

Diagnostic Accuracy of Abdominal Ultrasonography in Detection of Hollow Visceral Injury in Cases of Blunt Trauma Abdomen

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ABSTRACT

Aim: To evaluate diagnostic accuracy of abdominal ultrasonography in detection of hollow visceral injury in cases of blunt trauma abdomen by taking the operative findings as gold standard.

Methods: This cross-sectional study was conducted in the Emergency wing of Radiology Department, DHQ Hospital, Mirpur AJK from 1st January 2017 to 30th June 2017. A total of 163 patients with blunt abdominal trauma were included in the study. All the patients were subjected to abdominal USG followed by surgery (operative findings were considered as gold standard). Diagnostic accuracy of USG was detected by determining its 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

Trauma patient's management constitute the major burden of emergency department workload in modern clinical practice and blunt mechanism of abdominal visceral injuries leads to considerable magnitude of mortality and morbidity in injured patients and early diagnoses and prompt management is key to success in polytrauma patients¹.

There is considerable variation in the prevalence of abdominal organs injury following blunt trauma, ranging from 7.7% to 65%. The commonest causes of blunt mechanism of abdominal injury are fall from heights, road traffic accidents and variety of sports injuries^{2,3}.

There is always emphasis on prompt assessment, monitoring and management in patients with abdominal injuries. Missed intraabdominal injuries continue to cause preventable deaths⁴.

The management of blunt trauma abdomen becomes challenging for surgeon when they have to take the decision regarding operative or conservative management particularly when they have limited diagnostic facilities. Clinical findings stay unreliable (diagnostic accuracy of clinical findings is only 47 to 87%) in most of the patients because of mantle obtundation, neurological deficit, effects of medicines, or other concomitant conditions and injuries^{5,6}.

In trauma settings, the usual diagnostic

modalities available to the surgeons are diagnostic peritoneal lavage, focused abdominal ultrasonography (FAS scan) and C T scanning⁷.

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 injuries⁸. Most of the time, the gastrointestinal perforations present as pneumoperitonium (air in peritoneal cavity). The presence of pneumoperitonium after blunt abdominal trauma is indication for immediate exploration of abdomen⁹.

Plane X-ray abdomen in supine position is highly sensitive (85%) in detection of pneumoperitonium which indicates gastrointestinal perforation¹⁰. However, in all cases of blunt abdominal trauma, radiography is not possible. Moreover in pregnant females; radiation exposure might prove teratogenic¹¹.

Ultrasonography (US) is a rapidly expanding modality in our country and has been widely used in the evaluation of the abdominal trauma patients as focused abdominal sonography⁴. Ultrasonography helps in detecting free air in the peritoneum (by peritoneal strip sign) in patients with trauma to the abdomen which is an important sign of a perforation in gastrointestinal tract¹².

Pneumoperitoneum that is presence of intraperitoneal free air (IFA) is the sign of life-threatening conditions in patients with acute abdomen. Intra peritoneal free air results from perforation of hollow viscous, intraperitoneal gas insufflations, penetrating abdominal trauma, infection

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with gas producing microorganisms, or spontaneous pneumoperitoneum¹³.

Moriwaki et al¹⁴ conducted a study that included 289 patients with blunt abdominal trauma. All the patients were evaluated with ultrasonography for the presence of gastrointestinal perforation (by detecting pneumoperitoneum). The confirmation of GI perforation was done by intraoperative findings (gold standard). The sensitivity, specificity and accuracy for the diagnosis of gastrointestinal perforation by US were 85.7%, 99.6% and 98.9% respectively.

MATERIAL AND METHODS

This cross-sectional study was conducted in the Radiology Department, DHQ Hospital, Mirpur AJK from 1st January 2017 to 30th June 2017. A total of 163 patients with blunt abdominal trauma were included in the study 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. Both sexes with age 20–40 years, history of blunt abdominal trauma, abdominal tenderness, gardening and patients presenting in ER within 12 hour of injury were included. 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. Statistical analysis was based using SPSS-12. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy were calculated by taking operative findings as gold standard.

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. There were 143(87.7%) male patients and 20(12.3%) female patients in the study. The female to male ratio was 1: 7.15 (Table 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. 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 2)

Table 1: Demographic information of the patients (n=163)

Variable	No.	%
Age (years)		
20 – 25	54	33.1
26 – 30	45	27.6
31 – 35	37	22.7
36 – 40	27	16.6
Gender		
Male	143	87.7
Female	20	12.3

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

FAST	Operative finding		Total
	Positive	Negative	
Positive	101 (TP)	3 (FP)	104
Negative	10 (FN)	49 (TN)	59
Total	111	52	163

$$\text{Sensitivity} = \frac{101}{111} \times 100 = 90.9\%$$

$$\text{Specificity} = \frac{49}{52} \times 100 = 94.2\%$$

$$\text{Positive predictive value} = \frac{101}{104} \times 100 = 97.1\%$$

$$\text{Negative predictive value} = \frac{49}{59} \times 100 = 83\%$$

$$\text{Accuracy} = \frac{150}{163} \times 100 = 92\%$$

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%.

In the literature lots of studies conducted regarding the diagnostic role of USG in detecting solid organs injuries. There is scarcity of studies few studies to identify the diagnostic accuracy of abdominal USG for detection of GI perforations.

Moriwaki et al¹⁴ reported that 484 patients with abdominal trauma USG showed sensitivity for the diagnosis of gastrointestinal perforation by US were 85.7% and specificity was 99.6%. 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.

McGahan and colleagues¹⁵ reported that 188 patients with suspected gastrointestinal tract perforations. All patients had abdominal ultrasonography, upright chest radiography and left lateral decubitus abdominal radiography examinations. 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 were explored surgically. In the diagnosis of pneumoperitoneum, ultrasonography had got improvement in its sensitivity negative predictive value, accuracy and specificity compared with plain radiography.

In a study by Richard et al¹⁶ stated that emergency US was performed in 1,686 patients. The sensitivity of emergency US for the detection of bowel and mesenteric injury in the entire study group was 58% and in 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 et al¹⁷ performed a study on 10 cadavers. They injected air in abdominal cavities of 10 cadavers and sonography utilized for localization and evaluation of the minimal detectable air volume. In all these cases they were able to diagnose pneumoperitoneum preoperatively by ultrasound assessment. They found supine abdominal position with slight (10-20 degrees) elevation of thorax a best position for sonography. The best probe position was in the epigastrium and little to the right side of midline while in the verticle direction.

Braccini et al¹⁸ conducted another study to compare ultrasound versus conventional plain X ray abdomen in the diagnoses of pneumoperitoneum. They concluded that ultrasound abdomen could therefore be considered as a valuable alternative imaging technique in finding out free air in peritoneal cavity.

CONCLUSION

The abdominal ultrasonography is a reliable investigation for detection of gastrointestinal perforation among patients with blunt abdominal trauma. Therefore based on our results we may

recommend its use in all patients of blunt trauma abdomen along with other investigation to rule out bowel perforation. Once a patient has positive findings on abdominal USG for GI perforation should be subject to immediate exploration.

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