Precise evaluation of subjects with blunt torso trauma is a challenging task for emergency doctor by utilizing FAST method to detect abdominal free fluid is a quick solution that can be used by an affordable, compact unit of sonography during the initial survey. While CT of abdomen is considered the set standard as being best, but it has its drawbacks high expenditure and time, the requirement to move the subject from the emergency department and radiation exposure means that ultrasound can safely replace it, as long as FAST presents high values sensitivity and specificity<sup>15</sup>. Our study shows consistency with previous studies by showing very high values of sensitivity and specificity were obtained 100 percent sensitivity and 91.67 percent specificity. Computed tomography is considered a gold standard for blunt torso trauma as it includes shifting the patient, long time of assessment and also exposes the patient to different types of radiations. As a result, the FAST is increasingly being used in emergency departments and in trauma referral centres because of the workload in emergency as well radiology departments as it can easily be done on bedside. Therefore, the US plays a major part in the classification of victims who may require more procedures for hemodynamic stabilisation<sup>16</sup>. It was congruous in current study as a few patients with critical injuries could not be shifted for CT scanning due to shortage of time so it was preferable to shift the seriously injured patients for treatment procedures directly without undergoing CT scan. Research has shown that road traffic incidents, falls and attacks are responsible for most cases of Blunt torso trauma. The most often damaged organs are liver, spleen, visceral injuries and kidneys in blunt abdominal trauma which is congruous with the findings of our study most of the patients had no visceral injury (n=42), victims with spleen injury (n=32), liver injuries (n=29) showing consistency with previous findings<sup>17</sup>. Current Study also showed high negative and positive predictive values 100% and 85.42% respectively which is congruous with previous studies showing high npv and ppv values as in a recent study conducted in 2019 in which FAST scans were conducted to assess blunt torso trauma and the ppv and npv 90% and 80.5%<sup>18</sup>. In the present study most of the participants were between the age range 25 and 50. It is different from the findings of previous studies where most of the participants were of younger age as they tend to spend life in outdoor areas as compared to older people<sup>16</sup>. In this study it might be that the patients included different people who travelled on motor cycles and had a greater chance of injury and it depends upon the type of vehicle and driving skills. However there were few patients of young as well old age, around sixty as these age groups tend to be dependent upon other figures and are not used to of outdoor experiences that much. Keeping in view the findings of current study and comparing them with previous studies carried around the world in assessing the diagnostic accuracy of FAST scan VS CT scan it is clear that both play a major role in diagnosis of blunt torso trauma and are

increasingly being used in emergency departments, but it is recommended to get the CT scan of the patient done after FAST scan if the patient is stable for confirmation of in depth injuries and more accurate results (as shown in Image 1 and 2)



Image 1 :A patient showing free fluid in hepatorenal pouch.

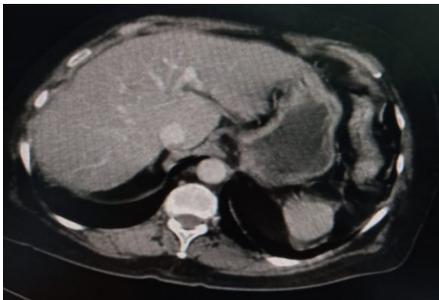


Image 2: Axial CT scan of a patient showing hepatic laceration and free fluid surrounding liver.

### Conclusion

CT scan is a superior diagnostic for the detection of Blunt abdominal trauma compared to USG. Although USG is very valuable tool, it can miss some of the crucial injuries which need immediate attention for the life of the patient. It is therefore recommended that if the patient is stable, all USG should be followed by CT scans.

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