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Original Research Article

Evaluation and management of blunt injury abdomen based on focussed assessment with sonography in trauma

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ABSTRACT

Background: The initial evaluation of patient with multiple trauma is a challenging task. FAST (focussed assessment with sonography in trauma) provides a viable alternative to computed tomography in blunt abdominal trauma patient. The aim of this study was to find the accuracy and utility of FAST in clinical decision making, as well as limitations.
Methods: A total of 100 patients with blunt abdominal trauma who underwent FAST examination were included. Positive scan was defined as the presence of free intraperitoneal fluid. The sonographic scoring for operating room triage in trauma (SSORTT Score) was calculated using cumulative sum of ultrasound score, systolic blood pressure, and pulse rate. FAST findings were compared with computed tomography findings and in operated cases compared with surgical findings & clinical outcome.
Results: We determined SSORTT score in all 100 cases. In our study, the sensitivity, specificity, positive and negative predictive values for FAST in identifying intraabdominal injuries were 93.9%, 94.2%, 87.5%, and 97.2%. In our study we found out that patients with a SSORTT score of 2 and above had a high likelihood of requiring a therapeutic laparotomy.
Conclusions: In our study we found that FAST is a rapid, reproducible, portable and non-invasive bedside test, and can be performed at the same time as resuscitation. Ultrasound is limited mainly by its low sensitivity in directly demonstrating solid organs injuries.

Keywords: Abdominal trauma, Focussed assessment with sonography in trauma, Computed tomography, Management

INTRODUCTION

Trauma burden globally is on the increase accounting for high levels of mortality and morbidity. WHO also estimates that, by the year 2020, trauma will be the first or second leading cause of "years of productive life lost" for the entire world population in both developed and developing world.[1]

It is the leading cause of death from ages 15-44 in the developed countries, and an ever-increasing cause of death and disability in the developing world. In fact, traumatic injury may soon outpace infectious diseases as a leading cause of worldwide mortality.[1] Abdominal injuries rank third as a cause of traumatic death just after head and chest injuries.[2] Diagnostic peritoneal lavage (DPL), ultrasound, and computed tomography (CT) are typical tests used for abdominal evaluation in trauma.[3,4] Diagnostic peritoneal lavage has disadvantage of being invasive technique, hence it is not suitable for conscious traumatic patients and in pediatric patients.[5]

Ultrasound has become a standard of care in most emergency departments. Bedside ultrasonography

provides non-invasive, readily available, and time-saving option for patients with blunt abdominal trauma.[6,7]

CT has replaced diagnostic peritoneal lavage (DPL) as the first method of choice in many trauma centers worldwide.[8,9] However, it has several disadvantages as it is relatively expensive, involves the usage of ionizing radiation and requires the shifting of patient to the scanner which may interfere with ongoing resuscitation.

Emergent sonography in form of focused abdominal sonography for trauma (FAST) has emerged and been embraced as a rapid, non-invasive, and accurate method of evaluating blunt abdominal trauma that can be easily used by emergency room clinicians and trauma surgeons. FAST is a rapid, four-view ultrasound examination carried out during the primary survey that assesses for haemoperitoneum, haemothorax, and haemopericardium.

The aim of this study was to discuss the accuracy and utility of FAST in clinical decision making, as well as limitations and also to determine whether specific SSORTT scores are good predictors of a need for a therapeutic laparotomy among blunt abdominal trauma patients in a low resource setting.

METHODS

This research is a prospective interventional study which was done in Hamidia Hospital Bhopal (Madhya Pradesh) from January 2016 to June 2017. Among all the patients who had come with a history of blunt abdomen trauma, 100 patients who were admitted were selected using purposive sampling technique included in the study.

Inclusion criteria

Inclusion criteria were clinical suspicion of intra-abdominal injury, haemodynamically stable and unstable patient.

Exclusion criteria

Exclusion criteria were pregnant patients, morbid obese patients, children less than 14-year age with trauma.

