

Evaluation of Focused Assessment Sonography for Trauma (Fast) Examination for Abdominal Trauma in Baghdad Teaching Hospital

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Abstract

Background: The focused assessment sonography for trauma (FAST) exam has been one of the most widely used applications in emergency bedside ultrasound and has become a standard part of the initial assessment and resuscitation of the trauma patient.

This is a prospective study of (76) patients presented with abdominal trauma and admitted to casualty department of Baghdad teaching hospital from June 2010 to January 2011 and they were subjected to focused assessment sonography in trauma examination (FAST).

Objective: To evaluate the sensitivity, specificity and accuracy of focused assessment sonography in trauma examination (FAST) for patients with abdominal trauma.

Patients and Method: Seventy-six patients presented with abdominal trauma were examined with (FAST) by emergency physicians, the results were considered positive if detects intra peritoneal fluid and negative if does not detect intra peritoneal fluid. All cases with positive results and hemodynamically unstable were sent for explorative laparotomy and those patients who were stable were kept under observation in the surgical ward for further examination and repeat FAST or CT scan. The cases of negative results and no other injuries were kept for observation in the surgical ward.

Results: Among the (76) patients (60 blunt, 16 penetrating) included in the study we found patients with blunt abdominal trauma, (13) patients (21.6%) had positive FAST results, (43) patients (71.6%) had negative FAST results, (2) patients (3.3%) had false positive results and (2) patients (3.3%) had false negative results.

In blunt abdominal trauma the sensitivity was 86.6%, specificity 95.5% and accuracy of 93%. Regarding the (16) penetrating trauma, (3) patients (18.75%) had positive results, (10) patients (62.5%) had negative results and (3) patients had false negative results. The sensitivity was 50%, specificity 100% and accuracy of 81%.

The overall sensitivity of this FAST study is (76.1%), specificity of (96.3%) and accuracy of (90%).

Conclusion: FAST examination for blunt abdominal trauma has a high sensitivity, specificity and accuracy rates in detecting intraperitoneal bleeding, while due to low sensitivity and high specificity in penetrating abdominal trauma, it can be used as "rule in" technique in evaluation of abdominal trauma victims.

Keywords: FAST; Abdominal Trauma; Penetrating Abdominal Trauma

Introduction

The (FAST) focused assessment sonography in trauma has assumed an increasing role in the management of patients presenting to the emergency department. Primary application has been in the evaluation of patients with blunt abdominal trauma but has expanded to include patients with penetrating trauma. The use of ultrasound for abdominal trauma was described initially by Kristensen and colleagues in 1971 [1].

FAST is an organized series of sonographic windows or views that attempt to identify the presence or absence of fluid in anatomic potential spaces (e.g. Pericardium or Morrison's pouch) or anatomically dependent areas (e.g. Pelvis, poster inferior thorax and splenorenal recess) (Figure 1-3). It's in fact a cardiac and thoracoabdominal survey that allows the physician to identify or exclude immediate or potential life threat in trauma patient [2].

Required views for FAST examination [1-5]:

1. Subxiphoid- cardiac window (sub costal view)
2. Right upper quadrant (Morrison's pouch) (Figure 1)
3. Left upper quadrant (splenorenal view) (Figure 2)
4. Suprapubic window (pelvic view) (Figure 3).

