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Ultrasound and Computed Tomography Correlation in Blunt Abdominalinjury

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ABSTRACT

To evaluate the usefulness of ultrasonography and computed tomography in detection of intra-abdominal injury in patients with blunt abdominal trauma and to provide information that could determine choice of management and correlate the combined role of ultrasound and computed tomography findings with surgical, early diagnosis and management of solid visceral injuries from blunt abdominal trauma with high sensitivity and specificity resulting in reduction of mortality and morbidity.

Keywords: ultrasonography, trauma and liverhemorrhage.

1. INTRODUCTION

Blunt abdominal trauma is a leading cause of morbidity and mortality among all age groups. Blunt injury occurs most frequently with motor vehicle collision [1]. Blunt injury of abdomen is also a result of fall from height, assault with blunt objects, industrial mishaps, sport injuries, bomb blast and fall from riding bicycle. The rapid increase in number of motor vehicles and its aftermath has caused rapid increase in number of victims to blunt abdominal trauma. Motor vehicle accidents account for 75 to 80 % of blunt abdominal trauma.

Blunt abdominal trauma is usually not obvious. Hence, often missed, unless, repeatedly looked for. Due to the delay in diagnosis and inadequate treatment of the abdominal injuries, most of the cases are fatal. The knowledge in the management of blunt abdominal trauma has progressively increasing. Prevalence of intra abdominal injuries varies widely; rapid diagnosis is essential and appropriate prioritizing diagnostic workup and treatment is critical to ensure patient survival[2] to decrease mortality and morbidity.

The recent trend is heavily in favour of non-operative or conservative surgical management of abdominal solid visceral injuries given the various sophisticated and highly accurate non invasive

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imaging tools at radiologists' disposals today. In spite of the best techniques and advances in diagnostic and supportive care, the morbidity and mortality remains at large.Blunt injury as cause of intra abdominal injuries have been recognized since historical times. Aristotle was the first to record visceral injuries from blunt trauma.[3-6] Hippocrates and Galen are said to have given apt description of the condition.

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.[7] Trausse in 1827 presented fracture of body of pancreas in blunt trauma. Owen in 1848 gave a graphic description of a case of closed abdominal injury and fatal hypovolemic shock due to liver rupture following a fall.Jance (1856) described a fatal isolated pancreatic injury due to a kick. In 1870 Burn was the first one to resect the liver successfully and Burkhart in 1886 controlled acute traumatic liver hemorrhage by suturing.

Von Recklinghausen (1861) described renal artery thrombosis occurring as a result of blunt injury.Branch in 1938 reported 2 cases of liver laceration by resection of left lobe. The development of emergency medical service is an important milestone in history of clinical and surgical practice of trauma.[8-11] Greeks required physicians to be present during the battle and Romans established the hospital close to the battlefield.Cincinnati General Hospital first instituted the ambulance system in 1856.In 1965 Root first described the flushing of sterile solution through the peritoneal cavity to obtain peritoneal contents.Initial imaging technique like ultrasound and plain radiographs has a role in triage of patients for operative and conservative management thus reducing mortality.

2. MATERIALS ANDMETHODS

Method of Collection of data

A prospective study will be conducted over a period of 20 months from February 2015 to October 2016 on 30patients. They will be evaluated with Ultrasonography and correlated with CT and post operative findings in cases where ever laparotomy will be performed. Patients having solid organ injury, hemoperitoneum and air under diaphragm are subjected to higher modalities/ investigations / laparotomy where ever needed.

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Inclusion criteria

Patients presenting with blunt injury abdomen

1. Clinical suspicion of intra-abdominalinjury
2. Hemodynamicallystablepatient
3. Multi-traumapatient

Exclusion criteria

1. Abdominal penetratinginjuries
2. All hemodynamicallyunstablepatientswith obvious peritoneal signs and progressive abdominal distension – were taken up for surgery immediately, hence ,were excluded from thestudy.

