Original Article

Diagnostic Value of Ultrasonography in Evaluation of Blunt Abdominal Trauma

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ABSTRACT

Objectives: To evaluate the diagnostic value of ultrasound in detecting intraabdominal injuries in patients with blunt abdominal trauma.

***Patients and Methods*:** The study was conducted in the department of radiology, Combined Military Hospital Lahore, from 13th September 2006 to 29th September 2007. A total of 70 patients with blunt abdominal trauma were included. They all underwent Ultrasonography (US) followed by Computed Tomographic (CT) scan of abdomen. Sensitivity, specificity, positive and negative predictive values and accuracy of US in detecting intraabdominal injury were calculated keeping CT findings as gold standard. The cases in which laparotomy was performed; the surgical findings were taken as the standard.

Results: US examinations were positive in 34 patients. Of these, US showed free fluid in 18 (52.9%), and abdominal organ injury in 12 (35.3%) and only abdominal organ injury in 4 (11.8%). True-positive findings were seen in 28 (82.35%) of these on CT and/or laparotomy. There were two false negative cases. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of US in detecting intraabdominal injury were 93.3%, 85.0%, 82.3%, 94.4% and 88.5%, respectively.

Conclusion: Ultrasonography has high diagnostic performance in the screening of patients with blunt abdominal trauma. (Rawal Med J 2008;33:154-159).

Keywords: Ultrasonography, Computed tomography, Blunt abdominal trauma.

INRODUCTION

Abdominal trauma is one of the commonest injuries.[1] Blunt abdominal trauma (BAT) usually occurs due to road traffic accidents (RTA), fall from heights or during sports.[2] Prevalence of intraabdominal injury (IAI) varies widely, ranging from 7.7% to 65%.[3] Rapid diagnosis is

essential[4] and appropriately prioritizing diagnostic work up and treatment is critical to ensure patient survival.[5] Although diagnostic peritoneal lavage (DPL) is thought to be superior to clinical examination in assessing abdominal injuries, it is an invasive procedure.[6] CT of the abdomen can depict such injuries accurately and is relatively noninvasive. It is not usually the first option, because it is relatively expensive and requires radiation exposure and injection of contrast material.[4] The CT has higher accuracy in assessment of solid organ injuries and other injuries related to trauma.[7] During past several years, US has become an important modality in many centers in the screening of BAT.[8] US is the primary imaging modality of choice for diagnosis of IAI.[1] It is non invasive, rapid, relatively inexpensive and a reliable diagnostic tool for assessment of presence of abdominal fluid[2,4] and in detecting liver, spleen and kidney injuries.[9] The purpose of this study was to evaluate the diagnostic value of US in identifying IAI in patients with BAT.

PATIENTS AND METHODS

The study was conducted in the department of radiology, Combined Military Hospital Lahore, from 13th September 2006 to 29th September 2007. A total of 70 patients with blunt abdominal trauma and strong clinical suspicion of IAI, who were hemodynamically stable

were included in the study. Those who were already operated, pregnant, had penetrating injuries or burns were excluded. US examinations were performed with a 3.5/ 5.0-MHz convex probe on Aloka Doppler US Machine (Model: SSD-5500). The presence of free fluid within the abdominal cavity was accepted as a positive sign for hemoperitoneum. Visceral organs were evaluated for parenchymal abnormalities consisting of intraparenchymal masses, hematomas, lacerations, and/or geographic zones of echotextural heterogeneity. In the presence of medical ascites (eg, cirrhosis or other cause of nontraumatic intraperitoneal fluid), free fluid was considered positive because hemoperitoneum could not be excluded.

US examination was followed by CT examination. CT examinations were carried out with spiral CT (Toshiba Xpress/GX, Japan). All patients were administered 100 ml of intravenous non-ionic contrast material. Free fluid with attenuation value>30 Hounsfield Units (HU) was labeled as hemoperitoneum. Injuries to individual organs were graded according to organ injury scaling (OIS) system and injury severity grades.[10,11] The decision to manage patients either conservatively or proceed to laparotomy was made by the attending surgeon based on clinical condition along with US and CT results.

