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Original Research Article

Role of Plain Radiographs and Ultra Sonogra in the Evaluation of Blunt Abdominal Trauma

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Abstract

Background: Blunt abdominal trauma is one of the commonest injuries. Blunt abdominal trauma usually occurs due to road traffic accidents; fall from height or during sports. Prevalence of intra-abdominal injuries varied widely, rapid diagnosis was essential and appropriate prioritizing diagnostic work up and treatment was critical to ensure patient survival to decrease mortality and morbidity.

Methods: A prospective study was conducted over a period of two years, on 100 patients. They were evaluated with plain radiographs and Routine real-time ultrasound scanner (Philips IU22) with correlated CT (Siemens somatom 6 slice) and post operative findings in cases wherever laparotomy was performed.

Conclusion: To conclude a multipronged multimodality approach employing combination of abdominal radiographs, ultrasonography in evaluating trauma cases can be fairly useful and accurate in early diagnosis and management of solid visceral injuries results from blunt abdominal trauma where limited diagnositicmodalities lacking CT and ICU support with high sensitivity and high specificity resulting in reduction of mortality and morbidity.

Keywords: Abdominal radiographs, Ultrasonography, laprotomy.

Introduction

Blunt abdominal trauma is a leading cause of morbidity and mortality among all age groups. Blunt injury occurs most frequently with motor vehicle collisions. [1] Prevalence of intra-abdominal injuries varies widely; rapid diagnosis is essential and appropriate prioritizing diagnostic work up and treatment is critical to ensure patient survival [2] to decrease mortality and morbidity. The recent trend is heavily in favor of non-operative or conservative surgical management of abdominal solid visceral injuries given the various sophisticated and highly accurate noninvasive imaging tools at trauma surgeon's disposals today. However the feasibility and safety of such an approach especially in a

limited resource setup and non-availability of intensive care units and advancedimaging/instrumental technique like CT, angiography Etc Blunt injury as causes of intra-abdominal injuries have been recognized since historical times. Aristotle was the first to record visceral injuries from blunt trauma. Hippocrates and Galen are said to have given apt description of the condition. [3] By 1500 BC distinct triage and surgical protocol had been developed in Babylonia under the rule of Hammurabi as said by Edwin Smith Papyrus. The ancient Chinese used a sharp blow on the region of the spleen as a method of assassination. Trausse in 1827 presented fracture of body of pancreas in blunt trauma. Jance (1856) described a fatal isolated pancreatic injury due to a kick. In1870Burn was the first one to respect the liver successfully and Burkhart in 1886 controlled acute traumatic liver haemorrhage by suturing. [4] Von Reclinghausen (1861) described renal artery thrombosis occurring as a result of blunt injury. In 1934 Aenhium used puncture of abdominal wall as a diagnostic procedure in abdominal injuries. Branch in 1938 reported 2 cases of liver laceration treated by resection of left lobe. The development of emergency medical service is an important milestone in the history of clinical and surgical practice of trauma. Greeks required physicians to be present during the battle and Romans established the hospitals close to the battlefield. Cincinnati General Hospital first instituted the ambulance system in 1865. [5] In 1965 Root first described the flushing of sterile solution through the peritoneal cavity to obtain peritoneal contents. [6]

Objectives

To evaluate the usefulness of ultrasonography and plain radiographs in detection of intra-abdominal injury in patients with blunt abdominal trauma and to provide information that could determine choice of management (non-operative versus operative). To evaluate the sensitivity, specificity and negative predictive value of plain radiograph and ultrasonography in blunt abdominal trauma.

