ORIGINAL ARTICLE

Diagnostic Accuracy of Ultrasound in Detection of Visceral Injury in Blunt Abdominal Trauma

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ABSTRACT

Background: Blunt abdominal trauma (BAT) is regularly encountered in the emergency department. The present study is designed to determine the frequency of splenic injury after blunt abdominal trauma and common types of trauma leading to it. Splenic injury carries immense medicolegal importance.
Aim: To determine the diagnostic accuracy of ULTRASOUND in detection of visceral injury in blunt abdominal trauma considering CT as gold standard.
Methods: This study was conducted at Department of Diagnostic Radiology, Pakistan Institute of Medical Sciences (PIMS), Islamabad. Study design was cross-sectional (Validation) study and the duration of the study was 6 months. The sample size was calculated by using WHO sample size calculator taking sensitivity 93.3% 2,6, specificity 85% 2,6, prevalence 65% 3, desired precision 10% and confidence interval of 95% it came out to be 141. More over purposive non-probability sampling technique was used for sample collection.
Results: In this study mean age was 30 years with SD±2.13. Sixty seven percent patients were male while 33% patients were female. Diagnostic accuracy of Ultrasound of visceral injury in blunt abdominal trauma was analyzed sensitivity of ultrasound was 93.5%, specificity was 84.8%, Positive predictive value was 82.8%, Negative predictive value was 94.3% while diagnostic efficacy was 88.65%.
Conclusion: Ultrasonography has high diagnostic performance in the screening of patients with blunt abdominal trauma.
Keywords: Ultrasound, CT scan, visceral injury, blunt abdominal trauma.

INTRODUCTION

Visceral injuries in blunt abdominal trauma has become very common globally; it need prompt assessment and management[1]. Blunt abdominal trauma usually occurs due to road traffic accident 62.86%, fall from height 20%, assault 11.43% and others 5.71%[2]. Prevalence of intraabdominal injury varies widely, ranging from 7.7% to 65%[3]. Out of 70 patients 52 (74.3%) were males and 18(25.7%) females [2]. Ultrasonography has high diagnostic performance in screening of patients with blunt abdominal trauma[3]. Ultrasound will be regarded as a safer diagnostic tool. It can rapidly be performed at the bedside even without interrupting resuscitation[4]. Ultrasound is commonly confined to detection of abdominal free fluid (an indirect sign of organ injury), intrabdominal parenchymal contusion, hematoma and laceration (direct signs of injury[5]. In the primary evaluation of trauma patients in emergency department, applying ultrasound is a common practice[4]. Sensitivity and specificity of ultrasound in detecting visceral intraabdominal injury are 93.3% and 85% respectively[2,6]. CT is a gold standard technique in the assessment of trauma patient because it is panoranic and highly sensitive compared with ultrasound. According to previous studies, when it is available, it can be performed easily, it is repeatable in short intervals and able to provide rapid information, while ultrasound has low sensitivity in detection of solid organ injury and overlooks significant damage[6]. In haemodynamically stable patients the diagnostic modality of choice is CT with intravenous contrast[6]. Although CT is very useful in detecting abdominal trauma but there are certain conditions where it is difficult to perform, like in patients with contraindication to CT contrast agents, radiation exposure and in hemodynmicaly compromised patients[7] as the patient has to be transported to less monetized unit radiology or the setups where the facility is not available. However in these conditions we can perform ultrasound easily, it is readily available in most of the setups and is cheaper. If with the help of this study it is proved that ultrasound is as reliable as CT in detection of blunt abdominal trauma then we can provide the patient with a simple and economical alternative to CT.

MATERIALS AND METHODS

A total of 141 cases presented in emergency with blunt abdominal trauma with above 18 years and below 65 years of age were included in the study

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while those that were already operated, pregnant, had penetrating injuries or burns were excluded from the study, the study was conducted at Department of Diagnostic Radiology, Pakistan Institute of Medical Sciences (PIMS), Islamabad. It was a Cross-sectional (Validation) Study, it was conducted during October 2011 to April 2012. The study was conducted on patients with blunt abdominal trauma and strong clinical suspicion of IAI, who were hemodynamically stable. Confounding variables were identified and were excluded from my exclusion criteria. US examinations was performed with a 3.5/ 5.0-MHz convex probe by me on Mind ray Doppler US Machine. 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 (e.g. cirrhosis or other cause of non-traumatic intraperitoneal fluid), free fluid was considered positive because hemoperitoneum cannot be excluded. US examination was followed by CT examination. CT examinations was carry out with spiral CT. Free fluid with attenuation value>30 Hounsfield Units (HU) was label as hemoperitoneum. CT findings were used as the diagnostic standard. The scans was viewed by a single consultant radiologist at P.I.M.S diagnostic radiology department who would be blinded to ultrasound findings. The data was analyzed in SPSS version 10. Mean, median, mode and standard deviation for numerical data like age and frequency percentages for categorical data like gender was calculated. A 2 x 2 table was used to determine Sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy.

