The Value of Focused Assessment Sonography for Trauma the Management of Patients with Blunt Trauma to the Abdomen

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ABSTRACT:

BACKGROUND:

During the last decade focused assessment with sonography for trauma increasingly has become the initial diagnostic modality of choice in trauma patients.

OBJECTIVE:

This study was carried to evaluate the sensitivity, specificity and accuracy of FAST when done by residents in the emergency surgical department, & its effect in determining the type of management.

PATIENTS AND METHOD:

210 patients with blunt abdominal trauma were assessed with FAST within 30 minutes from admission to the emergency room. FAST results were considered positive if it detected intra peritoneal fluid , negative if it did not detect intra peritoneal fluid , and indeterminate (equivocal) if the results were not conclusive.

In cases with negative Fast results and no other injuries were detected the patients were kept in the emergency department for 24 hours for observation and discharged later on.

Those with indeterminate initial FAST or who deteriorated clinically after negative initial FAST were subjected to repeated FAST and / or emergency abdominal and pelvic computed tomography (C.T scan) or explorative laparotomy according to their clinical condition.

Patients with positive ultrasonography results underwent emergency abdominal or pelvic C.T, or surgery according to their clinical picture.

RESULTS:

From the 210 patients included in the study we found that 177 patients (84.2) % had negative FAST results, 22 patients (10.4)% had positive FAST results , 2 patients (0.95)% had false positive results , 8 patients (3.8)% had false negative FAST results and 11 patients (5.2)% had equivocal FAST results.

After exclusion of equivocal cases , FAST had sensitivity of (71.4)% specificity of (98.8)% , accuracy of (89.1)%, positive predictive value of (90.9)% and negative predictive value of(95.4)%.

CONCLUSION:

FAST is useful adjunct to the initial evaluation of blunt trauma patients with reliable accuracy & high negative predictive value.

FAST had a great effect in determining the type of treatment especially in case of mass causality.

And using FAST by general surgeons helps in the determination of the type of treatment for patients with blunt trauma**.**

KEY WORDS: blunt abdominal trauma, exploratory laparotomy .

INTRODUCTION:

Focused assessment sonogram for trauma (FAST) is a rapid technique for detecting free intraperitoneal or pericardial fluid in patients suffering from torso trauma. FAST scan is used as an adjunct to the primary or secondary survey assessment (depending on hemodynamic stability of the patients) and relies on the principle that in the supine patient, free fluid such as blood collects in certain anatomical sites [(1)].

FAST assesses the following potential spaces for free fluid in the thorax , abdomen & pelvis : the pericardium , morison's pouch (between the liver & Rt. Kidney) , the lienorenal interface (between spleen & Lt. Kidney) & the pouch of

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douglas (Rectovesical pouch in the male) behind the bladder [2].

Emergency physicians and trauma surgeons have used FAST to assess trauma patients Since the early 80s [3]. In the united states FAST was popularized by Rozycki et al in the early 90s [4].

initial & follow up experience indicated that FAST was accurate , non invasive & expeditious in assessing the critically injured patients in the emergency department & the procedure could be performed by surgeons as well as radiologists with equal reliability, & was particularly useful in detecting blood in the abdominal cavity. [5-7]

As a result FAST has essentially replaced diagnostic peritoneal lavage (DPL) in the algorithm of investigations of abdominal trauma for free fluid as it is non invasive , easily repeatable & does not interfere with further imaging [8,9,10,11]. the sensitivity of ultrasound for detecting hemoperitonium in the setting of blunt abdominal trauma varies from 80 – 100 % with a specifity ranging from 88 - 100 % However it is operator – dependant & is frequently unable to identify the source of bleeding if hemoperitoneum is identified [12,13].

Studies had shown that abdominal injuries can occur without hemoperitoneum in up to 7% of patients with blunt abdominal trauma but none or only few of these patients need laparotomy to treat their abdominal visceral injuries [4,14,15].The quantity of free intraperitoneal fluid that can accurately be detected on ultrasound has been reported to be as little as 100 mL .