TECHNIQUE

After receiving patient for suspected blunt abdominal organinjury history evaluated for type, duration andseverity of trauma. Patient positioned in supine position or appropriate position where patient feels comfortable, in other associated injuries like rib fractures, pelvic fractures

.etc. Patient abdomen scanned using appropriate Frequency probes for solid abdominal organ injury and to detecthemothorax, hemoperitoneum using Siemens ACUSON S-2000 ultrasound machine.Re-assessing the stability of patient, Screening X -Ray may be done for Erect abdomen Radiograph, C hest PA or AP and appropriate films for associated injuries. For Erect abdominal radiograph, patient was asked to be in erect position for 5-8 minutes and appropriate films are taken with appropriate Kv and mA factors. Patient is then taken for CT.Routineantero-posterior topogramofthe 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 patients (30 -40 minutes before , if time permits) . Axial sections of 5mm thickness was taken from the level of lung bases to the level of ischialtuberosities. Kilovolt peak 120 -140kVp,milliampere second: 200 - 250 mAs for an average sized patient (increased values for an oversized patients). Pitch: 1.5, Field of view : 240 - 350 mm ; collimation :2.5mm , Time for scan : 5-9 seconds. Plain scans were followed by intravenous contrast scans in suspended laceration.

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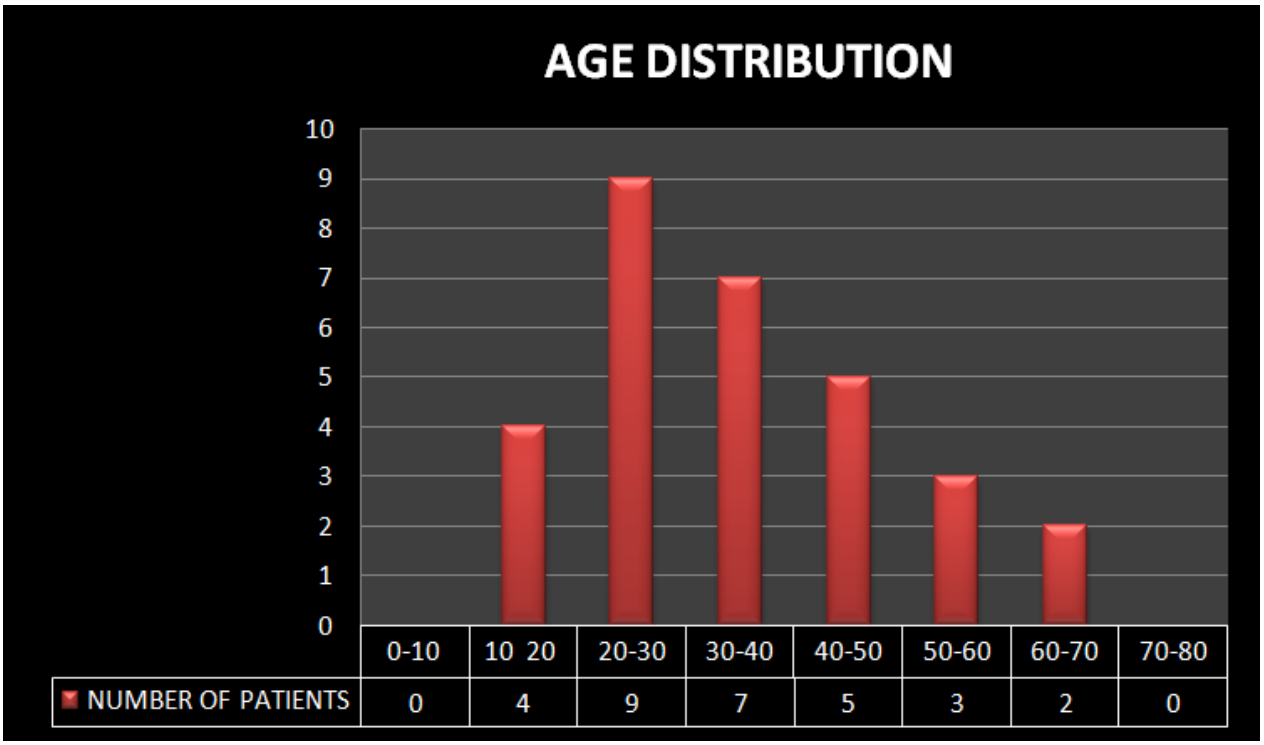
For intravenous contrast enhancement 80-100 ml of dynamic injection of (300 mg Iodine per ml)or in children a dose of 3 mg of Iodine /kg body weight was administered and axial sections were taken . Sections were taken in arterial (30 sec) and portal venous (60 -90 sec) phases. Delayed scanning (5 -7 minutes) was not routinely performed, only insuspectedcasesof renal orbladder trauma.