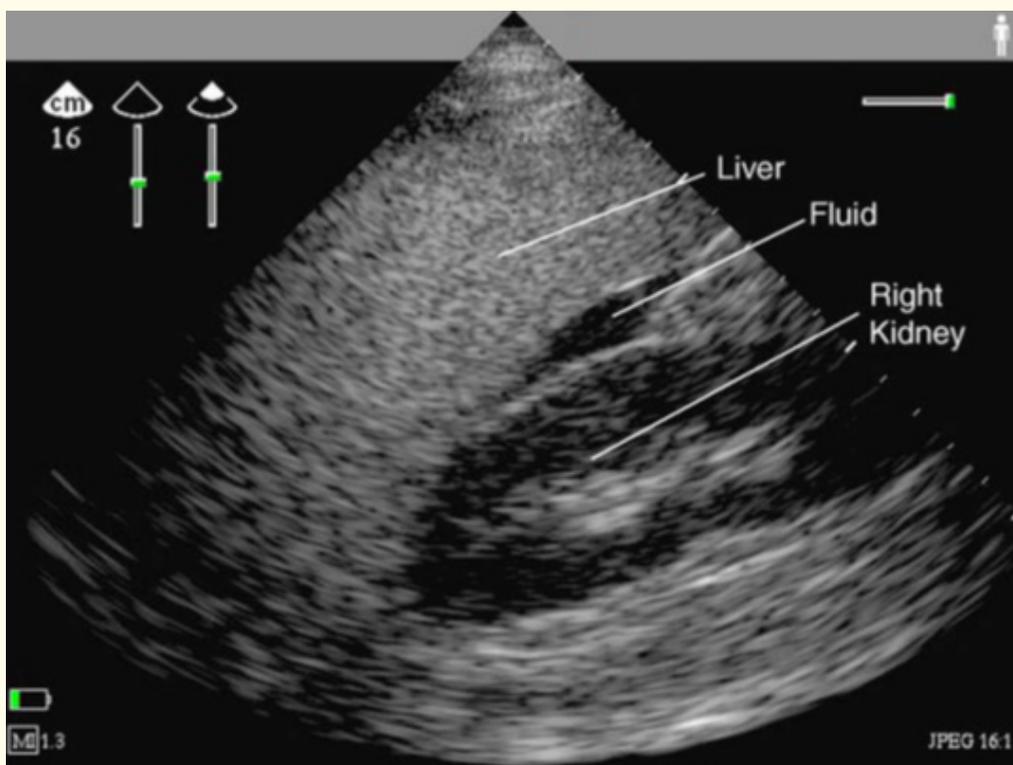


Figure 1: Fluid in hepatorenal interface.

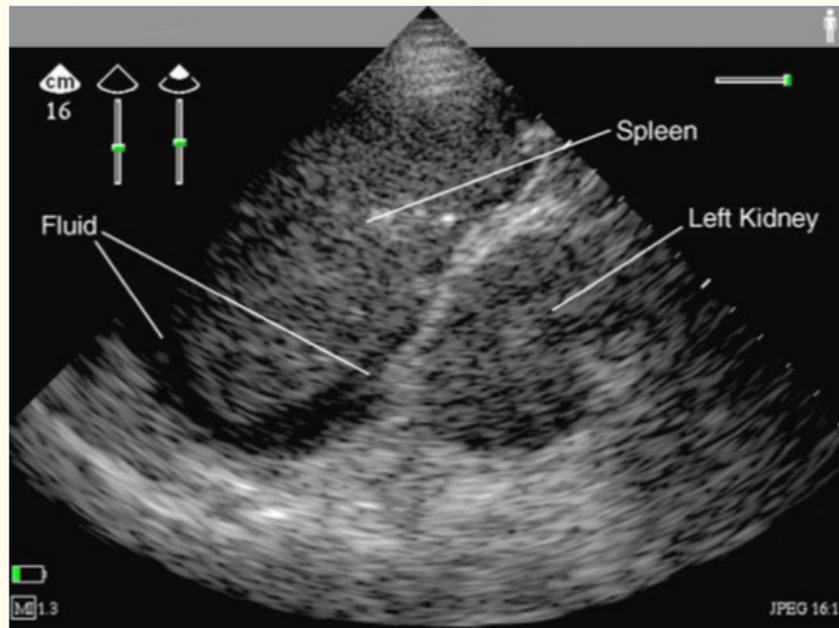


Figure 2: Fluid in splenorenal interface.