RESULTS

Age distribution among 141patients was analyzed as 42(30%) patients were in age range 20-30 years, 50(35%) patients were in age range 31-40 years, 35(25%) patients were in age range 41-50 years, 14(10%) patients were in age range 51-60 years. Mean age was 30 years with SD±2.13 (Table 1). Gender distribution among 141 patients was analyzed as 94(67%) patients were male and 47(33%) patients were female (Table 2). Diagnostic accuracy of Ultrasound of visceral injury in blunt abdominal trauma was analyzed sensitivity of ultrasound was 93.5%, specificity was 84.8%, Positive predictive value was 82.8%, Negative predictive value was 94.3% while diagnostic efficacy was 88.65% (Table 3).

Table 1: Age Distribution (n=141)

Age	Frequency	%age
20- 30 years	42	30
31-40 years	50	35
41-50 years	35	25
51-60 years	14	10
Total	141	100

Mean age was 30 years with SD ± 2.13

Table 2: Gender Distribution (n=141)

Gender	Frequency	%age
Male	94	67
Female	47	33
Total	141	100

Table 3: CT Scan VS Ultrasound Findigs (n=141)

Ultrasound findings	CT scan findings		Total
	Visceral injury present	Visceral injury absent	
Visceral injury present	58(83%)	12(17%)	70(49%)
Visceral injury absent	4(6%)	67(94%)	71(51%)
Total	62(44%)	79(56%)	141(100%)

Sensitivity=93.5%, Specificity=84.8%,
Positive predictive value=58/70=82.8%,
Negative predictive value=94.3%,
Diagnostic efficacy =88.65%

DISCUSSION

Computed tomography has been very sensitive in detection of blunt abdominal injuries. The sensitivity of computed tomography for detection of visceral organs in our study was about 93.5% and specificity was 84.8%. This is near to a study carried out by Stafford et al[61] which showed Sensitivity for solid organ injury 92.9% and specificity was 84%. Our results are also comparable to study carried out by Kailidou et al[8].

The sensitivity of CT in detection of hemoperitoneum was 100% in our study which is similar to study of Kshitish et al[9]. There were 4 cases of pelvic fractures for which operation was carried out and computed tomography detected all of these cases and the sensitivity of computed tomography was 100%. Eugene E et al[10] study also showed the 100% sensitivity of CT in detection of pelvic fracture.

In our study most of the patients were male 67%. This is in accordance to study of Willmann.[11] The mean age of patients was 37.7 yrs, which is nearly same as shown in most studies[12]. In our study most of cases of blunt trauma abdomen were due to road side accidents (70%). Dattani et al[13] study also showed that road side accident was the most common mechanism of injury to cause abdominal injuries.

In our study one case of renal injury was missed. The reason of missed renal injury on CT might be that post contrast film was taken very early about 30 seconds. While the literature[14] shows that for proper renal contrast enhancement, exposure should be done slightly late as compared to normal CT abdomen i.e. about 70 seconds after start of infusing IV contrast. IC injuries were missed on CT so the sensitivity and specificity of CT in bowel/ mesenteric injuries was 75% and 100% respectively in our study.

In study done conducted by Stuhlfaut JW et al [15] 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 Rhea JT et al[16] 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. 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[16] 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 OIS11 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. 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.

The limitation of our study was that sample size was small consisting of 30 operated cases. The reason for being nowadays blunt trauma abdomen patients are usually managed conservatively and operation for blunt trauma is usually not carried out especially those patients having normal CT scan abdomen. and the other reason that despite high sensitivity of CT, in our set up surgeons routinely preferred ultrasound for blunt trauma abdomen because resuscitation can be carried out during ultrasound as well as it can be performed at patient bed side and there is no requirement of transferring patient from trauma centre to CT scan room. The other limitation of our study was lower sensitivity in detection of bowel/mesenteric injuries and bladder injuries.

To summarize, no local study has been conducted before in determining the role of CT in blunt trauma abdomen, however few studies has been carried out to assess the role of US in blunt trauma abdomen. Despite its limitations this remains the pioneer local study to determine the role of CT in assessing blunt trauma abdomen.

CONCLUSION

CT has been shown to be very sensitive in defining visceral injuries as well as associated hemoperitoneum. Injuries of the bowel and mesenteric injuries were detected with reasonably high sensitivity. We conclude that CT had a high accuracy in detection of blunt trauma abdominal injuries.

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