4. RESULTS



In this study the youngest patient was 14 years and oldest was 67 years. Maximum patients were in age rangeof 21 -30 years.

TABLE 2 : GENDER DISTRIBUTION

GENDER	NUMBER	PERCENTAGE
MALE	21	70%
FEMALE	9	30%
TOTAL	30	100

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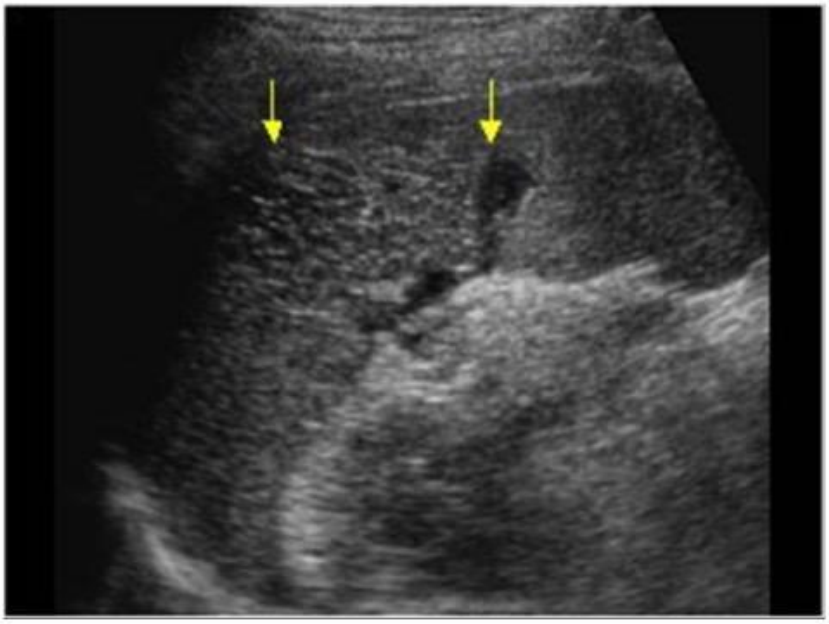

Ultrasound shows splenic laceration with free fluid around spleen.

CT axial section shows renal laceration

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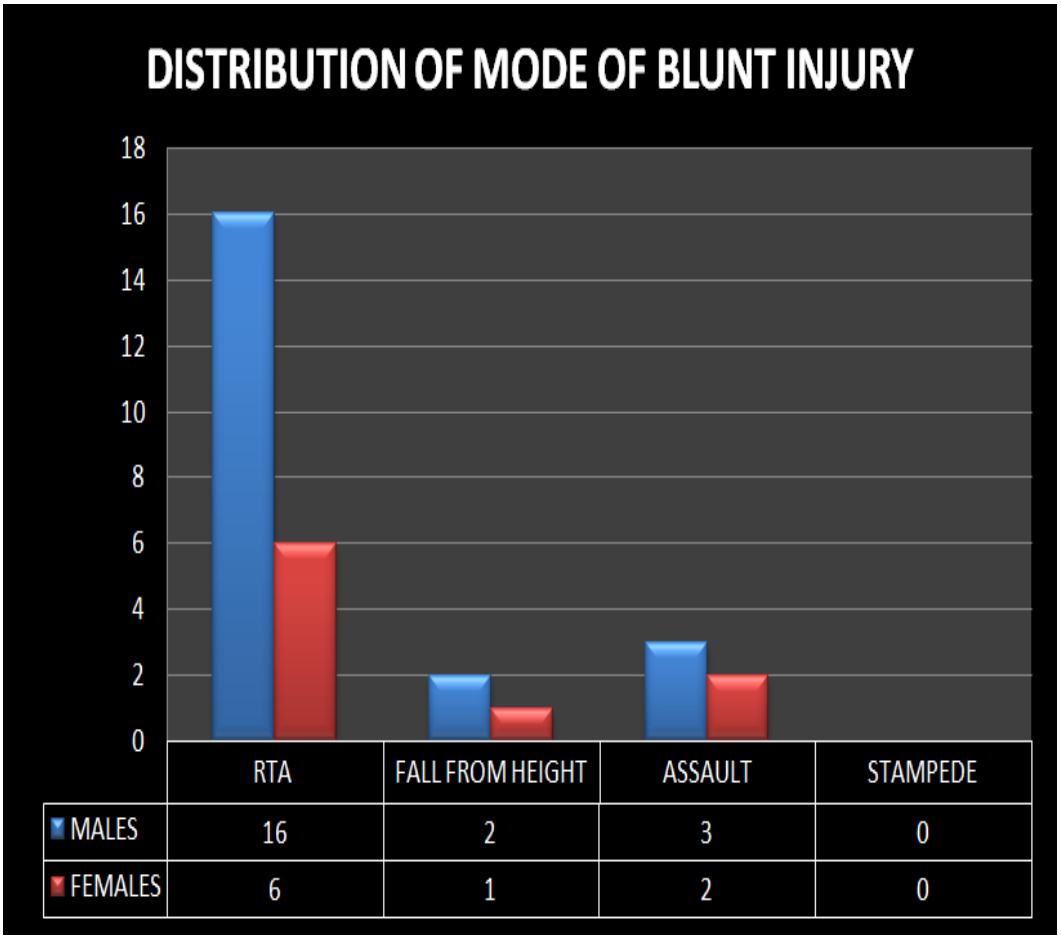