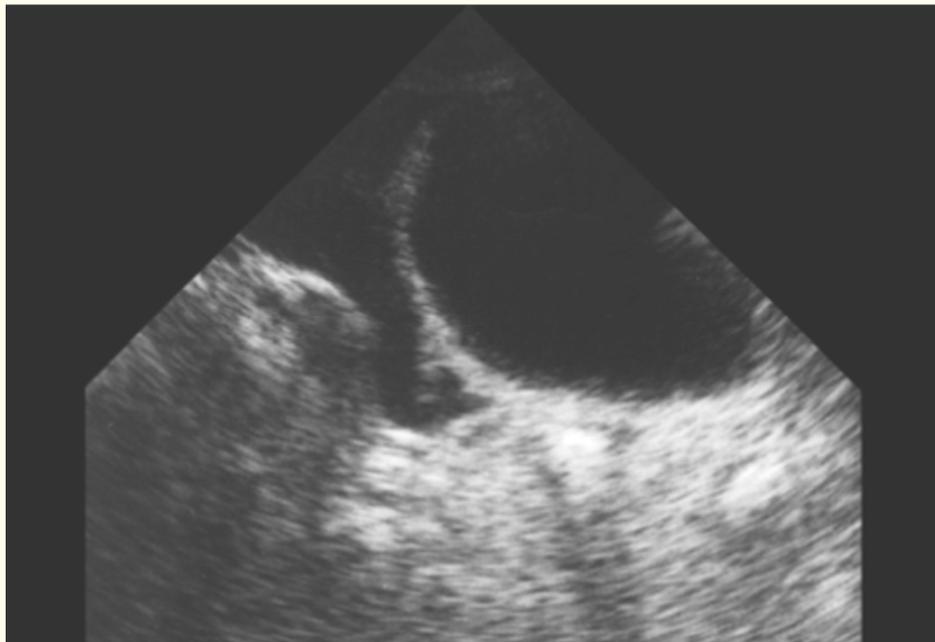


Figure 3: Pelvic view showing bladder and free fluid.

The volume of fluid required for a positive US depend on the site of injury and site of sonographic detection but generally 250 ml or greater is required, nearly 600 ml of fluid is necessary to cause a positive flank strips when fluid is from the pelvis [1,4].

The torso trauma ultrasound examination (often called EFAST) to detect pathologic free intraperitoneal fluid (typically hemoperitoneum, uroperitoneum, bile or bowel content), hemopericardium, hemothorax or pneumothorax [4]. Ultrasound has been reported to detect smaller quantities of fluid than chest radiography and as little as 20 ml of pleural fluid can be detected on ultrasound [6].

Typically, fluid in the peritoneum, pericardium and pleural cavity is anechoic (black) but it can have echogenicity with clotting, depending on the age of clot [2,5].

The FAST technique uses a low to middle frequency probe (2-5 MHZ) to evaluate dependent peritoneal spaces, pleural spaces and pericardium [2,4]. The trauma ultrasound does not capture every peritoneal injury [1,4,7]. Fast is not sensitive detector of solid organ injury [3,8].

Advantages of FAST examination: Noninvasive, can be repeated, portable, rapidly at patient's bedside, can be done while resuscitation in progress [3,5,9].

Disadvantages of US include the inability to determine the exact a etiology of the free intraperitoneal fluid and the operator-dependent nature of the examination. Other potential disadvantages of the FAST examination are the difficulty in interpreting the images in patients who are obese or have subcutaneous air or excessive bowel gas and the inability to distinguish intraperitoneal hemorrhage from ascites. The FAST examination also cannot evaluate the retro peritoneum as well as CT [3].

False positive FAST may be found in cirrhosis and in females who may have small amounts of physiologic free fluid in pouch of Douglas [7]. The only contraindication to ultrasound in trauma is an indication for emergency laparotomy [5].

The FAST examination is particularly useful for patients who [1]: are too hemodynamically unstable to leave the ED for CT scanning [2]; have a physical examination that is unreliable secondary to drug intoxication, distracting injury, or central nervous system injury; or [3] have unexplained hypotension and an equivocal physical examination [3]. Emergency physicians have prospectively demonstrated that the FAST examination could serve as a sensitive, specific and accurate diagnostic tool in the detection of free intraperitoneal and thoracic fluid in patients who had sustained major blunt or penetrating trauma. Overall, the FAST examination had a sensitivity of 90%, specificity of 99% and accuracy of 99% [3]. The FAST examination was found to be equally sensitive, specific and accurate for both blunt and penetrating torso trauma. Penetrating trauma patients could benefit from the rapid and accurate Information yielded by ultrasonography [3].

