

Diagnostic value of abdominal ultrasound in the evaluation of blunt abdominal trauma

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Abstract

The purpose of bedside ultrasound (US) in blunt abdominal trauma is to rapidly detecting of free intraperitoneal fluid. The aim of this study to evaluate the diagnostic performance of US in the diagnosis of blunt abdominal traumata at Al-Gamhuria General Hospital- Aden.

Outcomes of US, in terms of the sensitivity, specificity, positive predictive value and negative predictive value, were evaluated precisely in 159 consecutive patients and compared with the results of the surgical reports in cases undergone surgery and with those of the computed tomography (CT) scan in cases treated conservatively.

Of the 159 patients, 131 patients (82.4%) were males and 28 (17.6%) were females. A significantly higher true diagnosis rate was 90.6%. The overall diagnostic accuracy of US in terms of the sensitivity, specificity, positive predictive value and negative predictive value were 95.8%, 75.6%, 91.9% and 86.1% respectively.

US saves the time, gives mostly accurate findings and makes the decision.

Keywords: Utility of ultrasound, FAST examination, Blunt abdominal trauma.

Introduction

The evaluation of patients with trauma is often a diagnostic challenge for emergency physicians and trauma surgeons. Uncontrolled hemorrhage is responsible for over 50% of trauma related deaths[4,9,20]. Significant bleeding into the peritoneal, pleural, or pericardial spaces may occur without obvious signs[7,23]. Physical findings may be unreliable because of decreased patient consciousness, neurologic deficit, medication, or other associated injuries; like fractures of lower chest ribs, contusion, and abrasions of the abdominal wall[8,15]. US, as a screening tool; is inexpensive, accurate, simple and accessible, being used in the emergency department. FAST" is an acronym for Focused Assessment with Sonography in Trauma" and has become synonymous with bedside US in trauma[1,12,14,17,20,21].

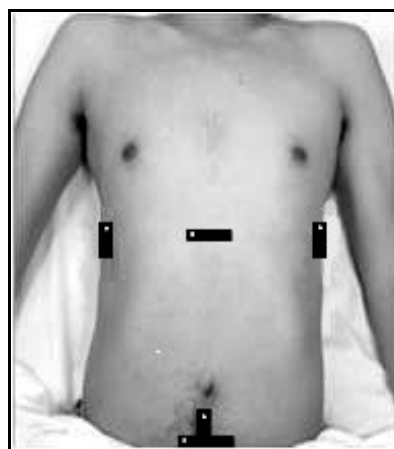


Figure 1: Probe position for FAST

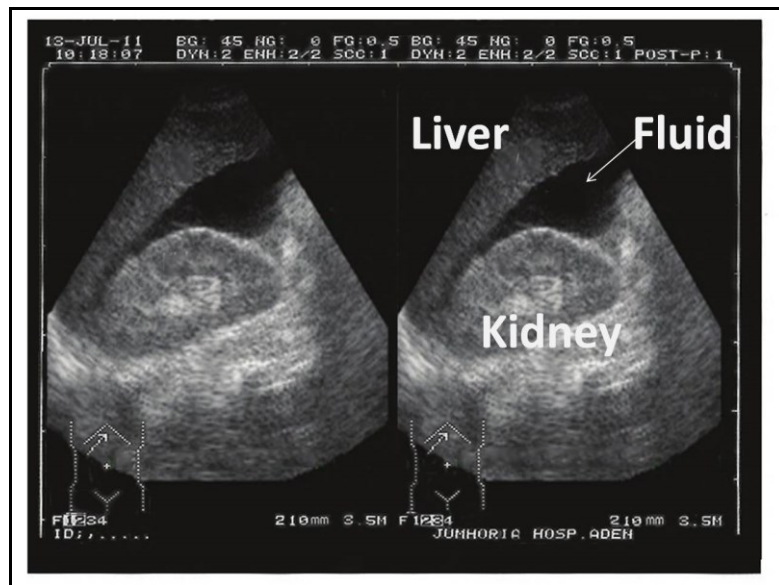


Figure 2: Fluid collection in Morrison's pouch

The purpose of bedside US in trauma is to rapidly identify free fluid (usually blood) in the peritoneal, pericardial, or pleural spaces [1,2,4,8,15,16].The basic four-view examination (perihepatic, perisplenic, pelvic, and pericardial views) has become the foundation of the FAST examination.

Material and Methods

This study is a prospective study, carried out at Al-Gamhuria General Hospital- Aden, from January 2009 to January 2013. 197 patients with blunt abdominal trauma. Thirty eight patients were excluded from study. Inclusion criteria included: Patients who had blunt abdominal trauma, who had admitted for more than 48 hour, who treated surgically or conservatively, and who had abdominal US findings and abdominal CT scan findings. Exclusion criteria Patients who were discharged from hospital in less than 24 hour, whose their abdominal US findings are negative and who were not treated surgically or conservatively.