RTA is a predominant mode of injury

TABLE 4 : AGE DISTRIBUTION IN ROAD TRAFFIC ACCIDENTS

AGE INYEARS	MALE	FEMALE	TOTAL
0-10	-	-	-
10-20	2	1	3
20-30	4	1	5
30-40	4	2	6
40-50	2	2	4
50-60	2	-	2
60-70	2	-	2
70-80	-	-	

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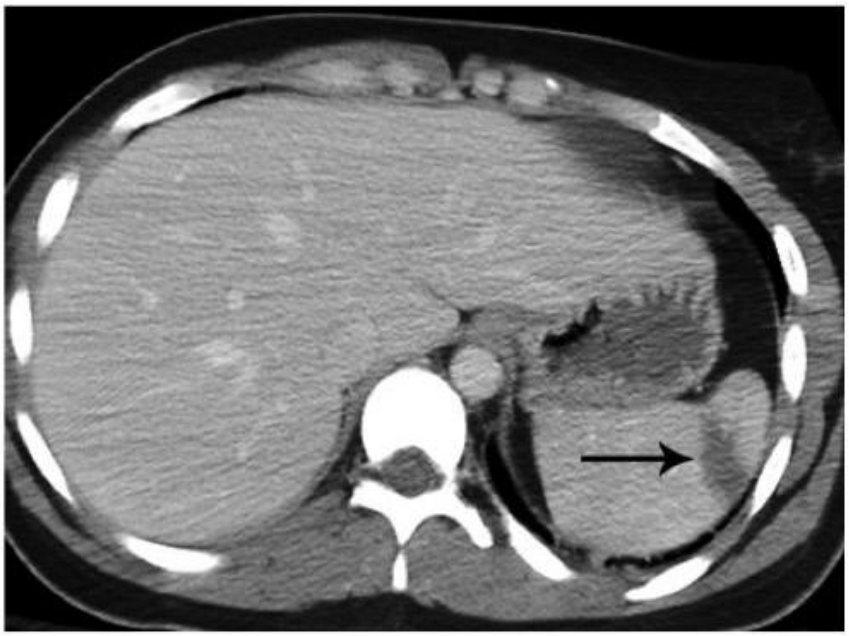
X-ray erect abdomen showing free air under diaphragm



CT axial section shows grade II laceration of spleen

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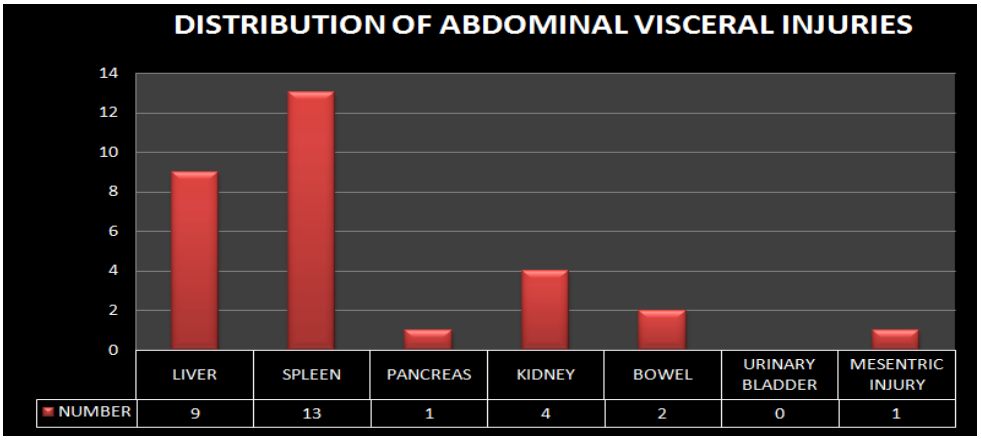