The identification and localization of significant hemorrhage in penetrating trauma patients would allow physicians "to prioritize resources for resuscitation and evaluation [3].

In our country the need for FAST examination to rapidly deal with trauma patients has been imperative and became expanded due to continuous terroristic ballistic attacks all over the country. In addition, FAST examination became a crucial part of training program for emergency medicine specialty in Baghdad teaching hospital.

Aim of the Study

- To evaluate the benefit of (FAST) examination in management of patients with abdominal trauma.
- To determine sensitivity, specificity and accuracy of (FAST) examination in abdominal trauma.

Patients and Methods

A prospective study of Seventy-six patients presented with abdominal trauma (blunt and penetrating) were admitted to the emergency room of Baghdad teaching hospital from June 2010 to January 2011 and received fully resuscitation measures and subjected to FAST examination by emergency physicians.

Four standard views were performed: right upper quadrant, left upper quadrant, subxiphoid and pelvic views. The ultrasound machine used was HONDA HS-2500, Transducer of 3.5 MHZ.

The test considered positive if free fluid is detected in any one of the above views.

Patients with clear indication for laparotomy were excluded from the study. Patients with positive FAST results and unstable general condition, usually send for operative room for laparotomy.

Patients with positive FAST results but they are stable general condition, admitted to the surgical ward for further evaluation for non-operative therapy, formal ultrasound or CT scanning.

But if deterioration occurs at any time then immediate laparotomy is considered. Patients with negative FAST results and without other injuries were kept in the surgical ward for observation, then discharged if not undergo any deterioration.

The methods used to confirm the results were laparotomy, formal ultrasound or CT scan.

The sensitivity, specificity and accuracy are calculated according to the following equations:

Sensitivity= no. of true positive/no. of true positive + false negative.

Specificity= no. of true negative/no. of true negative + false positive.

Accuracy= no. of true positive + no. of true negative/no. of true positive + false positive + false negative + no. of true negative.

Results

Seventy six Abdominal trauma patients (60 blunt, 16 penetrating) were admitted to the emergency room of Baghdad teaching hospital and submitted to (FAST) examination.

The demographic characteristics and mechanism of injury as shown in table 1 and 2. Among those (76) Patients with abdominal trauma, (60) were blunt abdominal trauma (78.95%), consist of 45 males (76%) and 15 females (25%), (16) were penetrating abdominal trauma (21%), consists of 14 males (87%) and 2 females (12.5%). Their age's ranges between 2 years and 70 years (Table 1).

Criteria	No. and % of patients
Total no. Of patients	76
Range of ages (year)	2 - 70
Blunt abdominal trauma	60 (79%)
Male: female ratio	M 45: F 15 (3:1)
Penetrating abdominal trauma	16 (21%)
Male: female ratio	M 14: F 2 (7:1)
Child ≤ 12 yr.	21

Table 1: Criteria and no. Of abdominal trauma patients.

Most of the injuries were due to motor vehicle accident (MVA), fall from height, blast injuries, bullets and stab injuries (Table 2).

Mechanism of Injury	Patients no. (%)	Male	Female
MVA	44 (73.3%)	33	11
FFH	12 (20%)	8	4
Other	4 (6.6%)	4	-
Total no. of blunt trauma patients	60 (79%)		
Blast	7 (43.75%)	5	2
Bullets	8 (50%)	8	-
Stab wounds	1 (6.25%)	1	-
Total no. of penetrating trauma patients	16 (21%)		

Table 2: Mechanism of injury.

MVA: Motor Vehicle Accident; FFH: Fall from Height.

