ORIGINAL ARTICLE

VALIDITY OF THE FAST SCAN FOR DIAGNOSIS OF INTRAABDOMINAL INJURY IN BLUNT ABDOMINAL TRAUMA

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Background: Blunt abdominal trauma is regularly encountered in the emergency department. The aim of the study is to determine the validity of assessment with sonography for trauma (FAST) scans in the evaluation of BAT in comparison to Computed tomogram/Exploratory laparotomy (CT/ELAP). **Methods:** This cross-sectional study was carried out at Ayub Teaching Hospital Abbottabad from January 2010 to December 2011. FAST was performed as part of the primary or secondary survey of the trauma patient in the emergency department in all patients with suspected blunt abdominal trauma. All of them also underwent either CT or ELAP depending on their clinical condition. The validity of FAST scan in comparison to CT/ELAP was documented. **Results**: Our study included 100 patients with suspected blunt abdominal trauma. The mean age was 31.52±16.79 years with 88% males. Road traffic accidents accounted for 80% cases and 20% were due to fall. Seventy percent were hemodynamically stable and 30% were unstable. Haemodynamically unstable patients had significantly more positive FAST scans and more positive CT/ELAP (p<0.05). Of the total, 52% had positive CT/ELAP and 54% had positive FAST scan. Majority (28%) had splenic injury. A positive scan had a statistically significant probability of a confirmed blunt abdominal trauma on CT/ELAP; p=0.00, OR=8.095, 95% CI=3.3–19.8. FAST scan had a sensitivity, specificity, positive predictive value and negative predictive value of 76.92%, 70.83%, 74.07% and 73.9% respectively. **Conclusion:** FAST scan had lesser accuracy as compared to previously published local and international data. More work is required before it can be routinely utilized to triage the blunt abdominal trauma patients to laparotomy.

Keywords: Blunt, abdominal trauma, laparotomy, FAST, scan

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INTRODUCTION

Blunt abdominal trauma (BAT) is regularly encountered in the emergency department with a reported mortality rate of around 11%.[1] Vehicular trauma is by far the leading cause of blunt abdominal trauma in the civilian population. Auto-to-auto and auto-to-pedestrian collisions have been cited as causes in 50–75% of cases.[2] Rare causes of blunt abdominal injuries include iatrogenic trauma during cardiopulmonary resuscitation, manual thrusts to clear an airway, and the Heimlich manoeuvre. Commonest involved organs include spleen and liver.[3]

Clinical assessment for possible intra-abdominal injury following blunt abdominal trauma is often unreliable, due to decreased patient consciousness, neurological deficits, medications, or other associated injuries.[4] Diagnostic peritoneal lavage is superior to clinical examination in assessing abdominal injuries, however, it is an invasive procedure and carries the risk of producing organ injuries. It also decreases the specificity of later ultrasound and/or computed tomography.[5] The accuracy of CT in hemodynamically stable blunt trauma patients has been well established. In a recent study the authors concluded that the negative predictive value (99.63%) of CT was sufficiently high to permit safe discharge of BAT patients following a negative CT scan.[6] CT is the standard investigation for blunt abdominal trauma but it entails inevitable time delay, requires patient transfer, and is unsuitable for hemodynamically unstable patients. Exploratory laparotomy (ELAP) confirms beyond doubt the presence or absence of intra-abdominal injury however not all patients with blunt abdominal trauma may undergo a laparotomy. Focused Assessment with Sonography in Trauma (FAST) is a quickly performed screening technique aimed at exploring the deep peritoneal recesses to detect collections of free fluid, as an indirect sign of acute haemorrhage and injury to visceral organs.[7,8] Bedside, ultrasound is an integral component of trauma management used primarily to detect free intra-peritoneal fluid after blunt trauma.[9] The trauma US examination focuses on dependent intra-peritoneal sites where blood is most likely to accumulate: the hepatorenal space (i.e., Morrison's pouch), the splenorenal recess, and the inferior portion

of the intra-peritoneal cavity (including pouch of Douglas). Anechoic (i.e., dark) areas caused by the presence of blood are best visualized when contrasted against solid organs (e.g. liver, spleen, and kidneys). These studies, when combined with evaluation of the pericardium, are referred to as the FAST scan (Focused Assessment with Sonography for Trauma). FAST sensitivity has been reported ranging widely: 64–98%.[10,11] Specificity is high, at 86–100%.[12] FAST provides a viable alternative to other investigations in the blunt abdominal trauma patient, and can be integrated into the primary survey in patients with signs of hemorrhagic shock or suspicion of intraabdominal injury. It has the additional advantages of being non-invasive, reproducible, and is capable of being rapidly performed at the patient's bedside by the physician on emergency duty. Indeed, the FAST scan is often regarded as being a simple extension of clinical examination rather than a definitive diagnostic investigation.