The data were collected prospectively. The obtained data were demographic (gender and age), abdominal US findings, type of treatment (operative or conservative), confirmatory procedure (laparotomy or abdominal CT scan) and time – frame was divided into two latent periods: First latent period defined as the interval between the time of injury to the time of diagnosis of US. Second latent period defined as the interval between the time of diagnosis of US to the time of surgery.

The decision for operative or non operative management is based on outcome of the clinical examination and findings of diagnostic tests. Patients were divided into operative group and conservative group .

For the confirmation of diagnosis of US in operative group operative findings was used as gold standard confirmatory procedure. In conservative group, abdominal CT scan was used as gold standard confirmatory procedure. For all patients, FAST scans were performed using the same US machine (Hitachi EUB-405 Plus) with a 3.5-MHz curve probe.Four standard views were performed in each case. For diagnostic accuracy of US, the sensitivity, specificity, positive predictive value and negative predictive value were used as diagnostic parameters.

Statistical analysis was performed with SPSS, version 17.0 of Windows (SPSS, Chicago, IL, USA). The data were presented as number of cases and percent.

Results:

One hundred and fifty nine patients were eligible for this study,131 (82.4%)were males and 28 (17.6%) were females.The males: females ratio was 4.7:1. The mean patients age was 28.51 ± 18.71 years. Patients ranged in age from 3 years to 80 years.

Table 1: Age group by gender

Age	Gender		Total n (%)
	Male	Female	
1 – 10	16	11	27 (17)
11 – 20	37	5	42 (26.4)
21 – 30	49	4	53 (33.3)
31 – 40	11	5	16 (10.1)
41 – 50	7	2	9 (5.7)
51 – 60	8	0	8 (5.0)
71 – 80	3	1	4 (2.5)
Total n (%)	131 (82.4)	28 (17.6)	159 (100)

Note: Bold values were used to highlight the higher values

Young patients of the age group 21 – 30 years were the most commonly affected. Other age groups are reported in Table 1.

Table 2: Operative versus nonoperative management

Treatment	N (%)
Operative	121 (76.1)
Conservative	38 (23.9)
Total n (%)	159 (100)

Note: Bold values were used to highlight the higher value

After clinical evaluation and suitable investigation, 121 (76.1%) patients with pneumoperitoneum or hemoperitoneum with hemodynamic instability undergone exploratory laparotomy. 38 patients (23.9%) were selected for non- operative management (NOM) because they had no signs of peritonitis or they had hemoperitoneum without hemodynamic instability.

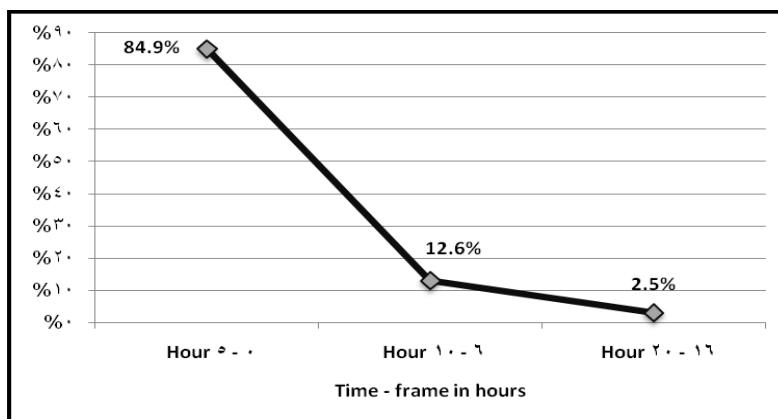


Figure 3: Time frame of first latent period

The majority of patients (84.9%) were subjected for FAST examination between 0 – 5 hours of first latent period.