Most of the injured victims of blunt abdominal trauma were due to motor vehicle accidents with predominance of males (Table 2) and age groups shows that young patients ages < 30 yr are affected more than other age groups (Figure 4). While penetrating abdominal trauma showed that bullets were the major cause followed by blast injuries (Table 2) and the most age group affected was 21 - 30 year with predominance of males (Figure 5).

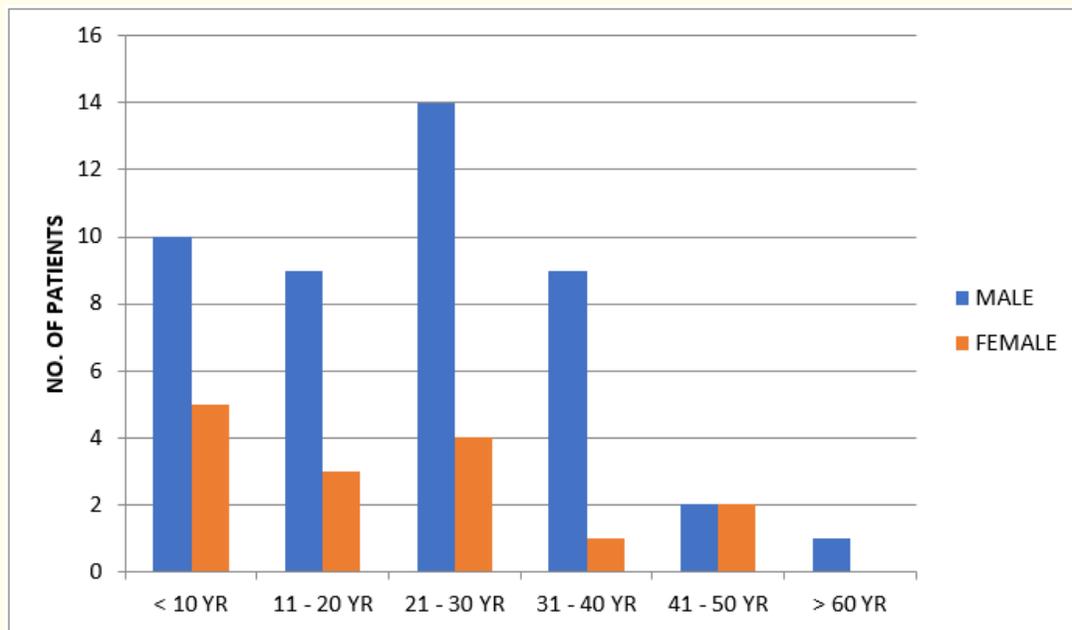


Figure 4: Age and gender - Blunt Abdominal Trauma.