Review of Literature

Mohapatra S, Pattanayak SP, Rao KRRM, Bastia B. Options in the management of solid Visceral injuries from blunt abdominal trauma. Indian J Surg 2003; 65:263-8[2]. This review highlighted that non-operative management of solid visceral injuries from blunt abdominal trauma, especially in stable patients, has become the order of the day in developed countries. However, the safety and feasibility of such an approach in the absence of modern amenities like CT, angiography and ICU supporthas remained a point of controversy. This prospective study analyzes the manifestations, management and outcome of solid visceral injuries in 72 patients with blunt abdominal trauma, relying solely on readily available diagnostic modalities, viz. abdominal X-ray, ultrasonography and paracentesis, in the setting of a hospital lacking CT and ICU support. Chest injury was the predominant associated injury (26%), but head injury was the most common extra-abdominal injury causing death. Plain abdominal X-ray accurately diagnosed all 3 cases of intestinal injury. Abdominal ultrasonography had a sensitivity of 89%, specificity of 100%, and accuracy of 100% in diagnosing abdominal solid visceral injuries. Frequency of solid visceral injuries encountered were liver 47.9%, spleen 29.2%, kidneys 14.6% and pancreas 8.3%. Organ salvage was possible in 90.3% of operated cases. Postoperative morbidity was 26%, mostly due to chest and wound infections. Non-operative morbidity rate was 20% with failure of non-operative

management occurring in 10%cases. The overall mortality was 21%. All deaths in the non-operative group (mortality 9%) were due to associated head injury, whereas deaths in the operative group (14% mortality) were a consequence of the abdominal trauma and/or surgery. Atif Latif, Muhammad Ashraf Farooq, Muhammad Adeel Azhar. Diagnostic Value of Ultrasonography in Evaluation of Blunt Abdominal Trauma. RMJ. 2008; 33(2): 154-158 [6] Atif latif et al in their study observed 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. Mehmet Selim Nural, Türker Yardan, Hakan Güven, Ahmet Baydın, İlkay Koray Bayrak, Celal Katı. Diagnostic value of ultrasonography in the evaluation of blunt abdominal trauma. Diagn Interv Radiol 2005; 11:41-447 Mehmet selim et al showed that Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of US in detecting intra-abdominal injury were 86.5%, 95.4%, 62.7%, 98.7% and 94.7%, respectively. Matthew O. Dolich, MD, Mark G. McKenney, MD, FACS, J. Esteban Varela, MD, Raymond P. Compton, MD, Kimberly L. McKenney, MD, and

Figure 1: Ultrasonography of Spleen- Gradeii Laceration with Peri Spleenic Collection

Stephen M. Cohn, MD, FACS. 2,576 Ultrasounds for Blunt Abdominal Trauma. J Trauma. 2001; 50:108 –112.8 Matthew o Bolich et al in his study showed that Ultrasonography had a sensitivity of 86%, a specificity of 98%, and an accuracy of 97% for detection of intra-abdominal injuries. Positive predictive value was 87% and negative predictive value was 98%. Study concluded that emergency ultrasound is highly reliable and may replace CT scan and diagnostic peritoneal lavage as intial diagnostic modality in the evaluation of most patients with blunt abdominal trauma.

Sensitivity of 86%, a specificity of 98%, and an accuracy of 97% for detection of intra-abdominal injuries. Positive predictive value was 87% and negative predictive value was 98%. Study concluded that emergency ultrasound is highly reliable and may replace CT scan and diagnostic peritoneal lavage as intial diagnostic modality in the evaluation of most patients with blunt abdominal trauma. Yoshii, Hiroshi MD et al in his study showed for the detection of injuries, US was 94.6% sensitive, 95.1% specific, and 94.9% accurate. Individual organ injuries were identified with sensitivities of 92.4, 90.0, 92.2, 71.4, and 34.7% for the liver, spleen, kidneys, pancreas, and intestine, respectively.

Figure 2: Ultrasonography of Pancreas – Grade Ii Laceration through the Head of Pancreas.

Material and methods

A prospective study was conducted over a period of two years, on 100 patients. Department of Radiology, at Nalanda medical college and Hospital, Patna, Bihar. They were evaluated with plain radiographs and Routine real-time ultrasound scanner (Philips IU22) with correlated CT (Siemens somatom 6 slice) and post operative findings in cases wherever laparotomy was performed. Patients having solid organ injury, hemoperitoneum and air under diapharam are subjected to CT scan or laparotomy where ever needed.

Inclusion criteria

Patients presenting with blunt abdominal injury. Clinical suspicion of intra-abdominal injury, Haemodynamically stable patient, multi-trauma patient.

Exclusion criteria

Abdominal penetrating injuries, all haemo dynamically unstable patients with obvious peritoneal signs and progressive abdominal distention - were taken up for surgery immediately and were excluded from the study.