In this study we recruited patients with blunt abdominal trauma and subjected them to the FAST scan. We later performed CT abdomen and/or exploratory laparotomy of these patients depending upon the clinical situation. In our study we compared the results of FAST scans with the results of CT scan abdomen and/or laparotomy. If we are able to document the validity of FAST scan, we can integrate FAST scan into the primary survey in patients with suspicion if intraabdominal injury and here Fast can provide a viable, cheap and easy alternative to other investigations in blunt abdominal trauma patients.

MATERIAL AND METHODS

This cross-sectional validation study was carried out at Ayub Teaching Hospital Abbottabad, from January 2010 to December 2011. Patients with a history of or mechanism of injury suggestive of blunt abdominal injury, any subjective complaints of abdominal or flank pain, presence of abdominal tenderness to palpation, presence of abdominal distension, external signs of injury such as abdominal wall bruising ("seat-belt sign") or elicitation of any peritoneal signs were included and patients with penetrating abdominal injuries were excluded.

FAST was performed as part of the primary or secondary survey of the trauma patient in the emergency department. Using a portable ultrasound machine, the scans were performed and interpreted by a radiologist within 1 hour of the patient arriving the hospital. An ultrasound machine with live 2-D mode (rapid B-mode) and transducer frequencies between 3–6 MHz was used. CT was recommended for the evaluation of haemodynamically stable patients. In FAST negative patients if they were haemodynamically stable they were retained for observation for repeat clinical examination and CT. If they were haemodynamically unstable they were further evaluated for other causes of haemorrhage, by diagnostic peritoneal lavage (DPL) and if indications are fulfilled they underwent a laparotomy. Patients with FAST positive scans were admitted. If haemodynamically stable they were further evaluated by DPL and/or contrast enhanced CT of abdomen and pelvis. If indicated they underwent a laparotomy. If unstable they underwent an ELAP. All patients with indeterminate (inconclusive) FAST scan due to patient size, subcutaneous emphysema, or limited sonographic windows were treated as positive studies. Surveillance studies (i.e., DPL, CT, repeat FAST) were required in haemodynamically stable patients with indeterminate FAST results.

Laparotomy after injury from a blunt mechanism was based on following potential indications: unexplained signs of blood loss or hypotension in a patient who could not be stabilized and in whom intraabdominal injury was strongly suspected; clear and persistent signs of peritoneal irritation; radiological evidence of pneumoperitoneum consistent with a viscus rupture; evidence of a diaphragmatic rupture; persistent, significant gastrointestinal bleeding seen in naso-gastric drainage or vomitus; exploratory laparotomy indicated for patients with a positive DPL; exploratory laparotomy indicated in haemodynamically unstable patients with a positive FAST or a CT scan suggestive of intraabdominal injury.

All patients in the study underwent a FAST scan. All of them also underwent either CT or ELAP depending on their clinical condition. FAST examination results, which were recorded as positive or negative and were compared with the findings on CT or exploratory laparotomy, which were considered definitive.

RESULTS

Our study included 100 patients with suspected blunt abdominal trauma. The age ranged from 2–71 years with a mean age of 31.52±16.79 years. We have noted results as percentages which are also the numbers owing to sample size of 100. It included 88% males and 12% females. Eighty percent cases were due to road traffic accidents, 20% were due to fall and no cases were due to domestic violence as shown in Table-1. Thirty percent were haemodynamically unstable.

All patients underwent a FAST scan. Eight percent had a DPL performed and it was positive in two cases. Exploratory laparotomy was performed in 42% patients. CT scan was performed in 80% patients.

Twenty-two percent patients had both CT scan and also underwent an exploratory laparotomy.

