ORIGINAL ARTICLE

Diagnostic Accuracy of Ultrasonography in Detection of Gastrointestinal Perforation among Patients with Blunt Abdominal Trauma

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ABSTRACT

Aim: To determine the diagnostic accuracy of Ultrasonography in detecting GI perforation among patients with blunt abdominal trauma by taking the operative findings as gold standard.
Methods: This cross sectional study was carried out in the Emergency wing of Radiology Department, Nishtar Hospital, Multan which included 163 patients with blunt abdominal trauma. All the patients had abdominal USG followed by surgery (operative findings as gold standard). Diagnostic accuracy of USG was detected by determining sensitivity, specificity and accuracy.
Results: The sensitivity, specificity and diagnostic accuracy of abdominal USG was 90.9%, 94.2%, and 92%, respectively for detection of GI perforation.
Conclusions: Abdominal USG is a reliable test for detection of GI perforation among blunt abdominal trauma patients.
Keywords: Abdominal trauma; blunt abdominal trauma; gastrointestinal perforation

INTRODUCTION

Blunt abdominal trauma (BAT) is a leading cause of morbidity and mortality in adult patients in the emergency department, and speedy diagnosis and treatment are considered vital in the successful management of the trauma patient[1].

Prevalence of intraabdominal injury after abdominal trauma varies widely, ranging from 7.7% to 65%. Blunt abdominal trauma usually occurs due to road traffic accidents (RTA), fall from heights or during sports[2,3].

There is always emphasis on prompt assessment, monitoring and management in cases of blunt abdominal trauma. Missed intraabdominal injuries continue to cause preventable deaths[4].

Clinical evaluation of patients with blunt abdominal trauma has always been a challenge for the most of the abdominal trauma surgeons. Clinical findings stay unreliable (diagnostic accuracy of clinical findings is only 47 to 87%) in most of the patients because of altered consciousness, neurological deficit, medication, or other associated injuries[5,6].

In this scenario, the modalities available to the clinician in the emergency room are diagnostic peritoneal lavage, clinician performed ultrasonography in the Casualty Department and computed tomography scanning[7].

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Blunt abdominal trauma may be associated to the injury to solid (liver, spleen or kidney) or hollow organs (gastrointestinal tract). Gastrointestinal tract perforations constitute approximately 5 – 15% of all cases of intraabdominal injuries[8]. Most of the time, the gastrointestinal perforations present as pneumoperitonium (air in peritoneal cavity). The presence of penumoperitonium after blunt abdominal trauma is indication for immediate exploration of abdomen[9].

Plane X-ray abdomen in supine position is highly sensitive (85%) in detection of pneumoperitonium which indicates gastrointestinal perforation[10]. However, in all cases of blunt abdominal trauma, radiography is not possible. Many patients are too sick or debilitated to stand for chest radiographic examinations and in pregnant ladies; radiation exposure might be a problem[11].

Ultrasonography (US) is a rapidly expanding modality in our country and has been widely used in the evaluation of the patient with an acute abdomen[4]. Many patients will undergo Ultrasonography as their initial investigation. Ultrasonography helps in detecting pneumoperitoneum (by peritoneal strip sign) in patients with an acute abdomen which is an important sign of a perforation in gastrointestinal tract[12].

Detection of intraperitoneal free air (IFA) is of great value in identifying life-threatening conditions in patients with acute abdominal pain. IFA usually occurs as a result of a perforated hollow viscous, intraperitoneal gas insufflations, penetrating abdominal injury[13], infection with gas forming

organisms, or spontaneous pneumoperitoneum. Point-of-care ultrasound is an extension of the clinical examination in patients having an acute abdomen[14]. It is a goal-directed study that can be used for rapidly diagnosing intraperitoneal fluid, aortic aneurysms, gallstones, appendicitis, and hydronephrosis[15].

In a study by Moriwaki et al. 289 patients with blunt abdominal trauma were studied. All the patients were evaluated with Ultrasonography for the presence of gastrointestinal perforation (by detecting pneumoperitonium). The confirmation of GI perforation was done by intraoperative findings (gold standard). The sensitivity for the diagnosis of gastrointestinal perforation by US was 85.7%, specificity was 99.6% and accuracy was 98.9%[16].