After receiving patient for suspected blunt abdominal organ injury history evaluated for severity of trauma. Patient positioned in supine position or appropriate position where patient feels comfort position in other associated injuries like rib fractures, pelvic fractures etc. Patient abdomen scanned using appropriate frequency probes for solid abdominal organ injury and hemoperitoneum, hemothorax. Routine antero-posterior topogram of the abdomen was initially taken in all patients in the supine position. 500 ml of water-soluble oral contrast for suspected perforation, (1%-2% iodinated contrast material), was given before examination in all cases (30-45 minutes before, if time permitted). Plain scans were followed by intravenous contrast scans in suspended inspiration. For intravenous contrast enhancement 80-100ml of dynamic injection of (Ultravist - 300mg Iodine per ml) or in children a dose of 3mg of Iodine / Kg body weight was administered and axial sections were taken. Sections were taken in arterial (30 sec) and portal venous (60 - 90 sec) phases. Delayed scanning (5-7 minutes) was not routinely performed, only in suspected cases of renal or bladder trauma.

Results

A prospective study to find efficiency of plain radiographs and ultrasonography in blunt abdominal injury

Table 1: Age Distribution of Patients Studied

AGE IN YEARS	NUMBER	PERCENT
0-10	02	02
11-20	15	15
21-30	28	28
31-40	26	26
41-50	17	17
51-60	08	08
61-70	03	03
71-80	01	01
TOTAL	**100**	**100**

In this study youngest patient was 4 years and oldest was 72 years. Maximum patient were in age range of 21-30 years.

Table 2: Gender Distribution

GENDER	NUMBERS	PERCENTAGE
MALE	83	83%
FEMALE	17	17%
TOTAL	**100**	**100%**

In this study there were more males patients (83%) with blunt injury abdomenthan female patients.

Table 3: Mode of Blunt Injury Abdomen

MODE OF INJURY	MALES	FEMALES	TOTAL
RTA	64	12	76
FALL FROM HEIGHT	12	02	14
ASSAULT	07	02	09
STAMPEDE	00	01	01

Total number of deaths in our study were 5, out of these 4 are post operative secondary to post operative complication and one non operative before taking to operation theater, multiple organ injury.

Blunt solid abdominal injuries categorized into two groups i.e. low grade injury (LGI) involving grade I and II, high grade injury (HGI) involving grade III, IV and V.

Table 4: Distribution of Renal Injury Grades

	LOW GRADE INJUR	HIGH GRADE	TOTAL
CONSERVATIVE	15	02	17
OPERATED	02	01	03
TOTAL	17	03	20

Solid Injury up Graded Injury on Ct/OperativeLiver

One case of grade I missed on ultrasound, 3 cases of grade II upgraded to grade III, One of grade III upgraded to grade IV, One case of grade IV upgraded to grade V

Spleen

One case of grade I missed on ultrasound, 4 cases of grade II upgraded to grade III, 5 of grade III upgraded to grade IV

PLAIN RADIO-GRAPHS

Out of 50 splenic injury cases 15(33%) were associated with left lower rib fractures, 6 cases shown air under dooms of diaphragm on erect X-ray abdomen, all areassociated with bowel perforation.