Fifty-two percent had positive CT/ELAP and 48% had a negative CT/ELAP. Fifty-four percent had positive FAST scan and 46% had a negative FAST scan. No injury was detected in 44% patients. Among concomitant injuries splenic injury was observed in 22% cases. (Table-2)

Among 54 Positive FAST patients; 40 (74.1%) had confirmed blunt abdominal trauma on CT/ELAP and 14 (25.9%) had negative CT/ELAP. Among 46 negative FAST patients; 12 (26.1%) had confirmed blunt abdominal trauma on CT/ELAP and 34 (73.9%) had negative CT/ELAP as shown in Table-3. Hence patients with a positive scan had a statistically significant probability of a confirmed blunt abdominal trauma on CT/ELAP. (p=0.00, OR=8.095, 95% CI=3.303–19.840)

Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of the FAST scan in comparison to CT/ELAP was 76.92%, 70.83%, 74.07% and 73.9% respectively. FAST scan was correct in 74% cases. When the results of FAST and CT/ELAP were compared using the chi-square test it was found that patients with a positive FAST scan had a statistically significant probability of having a confirmed blunt abdominal injury on CT/ELAP. (p=0.00, OR=8.095, 95% CI=3.3–19.8)

Table-1: Mechanism of injury

Mechanism of Injury	Patients, (%)
Fall <2 m	9%
Fall >2 m	11%
RTA, driver	21%
RTA, front seat passenger	9%
Motorbike rider	11%
Cyclist	6%
RTA, pedestrian	29%
RTA, rear seat passenger	4%
Total RTA CASES	80%
Total history of fall	20%

Table-2: Concomitant injury in trauma patients

Location	Number
Spleen	28
Liver	8
Kidney	2
Retroperitoneal hematoma	4
Pelvic injury	8
Gut perforation	4
Hemothorax	1
Hemopericardium	1

Table-3: Information for focused abdominal sonography for trauma (FAST)

	CT , LAP		
	Positive Number (%)	Negative Number (%)	Total
FAST Positive	40 (74.1%)	14 (25.9%)	54
FAST Negative	12 (26.1%)	34 (73.9%)	46
Total	52	48	100

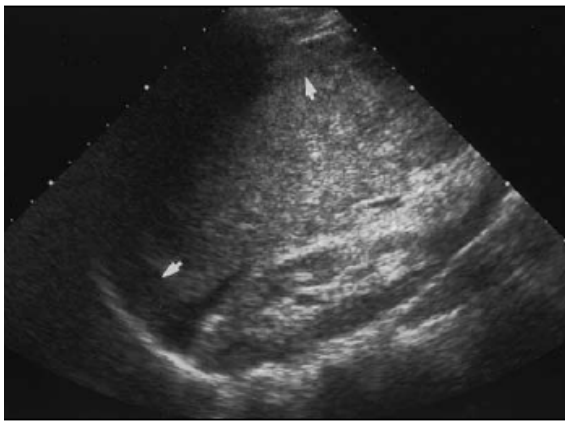

Figure-2: Image from a 23-year-old man with a splenic laceration after a motor vehicle accident

Longitudinal sonography of the left upper quadrant (LUQ) of the abdomen shows a hypo-echoic rim surrounding the spleen (arrows) and a heterogeneous appearance to the spleen.

DISCUSSION

Assessment of the abdomen for possible intraabdominal injury due to trauma is a common clinical challenge for surgeons and emergency medicine physicians. The true problem with torso trauma is not to determine the presence of an organ lesion, but to identify clinically significant intraabdominal injuries. Physical findings may be unreliable because of altered patient consciousness, neurological deficit associated with head injury or spinal injury, medication, or other associated injuries. In this scenario, the modalities available to the clinician in the emergency room are: diagnostic peritoneal lavage, clinician performed ultrasonography in the casualty department (FAST scan) and computed tomography scanning. DPL involves instillation of sterile normal saline in the peritoneal cavity and assessing the nature of effluent fluid to determine the probability of intraabdominal visceral injury. Although it is thought to be superior to clinical examination in assessing abdominal injuries, it is an invasive procedure with a risk of organ injury if performed by untrained persons. CT remains the radiological standard for investigating the injured abdomen but requires patient transfer to the CT scan suite and delay. It is unsuitable for patients who are haemodynamically unstable.