US findings were compared with the findings obtained by CT and laparotomy. CT was used as the diagnostic standard. When an injury was not detected with CT and surgery was performed on a high index of clinical suspicion of visceral injury then the surgical findings were taken as the standard. Patients were followed up until they were discharged from the hospital. Patients who were followed up by clinical observation and then discharged were considered as being normal. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of US were calculated.

RESULTS

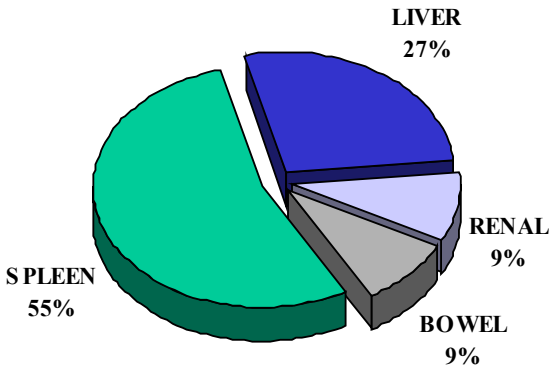
Out of 70 patients 52 (74.3%) were males and 18 (25.7%) females. The mean age was 34.94±17.42 years (range 5-70). The causes of BAT are summarized in Table 2.

Table 1. Causes of BAT (n=70).

	Number	Percentage
RTA	44	62.86%
Fall From height	14	20.00%
Assault	8	11.43%
Others	4	5.71%

Ten (14.3%) patients had laparotomy, while the remaining 60 (85.7%) were followed with clinical observation until the time of discharge. With US, positive findings were present in 34 (48.5%) patients. Of these, 18 (25.9%) had free intraabdominal fluid only, 12 (35.3%) had both free intraabdominal fluid and intraabdominal organ injury and 4 (11.8%) had intraabdominal organ injury only. With US free fluid (Fig 1) was identified in total 30 patients while organ injury was detected in 16 patients (Table 2). Out of 34 positive cases on US, 28 patients were confirmed on CT as IAI. In two patients who had no positive finding on US, GI system injury without free fluid was detected on CT (false negative). Thus, total positive cases on CT were 30.

Figure 1. Free Fluid in Morrison's pouch in a 16 years old boy with splenic laceration.



Out of these 30 patients, 8 (26.7 %) had free fluid only, 18 (60%) had free fluid and organ injury and 4 (13.3%) patients had organ injury only (Table 2). The frequency of organ injury as detected on CT is shown in Figure 2. Total 12 patients had splenic injuries. Out of these, six had grade 2 injuries, four had grade 3 (Fig 3) and two had grade 4 injury. Six patients had liver injuries and out of these four had grade 2 injuries (Fig 4) while two had grade 3 injury. Two renal injuries were of grade 3 and 4. US findings were compared to CT and laparotomy findings (Table 2). US detected isolated free fluid in 18 patients. On CT 4 (22.3%) out of

these 18 patients were labeled as negative for IAI (false positive) as minimal pelvic free fluid on US could not be attributed to hemoperitoneum based on attenuation values which were

Figure 2. Frequency of solid organ injury on CT (n= 22).

Out of the 12 patients, who had both free fluid and intraabdominal organ injury detected by US, 2 (16.7%) were declared negative for IAI (false positive) as free fluid /organ injury was not confirmed by CT. CT correlated well with surgical findings in all ten operated cases. In one case, a small hepatic laceration was seen at laparotomy along the falciform ligament, which was missed at CT scan. US results after comparison revealed that 28 of 34 (82.35%)

were true positive, 6 of 34 (17.65%) false positive, 34 of 36 (94.44%) true negative, and 2 of 36 (5.56%) false negative (Table 3).