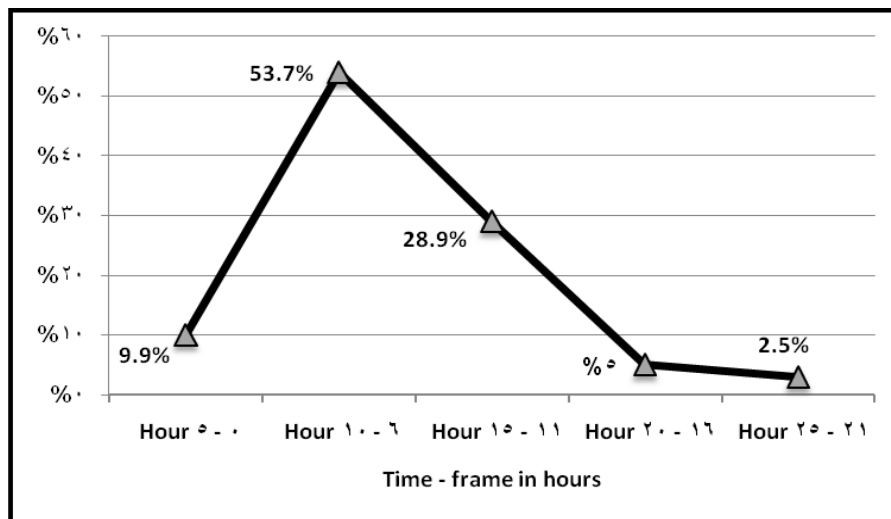


Figure 4: Time frame of second latent period

In the present study, 53.7% of the patients were taken for surgery between 6 – 10 hours of second latent period.

The diagnostic performance of FAST was compared with operative findings in operative group. Of the 110 laparotomies – positive cases, there were 108 FAST true positive cases and 2 FAST false negative cases. All laparotomies – positive cases showed significant injury. On the other hand, of the 11 laparotomies – negative cases, there were 5 FAST true negative cases and 6 FAST false positive cases. The diagnostic performance and accuracy of FAST in operative group is shown in Figure 5 and Table 3.

In comparison, FAST results with abdominal CT scan results, in NOM group. Of the 8 CT scan – positive cases, there were 5 FAST true positive cases and 3 FAST false negative cases. Where as of the 30 CT scan – negative cases, there were 26 FAST true negative cases and 4 FAST false positive cases.

The diagnostic performance and accuracy of FAST in NOM group is shown in Figure 5 and Table 3. The total rate of true diagnosis by FAST in both, operative group and NOM group, was 90.6% and 9.4% for false diagnosis rate in both groups.

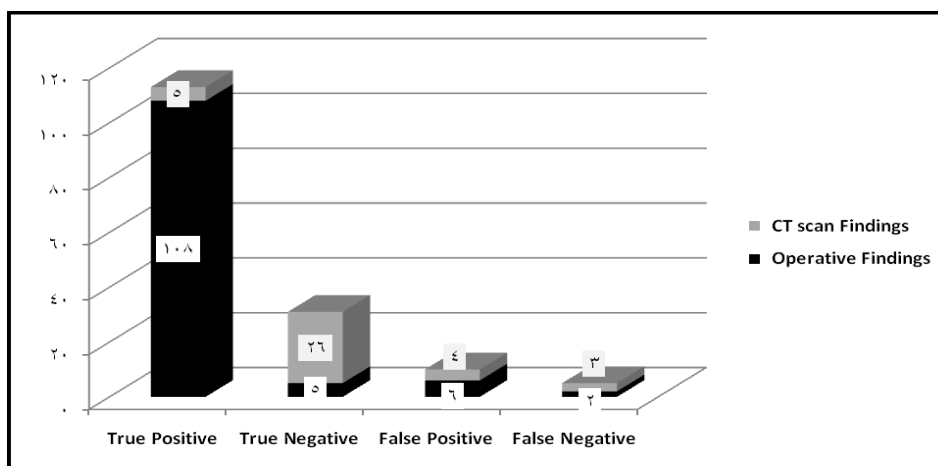


Figure 5: Comparison diagnostic performance of US with confirmatory procedures

Table 3: Diagnostic accuracy of US confirmed by confirmatory procedures

Confirmatory procedure	The accuracy of diagnostic ultrasound							
	TP	TN	FP	FN	SEN	SPC	PPV	NPV
Operative findings = 121	108	5	6	2	98.2%	45.5%	94.7%	71.4%
CT scan findings = 38	5	26	4	3	62.5%	86.7%	55.6%	89.7%
Total	113	31	10	5	95.8%	75.6%	91.9%	86.1%

TP: true positive; TN: true negative; FP: false positive; FN: false negative; SEN: sensitivity; SPC: specificity; PPV: positive predictive value; NPV: negative predictive value. Note: Bold values were used to highlight the higher values

The overall diagnostic accuracy of FAST in both, operative group and NOM group, were 95.8% for sensitivity, 75.6% for specificity, 91.9% for positive predictive value and 86.1% for negative predictive value.

Discussion

In patients with major trauma, FAST is often the initial imaging examination. US is readily available, requiring minimal preparation time, and may be performed with mobile equipment that allows greater flexibility in patient positioning than is possible with other modalities [1,4,7,10,12,15,19,21]. It is also effective in depicting abnormally large intraperitoneal collections of free fluid, which are indirect evidence of a solid organ injury that requires immediate surgery [2,3,6,8,13,17]. In our study, FAST examination in blunt abdominal trauma patients revealed high sensitivity (95.8%) with specificity of 75.6% in detection of free intraperitoneal fluid. These results are comparable to results of other international studies [5,12,15,16,19,21]. Rozycki et al [18] studied 371 patients with blunt trauma using, four views protocol, and demonstrated an overall sensitivity (81.5%) and specificity (99.7%), in blunt abdominal trauma.