USG is an easily accessible, portable, non-invasive, and reliable diagnostic tool for assessment of abdominal trauma. It can be performed at the bedside in the casualty department by the clinician without causing delay in the management of the patient. The idea of focused ultrasonography is to specifically identify the presence of fluid, i.e., blood

or enteral contents in the peritoneal cavity, pleura or pericardium was mooted by McKenney *et al* in 1996.[13] Abdominal ultrasonography is less time consuming, economical, non-invasive, easily repeatable and easily available. It can even be used in resuscitation area in unstable patients. It is especially helpful in diagnosis of solid organ injuries. FAST scanning expedites disposition of trauma patients, decreasing time to definitive care and reducing demands for CT scanning.[14] A direct comparison of FAST and DPL by Chambers *et al* showed FAST scans to be a good alternative, with a 97% specificity and a much low complication rate.[15]

Our study was an effort to evaluate the role of focused assessment with sonography for trauma in blunt abdominal trauma in our local conditions. In our study, which included 100 patients with suspected blunt abdominal trauma, the calculated sensitivity, specificity, PPV and NPV of the FAST scan in comparison to CT/ELAP was 76.92%, 70.83%, 74.07% and 73.9% respectively.

Several international studies have investigated the reliability and accuracy of FAST scanning in trauma. A Cochrane systematic review found that the sensitivity for detecting haemo-peritoneum in trauma patients was 85–95% and the specificity higher.[16] In blunt trauma studies investigating FAST scanning, outcomes have demonstrated an average specificity of 90–99% and sensitivity of 86–99%.[17–19] Both local data by Baloch *et al*[20] and international data by Brooks *et al*[21] have reported an accuracy rate of 90% for FAST scan in blunt abdominal trauma. However, our data shows a lower accuracy rate of 74%.

FAST has largely supplanted DPL for blunt trauma assessment, while CT scanning remains the gold standard in terms of radiological assessment[22], it had been proposed that FAST may be an acceptable alternative in resource-poor facilities, where CT is largely unavailable without transfer.[23] FAST was only used to determine the presence of free intra-peritoneal fluid or pericardial fluid, and not specific organ pathology.

The lower accuracy of FAST scans in our set up may be because we only included one FAST scan per patient, so it seems likely that the accuracy might have been improved by serial scans in the ED. Repeated scanning can significantly increase the sensitivity of FAST. An increase from 78% with early FAST scans to above 90% was shown following repeated examinations for free intra-abdominal fluid.[24] We also focused on presence of free fluid as an indicator of intra-abdominal injury. Searching for parenchymal abnormalities as well as free fluid could have improved the sensitivity of ultrasonography as reported by some studies.[25] Moreover, in our study majority of the FAST scans were performed by the radiology residents and diagnostic accuracy can be increased by FAST scans being performed by senior radiologists or by specifically training the radiology residents in performing FAST scans.

The evaluation of patients with blunt abdominal trauma has undergone significant evolution in the last twenty-five years. The standard in the past was the performance of diagnostic peritoneal lavage to determine if the patient had suffered injuries that required operative intervention. With the evolution of non-invasive techniques, abdominal ultrasound and computerized tomography have become the currently utilized methods to assess for intra-abdominal injury.[26]

We can conclude that an unstable patient with clearly positive findings on FAST scan should undergo laparotomy while patients who are stable enough should have CT scan performed in addition to FAST scan before undergoing laparotomy. All peripheral hospitals in our region usually have access to an ultrasound machine routinely used for obstetrics that could also be used for FAST. In our setting, peripheral hospitals with no CT scanning and limited radiology could make use of ultrasound as a tool for supplying useful information to surgeons in referral hospitals.

CONCLUSION

Abdominal ultrasonography is less time consuming, economical, non-invasive, easily repeatable and easily available, it can even be used in resuscitation area in unstable patients and can be used easily, after training for brief periods, by surgeons and emergency medicine physicians with limited experience in ultrasonography. Hence, it can be utilized to triage the blunt abdominal trauma patients to laparotomy. However in our study Fast had lesser accuracy as compared to previously published local and international data. More work is required to find ways to improve the diagnostic accuracy of FAST scan so that it can become a viable alternative to other investigations in blunt abdominal trauma patients and can be integrated into the primary survey in patients with suspicion if intra abdominal injury.

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