MATERIAL AND METHODS

This cross sectional study was carried out in the Emergency wing of Radiology Department, Nishtar Hospital, Multan which included 163 patients with blunt abdominal trauma. All the patients had abdominal USG followed by surgery (operative findings as gold standard). Diagnostic accuracy of USG was detected by determining sensitivity, specificity and accuracy. Patients reporting in ER with history of blunt abdominal trauma, and with abdominal tenderness, gardening Patients presenting in ER within 12 hour of injury were included in the study.

A total of 154 patients fulfilling the inclusion criteria reporting to ER of Nishtar hospital Multan with diagnosis of blunt abdominal trauma were included in the study. Informed consents were taken from all patients. The study was approved by ethical committee of hospital. All USG examinations were done by a radiologist who had at least 5 year experience of performing USG. All the patients received undergo through surgery and the findings detected by USG were confirmed by intraoperative findings. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy were calculated by taking operative findings as gold standard. The data was collected on a specially designed proforma.

Statistical analysis was based using SPSS10. Numeric variables like age were described as means and standard deviation. The qualitative variable like sex was described as frequency and percentage.

RESULTS

The mean age of the patients was 29.43±9.10 years [range 20–40]. There were 54(33.1%) patients of age range of 20–25 years, 45(27.6%) patients of age range of 26–30 years (Table 1).

There were 143(87.7%) male patients and 20 (12.3%) female patients in the study. The female to female ratio was 1: 7.15 (Fig.1).

Out of 163 patients included in the study, the abdominal USG was detected to be positive in 104 patients. Of these, 101 were proved on operative findings so were labeled as true positive, while rest of the 3 patients were labeled as false positive. Abdominal USG was negative in total 59 patients (Table 2).

The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of abdominal USG for diagnosis of gastrointestinal perforation among patients with blunt abdominal trauma was 90.9%, 94.2%, 97.1%, 83.0% and 92%, respectively. (Table 3)

Table 1: Distribution of patients by age (n=163)

Age (years)	n	%age
20 – 25	54	33.1
26 – 30	45	27.6
31 – 35	37	22.7
36 – 40	27	16.6
Mean±SD	29.43± 9.10	
Range	20 – 40	

Fig. 1: Distribution of patients by sex (n=163)

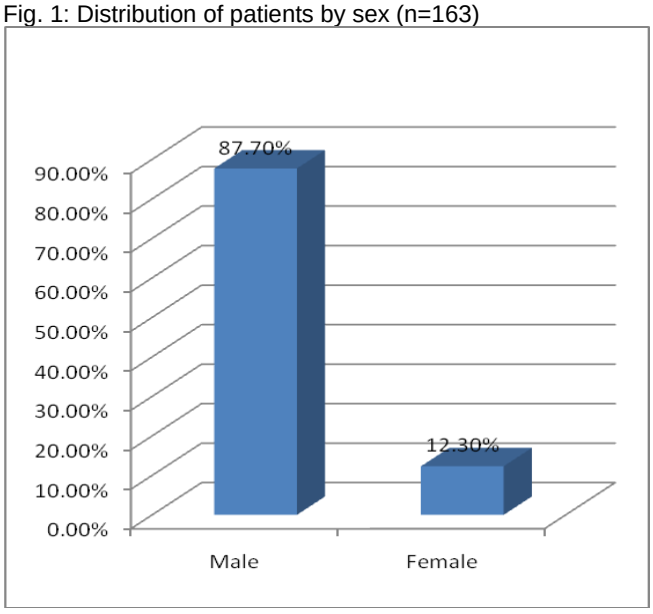

Table 2: Comparison of Ultrasonographic findings versus operative findings (n=163)

FAST	Operative Finding (Gold Standard)	
	Positive	Negative
Positive	101 (TP)	3 (FP)
Negative	10 (FN)	49 (TN)
Total	111	52

Key: TP= True positive FP= False positive
FN= False negative TN= True negative

DISCUSSION

This study was performed to determine the diagnostic accuracy of the abdominal USG for diagnosis of gastrointestinal perforations among patients with blunt abdominal trauma. It was found that the diagnostic accuracy of FAST was 92%.

Previously, a lot more literature is upon the diagnostic role of USG in damage of solid visceral injuries. A few studies are there which have been done to identify the diagnostic accuracy of abdominal USG for detection of GI perforations.