This study was set to evaluate the specificity, sensitivity and accuracy of FAST when performed by general surgery residents.

Also to evaluate the effect of FAST in determining the type of management & decreasing the number of unnecessary laparotomies especially in cases of mass casualty which are common in our country.

PATIENTS AND METHODS:

This is a cohort longitudinal prospective study held in the period from August 2009-December 2010.

The study involved210 consecutive patients who were affected by blunt trauma to the abdomen and attended the emergency department in Baghdad Teaching hospital and were subjected for FAST examination.

The initial evaluation of the trauma patient was performed with a primary & secondary survey, which included physical examination, chest & pelvic radiography & FAST examination.

The FAST examination is performed by a registrar in surgery under the supervision of an attending trauma surgeon where both of them had courses(in different levels) in FAST training during ATLS (advanced trauma life support) programs.

During FAST four windows were studied; pericardial, perihepatic, perisplenic & pelvic. In cases where visualization of the pericardial window is difficult from subxiphoid position the ultrasound probe is placed in the Lt. 2nd intercostal space in the midclavicular line.

The FAST examination is interpreted as positive, negative or indeterminate.

The FAST examination is considered positive when free intra abdominal or pericardial fluid is visualized and it is negative in the absence of this. Indeterminate FAST studies include those where visualization of the organs is inadequate or when there is doubt about the result of the study. The FAST examination is repeated in the emergency department by radiologist only if there is any doubt based on the clinical picture.

The definition of the results was as follows:

True positive: in which the FAST result was positive and the injury is confirmed by the best available reference (clinical findings, CT scan with or without exploratory laparotomy)

True negative: FAST negative and the lack of injury is confirmed by the best available reference so discharged smoothly after observation period.

False positive: FAST positive and the lack of injury is confirmed by the best available reference.

False negative: FAST negative, and the injury is confirmed by the best available reference.

Accuracy: The sum of the true FAST results divided by the total No. of_patients included for analysis.

Confirmatory tests included abdominal / pelvic CT scan, DPL (diagnostic peritoneal lavage) and findings on exploratory laparotomy or observation were used as confirmation tools for intra-abdominal injury.

For FAST examination we used the instrument HONDA HS 2500 probe 3.5 MHz curvilinear probe & for confirmation we used Aquilion 4 slices Toshiba whole body multispiral CT scan.

RESULTS:

Out of the 210 patients included in the study 22 patients (10.4 %) had positive FAST examination from which 15 patients were confirmed by exploratory laparotomy, where 7 patients had liver injuries (2of them had also small bowel injury &one of them had associated

splenic injury), 4 patients had splenic injuries (one of them associated with colonic injury &one of them associated with stomach injury), 2 patients had renal injuries with retroperitoneal hematoma &the last 2 patients had small bowel injury& mesenteric laceration.

The remaining 5 of the 22 patients were confirmed to have intraperitoned collection by CT scan due to liver injury in 3 of them & splenic injury in the other two patient).Two patients (0.95%) with positive FAST were confirmed to be false positive by CT scan.(table 1)

Table 1: Results of Patients with Positive FAST.

True + Ve Scan	No.of Patients	False + Ve Scan	No. of Patients
FAST (+) CT (+)	5	FAST (+) CT (-)	2
FAST (+) DPL (+)	0	FAST (+) DPL (-)	0
FAST (+) Exp.lap (+)	15	FAST (+) Exp.lap (-)	0
Total	20		2

On the other hand 177 patients (84.2 %) had negative FAST examination & according to their condition those patients who remain stable for 24 hrs were discharged home & those who deteriorated were subjected to another modality of diagnosis (Freqrent FAST, CT scan, DPL).
Accordingly in 8 patients (3.8%) the results of FAST were confirmed to be false negative after the confirmation of the presence of fluid collection by CT scan in 5 patients as 3of them had liver injuries , one patient had splenic injury &one patient with renal injury. In other 2 patients the results were proved to be false negative by frequent ultrasound and & the last one by DPL.(table2)

Table 2 : Results of Patients with Negative FAST.