Upon arrival in the Emergency unit patients with suspected blunt abdominal trauma were screened. All patients were adequately resuscitated and investigated as per the standard of care protocol.

Assessment was done using advances trauma life Support protocol. History and physical examination findings were recorded on pre-coded questionnaires.

Patients suspected to be having BAT were positioned in supine position and underwent FAST using sonosite TITAN portable ultrasound machine with a transducer frequency ranging from 3.5 to 5 MHz.

FAST sonography was performed for all the 100 patients by emergency surgery resident (principal investigator) and radiologists who were blind to the other tests.

A cumulative sum of the three parameters ultrasound score, systolic blood pressure, and pulse rate were determined and used as the SSORTT score. Positive scan was defined as the presence of free intraperitoneal fluid. Abdominal CT as the gold standard were done for all stable patients. All admitted patients were followed up for three days to determine whether they had laparotomy or not. Considering the SSORTT score, the decision regarding definitive management of the patient was made (Figure 1).

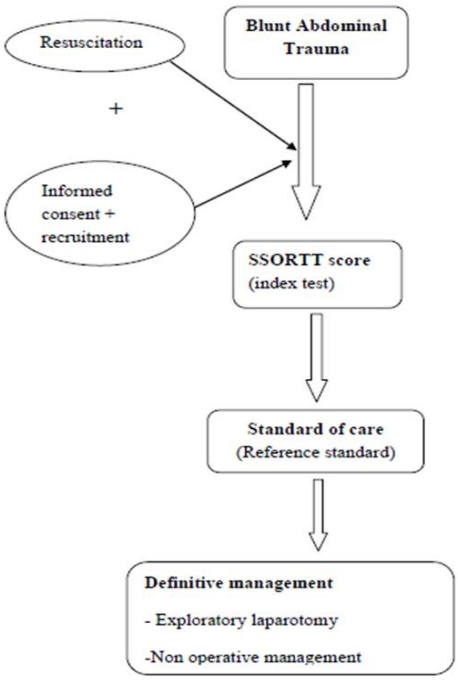

Figure 1: Procedure.

Performing FAST examination

Basically, the ultrasound procedure allows to assess four windows including perihepatic space, hepatorenal space, perisplenic space, pelvis and pericardium. A FAST protocol extension, the extended-FAST, was developed aimed to extend the evaluation, previously restricted to heart and abdominal wall evaluations, to the chest cavity, allowing pneumothorax, hemo-thorax and diaphragm rupture diagnosis (Figure 2).

Qualitative FAST reliably detected about 200 ml of free intraperitoneal fluid. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of Focused assessment with sonography for trauma in detecting hemoperitoneum in blunt abdominal trauma.

The sonographic scoring for operating room triage in trauma (SSORTT score) was calculated. The SSORTT

score was defined as a sum of the ultrasound haemoperitoneum score, systolic blood pressure, and pulse rate (Table 1).[18]

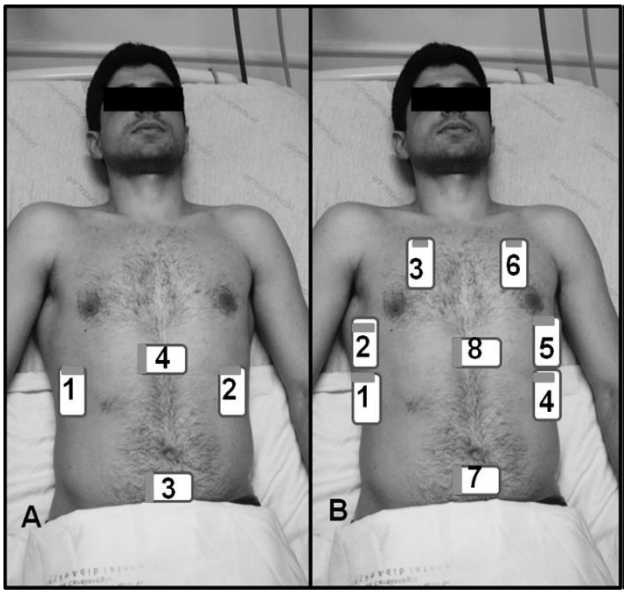

Figure 2 Rupture diagnosis.