In a study by Moriwaki et al, including 484 patients with abdominal trauma USG showed sensitivity for the diagnosis of gastrointestinal perforation by US were 85.7% and specificity was 99.6%[16]. Like our study, these results were encouraging. They showed a high sensitivity and specificity. The criteria for diagnosis of GI perforation were similar in both studies i.e. intraperitoneal free air and confirmed on histopathology.

In a study by Chen et al, a total of 188 patients with suspected hollow organ perforation were studied. All patients had abdominal ultrasonography, upright chest radiography and left lateral decubitus abdominal radiography examinations[17]. The sensitivity, specificity, positive and negative predictive value, and accuracy of chest and abdominal radiography were compared with that of abdominal ultrasonography. One hundred and seventy-eight patients underwent laparotomy. In the diagnosis of pneumoperitoneum, ultrasonography had improved sensitivity (92% versus 78%), negative predictive value (39% versus 20%) and accuracy (88% versus 76%), and similar specificity (both 53%) and positive predictive value (95% versus 94%) compared with plain radiography. They concluded that plain radiography in the diagnosis of pneumoperitoneum.

In a study by Richard et al, emergency US was performed in 1,686 patients[18]. The sensitivity of emergency US for the detection of bowel and mesenteric injury in the entire study group was 58%. In only those patients with isolated bowel and mesenteric injury, the sensitivity was 44%. They did not favor ultrasonography as a single diagnostic modality. However, they could determine that difference in sensitivity between immediate and delayed manifestation of bowel injury. When the 16 patients with bowel injury that was detected more than 12 hours after the initial US scanning were omitted from the false-negative US group, the sensitivity increased to 75%. However, in our study, we did not perform the delayed examination. So, this aspect could not be highlighted in our study.

Grechenig, performed a study on 10 cadavers. They injected air in abdominal cavities of 10 cadavers and sonography utilized for localization and assessment of the minimal detectable air volume[19]. In all the 10 patients we were able to diagnose pneumoperitoneum preoperatively by ultrasound assessment. They also determined the best position for ultrasound examination of the abdomen is supine with the thorax slightly elevated (10-20 degrees). The optimal probe position was in the right paramedian epigastric area in the longitudinal direction.

Braccini et al conducted another study to evaluate ultrasound (US) versus conventional plain film radiography (CPF) in the detection of pneumoperitoneum[20]. They included 30 patients with postsurgical pneumoperitoneum and a control group of 22 patients were studied using US and CPF. Sonograms and radiograms were obtained while patients were supine and in left lateral decubitus. The two orthogonal plain films of the abdomen were acquired with a horizontal X-ray beam. The epigastric region and right hypochondrium were investigated with ultrasonography. Four experienced, blinded radiologists examined 160 sonograms and 104 radiograms. Statistical analysis yielded a sensitivity of 75.7% for radiography versus 86% for ultrasonography, a specificity of 89.2% versus 83.5%, an accuracy of 81.5% versus 85%, a positive predictive value of 90.2% versus 87%, and a negative predictive value of 76.2% versus 83.5%, respectively. They concluded that US could therefore be considered a reliable alternative imaging technique in the detection of pneumoperitoneum.

CONCLUSION

The abdominal ultrasonography is a reliable investigation for detection of gastrointestinal perforation among patients with blunt abdominal trauma. Its use is recommended in all patients of blunt abdominal trauma a part of routine investigation to rule out bowel peforation. Surgical exploration should be considered for any patients A patient with positive findings of abdominal USG for GI perforation should be subject to immediate exploration.

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Table 3: The diagnostic accuracy of FAST

Sensitivity rate	$\frac{\text{True Positive}}{\text{True Positive + False Negative}}$	x 100 =
	$\frac{101}{101 + 10}$	x 100 = 90.9%
Specificity rate	$\frac{\text{True Negative}}{\text{True Negative + False Positive}}$	x 100
	$\frac{49}{49 + 3}$	x 100 = 94.2%
Predictive value of Positive test	$\frac{\text{True Positive}}{\text{True Positive + False Positive}}$	x 100 =
	$\frac{101}{101 + 3}$	x 100 = 97.1%
Predictive value of Negative test	$\frac{\text{True Negative}}{\text{True Negative + False Negative}}$	x 100
	$\frac{49}{49 + 10}$	x 100 = 83.0%
Accuracy	$\frac{\text{True Positive + True Negative}}{\text{True Positive +True Negative + False Positive + False Negative}}$	x 100
	$\frac{101 + 49}{101+49+3+10}$	x 100 = 92.0%