True - Ve Scan	No. of Patients	False - Ve Scan	No. of Patients
FAST (-) CT (-)	9	FAST (-) CT (+)	5
FAST (-) DPL (-), exp.lap (-)	0	FAST (-) DPL (+)	1
FAST (-) observation	160	FAST (-) Frequent U/S (+)	2
Total	169		8

From these 8 patients 6 of them treated conservatively & 2 of them needed exploratory laparotomy.
Eleven patients (5.2 %) had equivocal results in FAST examination & were treated accordingly.
For the patients who discharged home after 24 hrs observation no one of them returned to our hospital for a period of 2 weeks and all of them considered as true results.
After exclusion of equivocal cases FAST had asensitivity of (71.4 %), specificity (98.8 %) PPV (positive predictive value (90.9 %) NPV (Negative predictive value (95.4 %) & over all accuracy of(89.1 %).

Table 3 : Comparison between our study and the other studies with FAST results.

	Our Study 2010	Natarjan (36)	Miller(37) 2003	Lee(38) 2007	Brown(27) 2001
Sensitivity	71.4	41 %	42 %	85 %	84 %
Specificity	98.8	99 %	98.7 %	96 %	96 %
Accuracy	90.9	94 %	93 %	96 %	61 %
Positive Predictive Value	95.4	95 %	67 %	99 %	99 %
Negative Predictive Value	89.1	95 %	92 %	94 %	96 %
Patient Status	ALL	Hemodynamically Stable	Hem. Stable	ALL	ALL

DISCUSSION:

In our study the standard against which FAST was evaluated to determine its accuracy, was the clinical observation, DPL , CT scan & exploratory laparotomy.

According to the results obtained we found that FAST had high Negative predictive value (NPV) (95.4 %) so it helps in conjugation with the clinical observation period in reducing unnecessary hospital admission , CT scan requement or surgical intervention. Also by this way it could be used as a screening tool in the E.D as it was considered in previous studies. [16]

FAST was helpful in the early decision point whether the patient needs immediate operation to control bleeding, but FAST was usually used as an adjunct to the clinical evaluation and patients with FAST positive & their clinical findings deteriorated rapidly were usually admitted to the surgical theatre after resuscitation without CT examination to avoid time losing and their visceral injuries were confirmed by exploratory laparotomy and that reflected the importance of clinical evaluation . On the other hand three patients with FAST positive & CT positive results were treated conservatively depending on the stability of their clinical conditions, which means that not all patients with FAST positive results were treated surgically, as false positive results may be due to operator errors or the presence of intraperitoneal fluid which is unrelated to trauma, like liver cirrhosis , ascites , malignancy , heart failure or physiological intraperitoneal fluid.[17]

False negative results may be reduced in number by repeated FAST examinations as the early taken FAST might not show any collection because time is required for the fluid to accumulate intraperitoneally from raptured viscous or injured organs. In this study two patients were proved to be false negative by repeated FAST examination.

As mentioned in other work, the patients should be examined with full bladder to detect pelvic collection of fluid & displace bowel gas up.[18]So full bladder is an important step unless contraindication is present.

Small amount of hemoperitoneum is not uncommon in patients with large retro or extra peritoneal pelvic hematoma from red blood cells or plasma that enters the peritoneal cavity through small tear or even through intact serosal layer of the retroperitoned lining [19].One of the patients in our study was found to have small intraperitoneal collection due to retroperitoneal hematoma. This could further add to the difficulty in determining the exact site of injury or hemorrhage.

A large amount of hemorrhage into the retroperitoneal structure is an important but not uncommon cause for hemodynamic instability or occult blood loss in patients with blunt trauma. FAST unlike C.T. is not specific to the site of origin & extent of injury[20].