Table 1: SSORTT scoring system.

Variable	Points
Ultrasound score	
0 (No free fluid)	0
1 (Fluid in one location)	2
>1 (Fluid in more than one location or >2 mm in morrison or douglas pouch)	3
ED pulse	
<120 beats/min	0
≥120 beats/min	2
ED Systolic blood pressure	
>90 mm Hg	0
<90 mmHg	1
Total	0-6

ED: Emergency Department

Ethical considerations

Ethical approval was obtained from the research and ethical committee of Gandhi Medical College.

Statistical analysis

Data were collected using pretested questionnaires. Stored data were exported to Stata version 8.0 for analysis.

RESULTS

An analysis of data collected from 100 patients with blunt abdominal trauma admitted to Hamidia Hospital Bhopal who undergone FAST examination was done. The data obtained was observed and tabulated on various parameters.

Of all the 100 cases, maximum (71%) of patients belong to the 20-40 years age group. Of the age group involved in abdominal trauma, the age group 41 to 60 years and above 60 years constituted 10 percent (10 cases) and 8 percent (8 cases) respectively. Mean of the age distribution was 23.29±14.47 years (Table 2).

Table 2: Age distribution of blunt abdominal trauma patients.

Age group (in years)	No. of patients	%
<20	11	11
20-40	71	71
41-60	10	10
>60	08	08
Mean±SD	23.29±14.476	

In present study, majority of the cases were male (86%) and only 14 % were female. Males clearly outnumbered females (Table 3).

In our study, 54% of the cases arrived hospital after 1-2 hours of injury and only 4% of the cases arrived within one hour.

Table 3: Sex distribution.

Sex	No. of cases (%)
Male	86 (86)
Female	14 (14)

In our study, majority (53%) of the blunt trauma abdomen injury cases were caused due to road traffic accidents, followed by Assault (32%) (Table 4).

Table 4: Mode of injury.

Mode of injury	No. of cases	%
RTA	53	53
Assault	32	32
Fall	10	10
Others	05	05

Table 5: Fast positive and fast negative cases.

Fast examination	Positive confirmed by laprotomy or CECT (n=30)	Negative confirmed by repeat USG, CECT (n=70)
FAST positive	28 (true positive)	4 (false positive)
FAST negative	2 (false negative)	66 (true negative)

In our study, 30 percent cases were FAST positive and rest 70 percent were FAST negative. Out of 30 FAST positive cases, 28 were true positive. Out of 70 FAST negative cases, 66 cases were true negative (Table 5).

Table 6: Sensitivity, specificity, PPV and NPV of fast in bat cases.

	Formula	Values
Sensitivity	True positive/true positive +false negative	93.3%
Specificity	True negative/true negative +false positive	94.2%
PPV	True positive /true positive +false positive	87.5%
NPV	True negative /true negative +false negative	97.2%

NPV=Negative predictive value, PPV=Positive predictive value

In our study, the sensitivity, specificity, positive and negative predictive values for FAST in identifying intraabdominal injuries were 93.9%, 94.2%, 87.5%, and 97.2% (Table 6).

In our study therapeutic laparotomy was done in 23 cases (Table 7).

Table 7: Laparotomy findings: therapeutic laparotomy (n=23).

Laparotomy findings	No. of cases
Moderate to massive hemoperitonium	14
Grade iv/v solid organ injury	08
Bowel injury	06
Mesenteric tear	02
Bladder injury	01

In our study, 68% cases of the blunt trauma abdomen were associated with bruises and head injury was found 26% of the cases (Table 8).

Table 8: Injuries in blunt abdominal trauma patients.