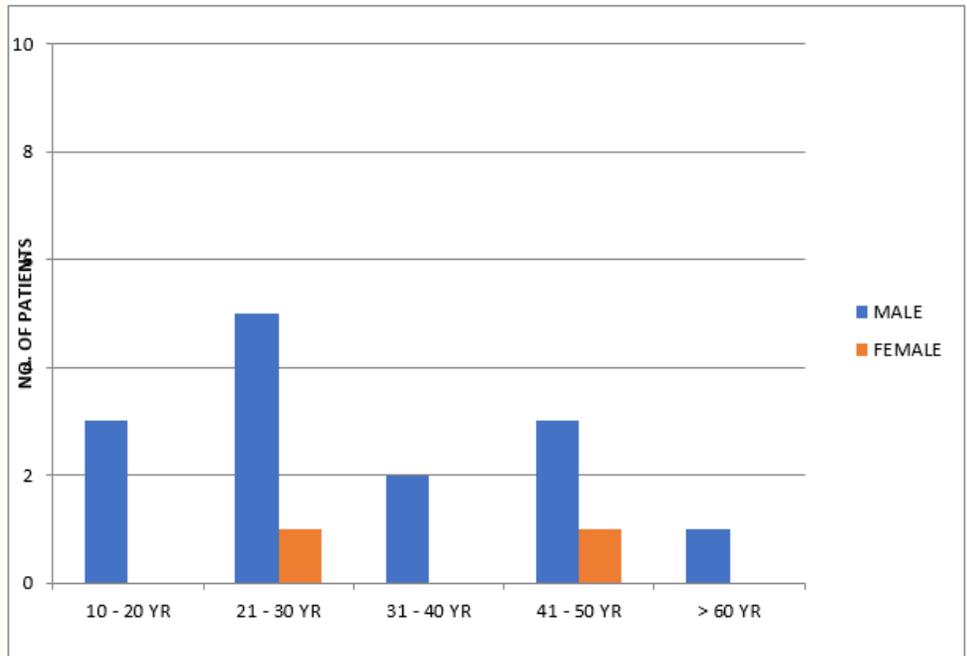


Figure 5: Age and gender- Penetrating Abdominal Trauma.

Among the 76 patients (60 blunt) who examined by FAST, (13) patients (21.6%) had true positive FAST results; those patients were followed in the surgical ward to confirm the diagnosis with explorative laparotomy or CT scanning. Five cases showed spleen injury, Splenectomies done for four cases; one case treated conservatively, three cases with liver injury, two cases with bowel injury and two cases with renal injury and one case with bladder injury.

Forty-three patients (71.6%) had true negative FAST results; they were admitted and observed in surgical ward for 24 hours and discharged if they have no other injuries.

Two patients (3.3%) had false negative results as confirmed by explorative laparotomy.

Two patients (3.3%) had false positive results as confirmed by observation and conservative treatment, doing formal ultrasound and CT scan.

The sensitivity of this study regarding blunt abdominal trauma is (86.6%), specificity of (95.5%) and accuracy of (93%) (Table 3).

While the 16 penetrating abdominal trauma who examined by FAST, three patients (18.75%) had true positive FAST results, confirmed by laparotomy, ten patients (62.5%) had true negative FAST results, confirmed by clinical finding, observation and ultrasound, one case confirmed by laparotomy.

Three patients (18.75%) had false negative FAST results, confirmed by explorative laparotomy and no false positive results were detected. So, the sensitivity of this study regarding penetrating abdominal trauma is (50%), specificity of (100%) and accuracy of (81.7%) (Table 3).

Type of trauma	True positive	True negative	False positive	False negative	Sensitivity %	Specificity %
Blunt abdominal trauma	13	43	2	2	86.6%	95.5%
Penetrating abdominal trauma	3	10	0	3	50%	100%

Table 3: Results of FAST in abdominal trauma.

In this study the overall sensitivity 76.1%, specificity 96.3% and accuracy of 90.7%.

Discussion

FAST examination became available nowadays in the emergency department and for 24 hours and can be done by the emergency physicians or surgeons, it's easy, can be repeated, noninvasive, reliable and have high sensitivity, specificity and accuracy rate [3,5].

Fast has been shown to be a valuable investigation for the assessment of blunt abdominal trauma in large series from north America reporting sensitivities of 80% - 88% and specificities 90% - 99% other papers have shown that FAST is equally accurate in the hands of non-radiologists [10]. the blunt abdominal trauma of our study shows that most of the injured victims were due to motor vehicle accidents with predominance of males (Table 2) and age groups shows that young patients ages 20 - 30 year are affected more than other age groups (Figure 4). While penetrating abdominal trauma showed that bullets were the major cause followed by blast injuries (Table 2) and the most age group affected was 21 - 30 year with predominance of males (Figure 5). In this study FAST examination of blunt abdominal trauma patients, was highly sensitive and specific (86.6%), (95.5%) respectively, in detecting free intraperitoneal fluid, with accuracy rate of (91%). While in penetrating abdominal trauma patients, the sensitivity was (50%) and specificity of (100%) with accuracy rate of (81.7%). So FAST can be a useful initial diagnostic study after penetrating abdominal injury but due to its low sensitivity it cannot be relied upon for distinguishing the injury.

These results are compared with other international studies [10-16] that declared results consistent to the data of our study as shown in table 4 and 5. High specificities of all these studies can be relied upon as" rule in" technique in evaluating trauma victims [13,15].