STATISTICAL METHODS

Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented on mean, SD (min – max) and results on categorical measurements are presented in number / %.Diagnostic statistics such as sensitivity, specificity, PPV. NPV and accuracy has been used to find the correlations ultrasonography with CECT scan or laparotomy.

TABLE 9: DISTRIBUTION OF HEMOPERITONEUM

GRADE	NUMBER
MILD	9
MODERATE	12
GROSS	4

Axial post-contrast CT shows capsular tear, hepatic laceration with injury close to the hilum

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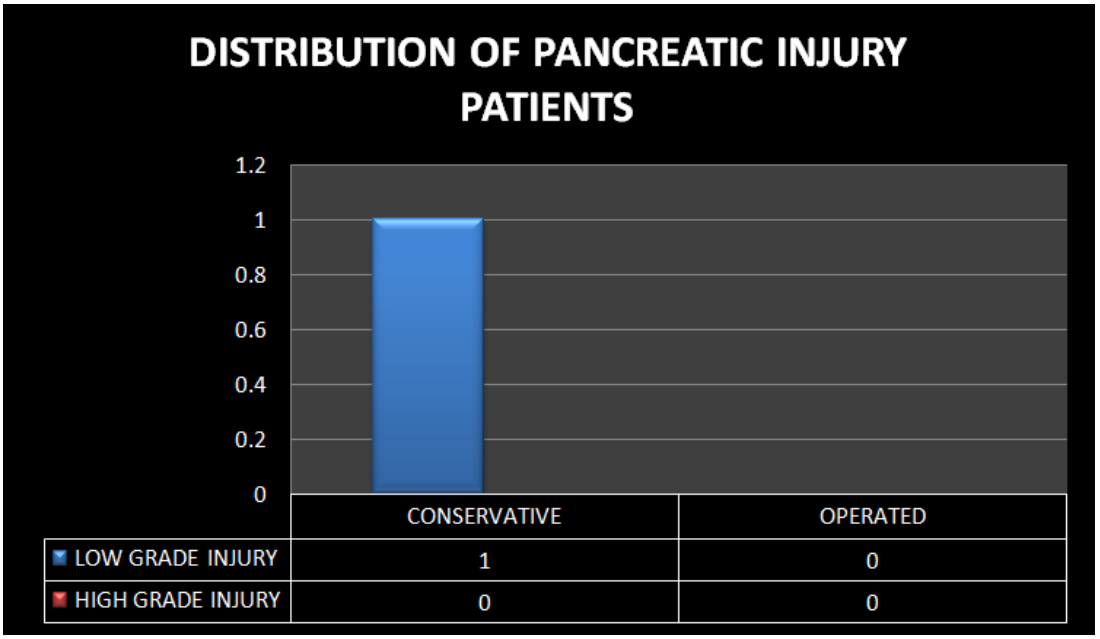
TABLE 12 : DISTRIBUTION OF SPLEEN INJURY

	LOW GRADE INJURY	HIGH GRADE INJURY	TOTAL
CONSERVATIVE	5	1	6
OPERATED	2	5	7



1) SOLID INJURY UPGRADED ON CT / OPERATIVE LIVER

a. **No** Case of grade 1 missed onultrasound

b. **2** Cases of grade 2 upgraded to grade3

c. 1 of Grade 3 upgraded to grade4

d. 1 Case of grade 4 upgraded to grade5

SPLEEN

a. No Case of grade 1 missed onultrasound

b. 2 Cases of grade 2 upgraded to grade3

c. 3 of Grade 3 upgraded to grade4

d. 1 Case of grade 4 upgraded to grade5

PANCREAS

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1 case of Grade 1 pancreatic injury was missed on Ultrasound