Discussion

In this study the youngest patient was 4 years old and oldest was aged 72 years. The maximum percentage of patients 28% were in the range of 21-30 years. This was followed by patients in the range of 31-40 years (26%). Majority of these patients were involved in road traffic accident. One patient with isolated pancreatic injury wasinvolved in bicycle handle injury. Following gender distribution among the individuals and mode of injury were found in this study. Incidence of male preponderance accounting for (83%) compared to the female (17%) was noted with blunt injury to abdomen and males out numbed the female patients in all types of mode of injury, 39 cases were posted for operative procedures depending on progressive clinical complications like gas under diaphragm, gross hemo peritoneum and high grade solid organ injury in clinically unstable patients.In this study splenic injury was most common accounting for 50% in this study. Majority had 27(54%) were grade II injuries. Mohapatras et al [7] in their study showed that abdominal sonography had a sensitivity of 89%, specificity 100% and accuracy 100% in diagnosing solid organ injuries. Frequency of solid organ injuries were liver 47.9%, spleen 29.7%, kidneys 14.6% and pancreas 8.3%. Overall mortality was 21% of all deaths in non-operative group were due to associated head injury whereas in operative group were a consequence of abdominal trauma/surgery. Plain abdominal radiography accurately diagnosed all 3 cases of intestinal injury. In present study abdominal sonography had a sensitivity of 96.8%, specificity of 100% and negative predictive value of 57% in diagnosing solid organ injury. Frequency of solid organ injuries were spleen50%, liver 36% , kidneys 20% and pancreas 5%, 5 deaths occurred , 4 out of these 5 were related to post operative complication like sepsis, wound infection etc and high grade injuries and 1 non operative death due to multi solid organ injury. Here bias of associated head injury may be related to referral neuro-center NIMHANS where associated head injury caseswere directly or without ultrasonography imaging referred for management of head injury. Thus, without head injury cases ultrasound has a primary role in evaluation ofblunt abdominal injury for management. In this study 6 intestinal injuries were detected out of 6 suspected cases on plain abdominal radiographs which is agreeing with Mohapatra set al[2] study. This study almost correlated with the study by Atif latif et al, [6] which showed sensitivity 93.3, specificity 85 and negative predictive value 94.4 of ultrasound in detecting intra-abdominal injury, in present study sensitivity of 96.8 and specificity of 100 were found. Study by Yoshill, Hiroshi M D[11] et al study has shown detection of solid visceral organ injury by ultrasound was 94.6 sensitivity, 95.1 specificity. Individual solid organ were identified with sensitivity of 92.4, 90.0, 92.2, 71.4 and 34.7 for liver, spleen, kidneys, pancreas and intestines respectively. In this study two cases showed urinary bladder injuries associated with pelvic fractures which were missed by ultrasound. Plain radiographs showed pelvic fractures. CECT showed contrast extravasation indicating bladder rupture and pelvic fractures. [8] Thus

combination of ultrasound and plain radiographs delinating pelvic fractures can be usefull in suspicion of bladder rupture helps in further management of the patient. Jeffrey et al [9] states that CT staging of blunt hepatic injuries has little discriminatory value in predicting outcome of stable patients as nearly all have an excellent prognosis. We agree with Jeffery et al, [9] in this study low grade hepatic injuries accounted for 23 out of and resolved well and had uneventful hospital stay which were detected on ultrasonography. In this study Renal injuries were the 3rd most commonly injured organ accounted for (20%) cases. Out of which 15 were grade I and II injuries, 2 were grade III and I was grade IV injury. In Grade IV injury nephrectomy was performed based on ultrasound and CT reports confirmation. Low grade injuries were managed conservatively, out of these 2 were operated for other associated solid organ injury. In this study 5 cases of pancreatic injury were diagnosed which showed grade I and II injuries. One patient underwent surgery for associated solid organ injury and others managed conservatively. Out of these 5 cases ultra sound detected only two cases and others were found on CT. thus ultrasound was inconclusive in assessing pancreatic injuries and to judge the accuracy of ultrasound in pancreatic injuries was inconclusive. Out of 81 cases presented with hemoperitoneum 12 cases had gross hemoperitoneum,4 cases out of 12 had mesenteric injury without other solid organ injury. All 4 cases were operated for mesenteric repair. Thus, without evidence of solid organ injury with presence of gross hemoperitoneum suspects mesenteric injury.

Neural M S et al [10] showed that ultrasound has sensitivity 86.5%, specificity 95.4, positive predictive value 62.7 and negative predictive value 98.7 for abdominal blunt visceral injuries. [11,12]

Conclusion

Imaging of abdominal trauma to accurately identifying specific organ injury is challenging and necessary to avoid unnecessary operative intervention in cases which need conservative management. To conclude a multipronged multimodality approach employing combination of abdominal radiographs, ultrasonography in evaluating trauma cases can be fairly useful and accurate in early diagnosis and management of solid visceral injuries results from blunt abdominal trauma where limited diagnositic modalities lacking CT and ICU support with high sensitivity and high specificity resulting in reduction of mortality and morbidity.

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