Tiling and colleagues [13] in 1990 reported a sensitivity of 89%, a specificity of 100% and accuracy of 98%, they also was first to comment on the effect of training and experience and reported that surgeons with extensive ultrasound experience could diagnose intra-abdominal fluid with a sensitivity of 96% and an accuracy of 99% [12].

Study	No. of patients	Sensitivity %	Specificity %
Our study	60	86.6%	95.5%
A Brooks (2004) [10]	100	100%	99%
Chi Leung (2008) [11]	242	86%	99%
Tiling T (1990) [12]	808	89%	100%
J Brenchley (2006) [13]	153	78%	99%
Beat Schnüriger (2009) [14]	226	80%	99.5%
Raed J (2009) [15]	64	92.3%	96%
T Jang (2003) [16]	241	78%	98.5%

Table 4: Comparison of FAST results in blunt abdominal trauma with similar studies.

Study	No. of patients	Sensitivity%	Specificity%
Our study	16	50%	100%
A Brooks (2004) [10]	10	33%	86%
Raed J (2009) [15]	29	62.5%	95.2%
Udobi (2001) [20]	75	46%	94%
T Jang (2003) [16]	53	95.2%	93.9%

Table 5: Comparison of FAST results in penetrating abdominal trauma with similar studies.

Raed., *et al.* [15] in 2008 reported an overall sensitivity of 80.9%, specificity of 95.8% for surgeons performed FAST. Ma., *et al.* [17] trained emergency physicians using 10 hours instructions, then 15 - 20 examinations on normal subjects. They described subsequent emergency physician examination of 245 adult trauma patients and found 90% sensitivity, 99% specificity and accuracy of 99%. Rozycki., *et al.* [18] found that the hepatorenal interface was the most common location of free fluid in blunt abdominal trauma associated with significant parenchymal injuries and multiple-view FAST examination is still recommended because the sensitivity is higher. In our study the fast-positive findings for free fluid in the Morrison's pouch were (12) cases, spleno renal recess (6) cases, pelvic (6) cases.

However FAST is operator dependent and has its own limitations [3,11,15] especially injuries without enough hemoperitoneum, hallow viscous, diaphragm, retroperitoneal structures injuries and concealed hematoma of liver and spleen [11,15]. Some limitations are related to the patient like obesity, surgical emphysema, wounds and dressing. So, the false negative cases were occurred (3 penetrating cases, confirmed by laparotomy and 2 blunt cases confirmed by formal ultrasound) due to concealed hematoma and errors due to not enough hemoperitoneum. Also, the patients must be examined with full bladder to detect pelvic collection of fluid and displace bowel gas up [11,15]. Timing of the scan is also very important factor in determine intraperitoneal collections, so negative cases must be observed for 6 hours, serial ultrasounds and CT also considered [11,13,15].

False positive cases (2 blunt) one confirmed by CT and the other by repetition of ultrasound, due to fluid in bowel and may be due to operator errors. Certain conditions may be associated with the presence of peritoneal fluid like ascites, ruptured ovarian cyst, or pelvic inflammatory disease. perinephric fat and fluid in the stomach or bowel might be mistaken as free intraperitoneal fluid also [11].

Recently published evidence has, however, suggested that the learning curve in using ultrasound to detect hemoperitoneum is such that emergency physicians need only do 10 supervised exams by time their error rate falls from 17% to 5% [19]. So, the FAST examination whether performed and interpreted by radiologist or emergency physicians, is a highly reliable test to screen for hemoperitoneum after blunt or penetrating trauma.

Conclusion

FAST examination has high sensitivity, specificity and accuracy rate regarding blunt abdominal trauma so it's a useful diagnostic tool in initial assessment, while due to low sensitivity and high specificity in penetrating abdominal trauma it can be used as "rule in" technique.

FAST examination used in abdominal trauma is easy to learn, rapid, repeatable, non-invasive, no radiation effect, can be done at bed side of the patient and can be done by surgeons or emergency physicians after a short course of training.

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