KIDNEY

a. No Case of grade 1 missed onultrasound

b. 2 Cases of grade 2 upgraded to grade3

c. No of Grade 3 upgraded to grade4

d. No Case of grade 4 upgraded to grade5

2) STATS FOR ORGAN SPECIFICINJURY

a. LIVER

Total liver injuries in thisstudy -9

Cases missedonUltrasound - NIL

TruePositive -9

LIVER INJURY

ULTRASOUND		**POSITIVE**	**NEGATIVE**	**TOTAL**
	POSITIVE	9	-	9
	NEGATIVE	0	-	0
	TOTAL	9	-	9

$$\textbf{SENSITIVITY} = \frac{\textbf{TRUEPOSITIVE}}{\textbf{TRUE POSITIVE + FALSENEGATIVE}} * 100$$

= 9 /9* 100 = 100

5. DISCUSSION

In this study the youngest patient was 14 years old and oldest was 63 years. The maximum percentage of patients (30%) were in the range of 21 -30 years. This was followed by patient in the

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range of 31 -40 years.Majority of these patients were involved in road traffic accident.Following gender distribution among the individuals and mode of injury were found in this study. Incidence of male preponderance accounting for 70% compared to the female was noted with blunt injury abdomen and male s out numbered the females patients in all types of mode of injury.Most of the male patients involved in road traffic accidents were in the 21 -30 years of age group.2 patients (6 %) were involved in the pediatric age group, both were involved in road traffic accident.In this study out of 30 patients, 28 were positive for solid organ injury and 1 had mesenteric injury.[12]No patients had head injury in this study, this bias probably because of direct references of head injury cases to higher centers.28 patients 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 43 % in this study.Majority had were grade II injuries.[13]

Mohapatras et al [45] in their study showed that abdominal sonography had a sensitivity of 89 %, specificity of 100% and accuracy of 100% in diagnosing solid organ injuries. Frequency of solid organ injuries were spleen 47%, liver 30 %, kidneys 15 %.In present study abdominalsonographyhad a sensitivity of 96.4%, specificity of 100% and negativepredictive value of 66.6% in diagnosing solid organ injury. Frequency of solid organ injuries were spleen 43 %, liver 30%, kidneys 13% and pancreas 3%. Here bias of associated head injury may be related to referral higher centers.[14] Thus without head injury cases ultrasound has a primary role in evaluation of blunt abdominal injury for management. In this study 1 abdominal intestinal injuries detected out of 1 suspected cases on plain radiograph which is agreeing with Mahapatra et al study.

This study almost correlated with the study by Atiflatif et al [15]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 96.4 and specificity of 100 were found.Study by Yoshil, Hiroshi M D et al study has shown detection of solid visceral organ injury by ultrasound was 94.6 sensitivity 95. 1specificity.Jeffrey et al [52] states that CT staging of blunt hepatic injuries has little discrimination value in predictingoutcome of stable patients as nearly all have an excellent prognosis.[16,17] We agree with Jeffery et al, in this study low grade hepatic injuries accounted for5out of 30 and resolved well and had uneventful hospital stay which were detectedon ultrasonography.

In this study 1 case of pancreatic injury wer e diagnosed which showed grade I injuries. Pancreatic injury was detected on CT, thus ultrasound was inconclusive in assessing pancreatic injuries and to judge the accuracy of ultrasound in pancreatic injuries was inconclusive.[18]Out of 28 cases presented with hemo-peritoneum 25 cases had gross hemo-peritonium, 1 case had

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mesentericinjury without other solid organ injury with presence of gross hemoperitonium and suspected mesenteric injury.Neural M S et al 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.In this study computed tomography detected all cases of solid abdominal injury and has a sensitivity of 100%, and specificity of 100 %.

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.Road traffic accident was the most common mode of blunt abdominal trauma in this study, most victims were males in the 20 -30 years age group.Abdominal ultrasonography showed sensitivity of 96.4%, specificity of 100%, and positive predictive value of 100% in diagnosing abdominal solid visceral injuries.Computed tomography showed sensitivity of 100%, specificity of 100% and accuracy of 100% in diagnosing abdominal solid visceral injuries.Frequency of solid visceral injuries were: spleen 43%, liver 30%, kidneys 13% and pancreas 3%. CT is 100 % accurate in diagnosing solid abdominal trauma.To conclude a multipronged multimodality approach employing combination of ultrasonography and computed tomography in evaluating trauma cases can be fairly useful and accurate in early diagnosis and management of solid visceral injuries from blunt abdominal trauma with high sensitivity and specificity resulting in reductionof mortality and morbidity.

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Ethical approval: The study was approved by theInstitutional Ethics Committee

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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