The high specificity shows the appropriateness of FAST scan as “rule in” technique in evaluating trauma victims [1,3,4,7,8,12] and many international studies concluded that the FAST scan can be used effectively in initial screening of blunt abdominal trauma patients [1,5,14,17,20].

FAST has its own limitations, for example, it is relatively poor in the detection of injuries without enough hemoperitoneum at time of examination such as concealed hematoma of the liver and spleen [22]. This explains our false negative cases where an injury of liver were missed. It's also reflects the importance of the amount of hemoperitoneum at time of FAST examination, though Branney [2] showed that a 100 cc of free fluid can be seen by US, but many studies suggest that the amount of blood needed to be detected ranged from 250 to 600 cc [6,13,14,19]. Early FAST, before the accumulation of blood, can be negative; and proper timing and repetition of the scan in suspicious cases increase its sensitivity [4,13,19,21,22]. In our study, FAST performed during the secondary survey and if we took in to consideration the time of transportation from the trauma site to the emergency room we can conclude that, at time of FAST scan is performed already enough time had passed for blood to accumulate in most of our patients, and that explain the fact that the sensitivity in our study is higher than many other studies. It is well accepted that hemoperitoneum following trauma is not necessarily an indication for immediate laparotomy and some quantitative measures are required in order to assist the surgical decision [2,6,9,13,14]. For this reason different authors described some scoring systems for hemoperitoneum. These are Huang scoring system [6] and McKenney scoring system [13], in which five regions were assessed: right subphrenic space, subhepatic space, left subphrenic space, perisplenic area, and pelvis. One point was granted to each positive area, and the final score was the summation of total positive areas plus the depth of largest collection in centimeters. The conclusion was that 87% with a score ≥ 3 required a therapeutic laparotomy.

Conclusions

We conclude that US is a useful diagnostic tool in the assessment of blunt abdominal trauma and in detecting intraabdominal fluid. US saves the time , gives mostly accurate findings and make the decision to emergency shifting of patient to operative room or admission for conservative treatment.

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الأهمية التشخيصية للموجات فوق الصوتية في تقييم إصابات البطن الرضية

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الملخص

الغرض السريري من استخدام الموجات فوق الصوتية في إصابات البطن الرضية هو سرعة الكشف عن وجود سوائل حرة داخل تجويف البطن.

هدفت هذه الدراسة إلى تقييم أداء الفحص بالموجات فوق الصوتية في تشخيص إصابات البطن الرضية في مستشفى الجمهورية - التعليمي - عدن ما بين عام 2009م و عام 2013م.

شملت الدراسة المرضى الذين شُخِّصَ لديهم إصابات بطن رضية وعددهم 159 مصاباً وكان عدد الذكور 131 (82.4%) و عدد الإناث 28 (17.6%). و من بين هؤلاء المرضى (76.1%) مصاباً خضعوا لعملية فتح البطن الاستقصائي و 38 (23.9%) مصاباً تم علاجهم تحفظياً.

ومن أجل إثبات الدقة التشخيصية للموجات فوق الصوتية؛ تم مقارنة نتائج فحص الموجات فوق الصوتية مع نتائج فتح البطن الاستقصائي في مجموعة المرضى الذين خضعوا للتدخل الجراحي. و أمّا مجموعة المرضى الذين خضعوا للعلاج التحفظي فقد تم مقارنة نتائج فحص الموجات فوق الصوتية مع نتائج الأشعة المقطعية. و من خلال النتائج المتوصل إليها تبين أن إجمالي معدل التشخيص الصادق للموجات فوق الصوتية في المجموعتين يُعتدُّ بها إحصائياً وهو 90.6%. وقد كان إجمالي الدقة التشخيصية للفحص بالموجات فوق الصوتية للمجموعتين معاً بالأغية الحساسية، النوعية، التنبؤية الإيجابية والتنبؤية السلبية 95.8%، 75.6%، 91.9% و 86.1% على التوالي و تلك النتائج يُعتدُّ بها إحصائياً.

أظهرت هذه الدراسة نفع استعمال الموجات فوق الصوتية في تقييم إصابات البطن الرضية و بأنها توفر الوقت و تساعد في صنع القرار المناسب لكل حالة على حدة.

الكلمات المفتاحية: فائدة الفحص بالموجات فوق الصوتية، الفحص المركز بالموجات فوق الصوتية لتقييم الإصابات، إصابات البطن الرضية.