Indeterminate cases or "equivocal" are the cases in which the results of FAST are not conclusive which necessitate to be followed by careful clinical observation , repeated FAST examination, emergency CT scan, or explorative laparotomy according to the clinical condition of them.

CT scan had several advantages. It has asensitivity of (92 – 98 %) for diagnosis of injury in blunt abdominal trauma. It helps in localizing & grading injuries, which is critical in making decisions regarding management [21]. It is fewer dependants on the operator & the images are more complete and reproducible. CT is not limited by bowel gas, superficial wounds, body habitus or subcutaneous emphysema. But in addition to the limited availability of CT scan & its limited capacity when we face a mass trauma " explosion injury " it has many limitations. The efficacy of CT in the diagnosis of bowel injury has been controversial, which was a major limitation of CT [22]. Also it cannot be used in pregrant & unstable patients & it exposes patients to ionizing radiation. However CT remains the gold standard for evaluation of blunt trauma patients. That means that FAST is not alternative to CT scan but it could be a preliminary test and it can solve the majority of diagnostic problems which decrease the need to CT scan with all its disadvantages.

The sensitivity of FAST in the literature varies between (63%) and (96 %)[23, 24, 25]. In this study, after exclusion of indeterminate cases, we found that FAST had a sensitivity of (71.4 %) specificity (98.8 %) positive predictive value (90.9 %) negative pradictive value (95.4 %) & accuracy of (89.1 %) as compared to the seven year study done by Bala Natarajan_etal in Omaha , they found the FAST sensitivity was (41 %) ,specificity of (99 %), PPV (94 %) ,NPV (95 %) the overal accuracy was (95 %)[26]. In their study the number of patients was 2105 patients which were hemodynamically stable so they offered CT scan examination as a confirmatory test for all the patients and according to their results they concluded that the use of FAST for hemodynamically stable patients was unworthy

and should be reserved for the hemodynamically unstable patients.

Another study by miller et al [27] showed a sensitivity , specificity , NPV , PPV & accuracy of (42 %), (98.7 %) , (67 %) , (93 %) & (92 %) respectively .This study also included the hemodynamically stable patients and concluded that FAST is not a good screening tool for these patients.

So our results were different from these two studies because we included both hemodynamically stable and hemodynamically unstable patients due to the conditions in our country and the difficulties in providing CT scan for every patients especially when mass casualties are presented to the emergency department.

But our results coincided more with the study of Lee et al [28] who showed a sensitivity , specificity , NPV & PPV of (85 %) , (96 %) , (99 %) & (96%), in which they evaluated the use of ultrasound for the triage of blunt abdominal trauma patients depending on the results of exploratory laparotomy and they did not use CT scan for routine evaluation of patients .

Another study by Brown et al [18] showed a sensitivity of (84 %) specificity of (96%) ,NPV (99 %), PPV (61 %) & accuracy of (96 %).This study included 2693 patients and they concluded that evaluation & management of blunt abdominal trauma continues to be a major challenge for trauma surgeons, so that FAST conducted emergently in the trauma setting is now used widely in the United States to evaluate hemodynamically unstable blunt trauma patients as it gives a rapid assessment of injuries [39-43].

The differences between our study & these studies may be due to operator experience & the number of patients included in the study which is more than in our study.

CONCLUSION:

FAST is a useful adjunct to the initial evalution of blunt trauma patient and those with a positive FAST are at risk for critical abdominal bleeding and are likely to need celiotomy soon. Resources can then be mobilized appropriately & patient care hopefully expedited.

Those with Negative FAST are not at substantial risk for bleeding and can be evaluated in aless urgent fashion.

Distinct minority of patients cannot be assessed by FAST, and in those situations, other clinical parameters must be followed to guide treatment.

When FAST performed by surgeons as in our experience it should only be used as a screening tool for bleeding and should not supplant CT scan as a definitive imaging test for intraabdominal injury.

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