Injury	No. of cases
Bruises	68
Abrasions	21
Cuts	09
Burn	02
Chest injury (rib hemothorax)	18
Occular injury	03
Head injury	26

In our study, sixty cases had SSORTT score of zero, twelve cases had score 1, six cases had a score of 2, seven cases had the score of 3, seven cases had the score of 4, five cases had the score of 5 and three cases had the score of 3 (Table 9).

Table 9: SSORTT scoring in blunt abdominal trauma cases.

SSORTT score	Total bat cases (n=100)
0	60
1	12
2	6
3	7
4	7
5	5
6	3

In our study, 68 cases were FAST negative and 32 cases were FAST positive. Majority of the cases that were FAST negative 58 cases (85.2 %) had the SSORTT score of zero. Twenty-four cases (75 %) of the FAST-positive cases had SSORTT score>2 (Table 10).

SSORTT score was defined as a sum of the ultrasound haemoperitoneum score, systolic blood pressure, and pulse rate. 20/23 (86%) patients who had therapeutic laparotomy had a SSORTT score of≥3. 59/77 (90%); patients who had nonoperative management had a SSORTT score of≤1 (Table 11).

Table 10: SSORTT score among fast positive and fast negative cases.

SSORTT score	Fast positive (n=32)	Fast negative (n=68)
0	2	58
1	1	11
2	3	03
3	6	01
4	7	00
5	5	00
6	3	00

Table 11: SSORTT score of blunt abdominal trauma cases predicting therapeutic laparotomy.

SSORTT score	Laparotomy (n=23)	No laparotomy (n=77)
0	1	59
1	0	12
2	2	04
3	5	02
4	7	00
5	5	00
6	3	00

DISCUSSION

This study included 100 patients presenting with blunt abdominal trauma (BAT) to Hamidia Hospital in Bhopal (Madhya Pradesh), during the period January 2016 to June 2017.

In this study the overall males to female ratio was 6:1 indicating that males outnumbered females. Furthermore, if one looks at the young (0 -39 years) and the older patients (40-79 years), the male to female ratio is 6.8: 1 at young age. In the older age group, it falls to 5:1. It is notable that few old men and women were admitted to this study (n=8)

This may be due to the fact that our Indian society restricts the female to the house, and a lot of females are not allowed to drive cars.

The SSORTT score was defined as a sum of the ultrasound haemoperitoneum score, systolic blood pressure, and pulse rate. 20/23 (86%) patients who had therapeutic laparotomy had a SSORTT score of≥3. 59/77 (90%); patients who had nonoperative management had a SSORTT score of ≤1.

More than 80% of the patients with abdominal tell-tale signs and head injury were subjected to a laparotomy. Majority of the patients with head injury were subjected to nonoperative management.

Among therapeutic laparotomy patients, massive haemoperitoneum was the commonest finding, followed by solid organ injury and gut perforation.

In our study we found out that patients with a SSORTT score of 2 and above had a high likelihood of requiring a therapeutic laparotomy and those below that were unlikely to need one.

Of the 77 patients that did not undergo laparotomy 3 patients died and the rest were either discharged or still admitted by day three. The 3 patients had multiply injured with severe extra-abdominal injuries.

Majority of patients that died had a SSORTT score of>2. All patients that passed away with intra-abdominal fluid had scores of>2.

SSORTT scoring had excellent diagnostic accuracy for identifying patients that needed or did not need a therapeutic laparotomy with sensitivity of 86.9 % and specificity of 88.5%.

In our study, sixty cases had SSORTT score of zero, twelve cases had score 1, six cases had a score of 2, seven cases had the score of 3, seven cases had the score of 4, five cases had the score of 5 and three cases had the score of 3.

The findings of this study are comparable to findings by Manka et al where patients with score of less than 1 were less likely to require a laparotomy.[10] The youths were mostly affected because they fall in the most active age bracket exposed to most injury risks.

Massive haemoperitoneum with solid organ injury was the commonest finding at laparotomy with ruptured spleen being the commonest solid organ injured followed by liver lacerations. There were six cases of gut perforations, one urinary bladder rupture and one with mesenteric tears.