Table 2. Conformity of US findings with CT findings (n=70).

Ultrasonography		Computed Tomography				
		Positive			Negative	Total
		FF	OI	FF + OI		
Positive	FF	8		6	4	18
	OI	-	2	2	-	4
	FF + OI	-	-	10	2	12
Negative		-	2	-	34	36
Total		8	4	18	40	70

FF= Free Fluid, OI= Organ Injury, FF+OI= Free Fluid + Organ Injury.

DISCUSSION

The present study indicated male prevalence as reported earlier.[2] The most frequent cause of BAT in our study was road traffic accident as has been reported before.[12]

Table 3. Diagnostic value of US in detecting IAI.

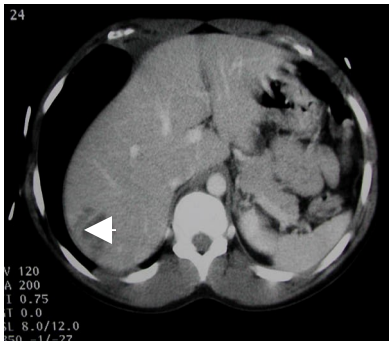
Parameter	Data	%
Sensitivity	28 of 30	93.3
Specificity	34 of 40	85.0
Positive predictive value	28 of 34	82.3
Negative predictive value	34 of 36	94.4
Accuracy	62 of 70	88.5

US detected free fluid without organ injury in total 18 patients. Out of 18, CT detected associated organ injury in 6 patients. Four patients were labeled as negative for IAI. In 8 patients no associated organ injury was detected even on CT. The possible reason could be that the organ injury might be subtle which was not visible on CT. In the study by Holmes and colleagues,[13] 8% of pediatric blunt trauma patients undergoing abdominal CT had isolated intraperitoneal fluid visualized.

Figure 3. Axial contrast enhanced CT abdomen shows grade 3 splenic laceration (arrow) in 35 years old male injured in a RTA.

Our study showed that 12 patients out of 22 had splenic injury with frequency of 54.50 %, as reported earlier.[14] The frequency of hepatic injury in our study is 27.20% which is contrary to a local study[15] in which liver was most commonly injured organ (35%) followed by spleen (32%), but it is in accordance with study by Ghazanfar et al[14] in which frequency of liver injury is 21%.

Figure 4. Axial CT image depicting grade 2 liver laceration (arrow) in a 29-year-old man involved in a high-speed motor vehicle accident.



There were 2 false negative and 6 false positive results. 4 of these false positive cases were females and they had minimal free fluid in pelvis, which was later on not confirmed to be hemoperitoneum by CT. The other two false positive cases were of cirrhosis and medical ascites and were interpreted as nontraumatic abnormality on CT. In a 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 who had pelvic free fluid.[16] Hence, most of these false positive results were reported to be originating from the physiological fluid observed in females. In the screening of BAT patients with US, the most important problem is false negative results, not the false positive ones. In our study, there were only 2 false negative results. It is clear that both in the previous studies[9,12,17] and our current study, one of the most important reasons that has led to false negative results was GI injury. When no free fluid is present in the abdomen, US is not successful in detecting the GI injuries. An isolated solid organ injury is another reason for false negative results.

The OIS[11] is a relatively new system with sole purpose to establish uniformity in different studies and thereby facilitate easy comparison. We found that overall likelihood of surgical management increased with higher OIS grading of solid organ injury, as in our study, 7 of 10 operated patients had grade 3 and 3 of 10 had grade 4 injuries.The results obtained in our study are in close proximity with as reported in earlier studies.[8,17,18] In conclusion, in BAT patients, US should be the first technique of choice for diagnosis. Since US has a high negative predictive value, we think it is sufficient to follow up the patients with clinical observation. If US findings are not normal or unsatisfactory, then CT examination can be performed provided the patient is stable.

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