In a study by Katz et al sensitivity, specificity, positive and negative predictive values for US in identifying intraabdominal injuries were 90.9%, 83.6%, 55.5% and 98.9%, respectively.[11] These values were reported as 94.6%, 95.1%, 88.3% and 97.8%, respecively, in the study by Yoshii et al.[12] and 84%, 96%, 61% and 99%, respectively, in the retrospective study performed on 2,693 patients by Brown et al. The results obtained in our study were similar to those of Katz et al. and Brown et al.

In our study, the sensitivity, specificity, positive and negative predictive values for FAST in identifying intraabdominal injuries were 93.9%, 94.2%, 87.5%, and 97.2%.

In the study by Yoshii et al that was performed on 1,239 patients, 19 false negative and 44 false positive results were reported. In all of these false positive results, minimal free fluid was identified by US; among these, 18 patients were identified with thoracic trauma, 10 with pelvic fractures and one with vertebral fracture, while 18 did not have any extra-abdominal injury.[12]

In the study by Richards et al on 3,264 patients, 132 false negative and 57 false positive results were reported.[13] In most of the false positive results, minimal free fluid was reported in US, yet this was not confirmed by other diagnostic tests.[13] In a different study by Richards et al. on 744 patients, out of 51 patients who had free fluid identified by US, 9 were false positive results; of these 9 patients 7 were female patients who had pelvic free fluid.[13] Hence, most of these false positive results were reported to be originating from the physiological fluid observed in females.[13]

A study by Brown et al on 92 patients, who had false positive results by US, revealed that 31 had no evidence of pathology on CT and 26 had had normal physiological free fluid.[14]

There are some studies which report that pelvic fractures might themselves cause intraabdominal free fluid in the absence of intraabdominal injuries.[15,16]

In a study by McKenney et al performed on 200 patients, false positive results by US examination, that were not correlated with the results of CT or DPL, were reported.[17] Of those patients in the study, 4 had solid organ injuries

(spleen and liver), and 2 had both hemoperitoneum and solid organ injuries.[17]

In a study by Richards et al of the 132 false negative results that were reported; 50 were splenic injuries, 46 were liver injuries, 40 were GI and 19 were renal injuries.[13]

In our study, there were 2 false negative results. These patients were diagnosed to have gastro-intestinal injuries. It is clear that both in the previous studies and also in our current study, one of the most important reasons that has led to false negative results was gastro-intestinal injury. When no free fluid is present in the abdomen, FAST is not successful in detecting the gastro-intestinal injuries.

In our study most of the patients (73.9 %) that underwent laparotomy did not had any complications. Wound infection was found in 2 cases and intra-abdominal collection were found in 2 cases that underwent laparotomy.

Limitations

Limitations of the study were the sample size was small to correctly evaluate role of FAST in detection and grading abdominal injuries in trauma. Ultrasonography is highly accurate in detecting intraperitoneal fluid but it cannot differentiate between blood, urine, bile or ascites. That is why the sonographic findings have to be correlated with the clinical findings to make critical decisions. FAST has to be used within a diagnostic algorithm to have a proper role. Ultrasound is limited mainly by its low sensitivity in directly demonstrating solid organs injuries.

CONCLUSION

FAST findings correlated well with intraoperative and computed tomography findings (p value<0.05). Our study proved that FAST ultrasound is a useful and non-invasive procedure that can be done at the patient's bedside. Therefore, it can be integrated into the primary or secondary survey. FAST ultrasound decreases the time to diagnosis for acute abdominal injury in BAT and helps accurately diagnose hemoperitoneum.

This study found SSORTT score had excellent diagnostic accuracy for identifying patients that needed therapeutic laparotomy at SSORTT scores greater than 2. SSORTT should be adopted for routine use in low technology settings.

Men in age group of 20-40 years are found to be mainly affected as they form the majority of the working population who are exposed to accident during travel or at place of work. This age group should have compulsory awareness programmes by government.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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