Blunt Abdominal Trauma: Making Decision of Management with Conventional and Ultrasonography Evaluation

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Abstract

Blunt abdominal trauma is one of the commonest causes of morbidity and mortality in modern era. Road traffic accidents; fall from height, assaults are the commonest modes of Blunt abdominal trauma. Rapid diagnosis was essential and appropriate diagnostic work up and treatment is critical to ensure patient survival to decrease mortality and morbidity. The recent trend of management is in favor of conservative surgical management of abdominal solid visceral injuries. However the feasibility and safety of such an approach especially in a limited resource setup, skilled man power and non availability of intensive care units and advanced imaging/instrumental technique like CT, angiography Etc like rural setups.

Majority of these patients were involved in road traffic accident. In this study out of 100 patients 96 were positive for solid organ injury and 4 had mesenteric injury. Abdominal sonography had a sensitivity of 96.8%, specificity of 100% and negative predictive value of 57% in diagnosing solid organ injury. 6 cases of intestinal perforation on plain abdominal radiographs showed air under diaphragm.

Multipronged multimodality approach employing combination of abdominal radiographs, ultrasonography in evaluating trauma cases can be fairly useful , where limited diagnositic modalities lacking CT and ICU support skilled surgeons , angiography etc and cost effective.

Key words: *Blunt abdominal trauma, ultrasonography, CT (computed tomography), solid visceral organs.*

I. INTRODUCTION

Blunt abdominal trauma is one of the commonest injuries. Blunt abdominal trauma usually occurs due to road traffic accidents; fall from height, assaults or during sports (1, 3). Prevalence of intra abdominal injuries varied widely, rapid diagnosis was essential and appropriate diagnostic work up and treatment is critical to ensure patient survival(2) to decrease mortality and morbidity.

The recent trend of management is in favor of non operative or conservative surgical management of abdominal solid visceral injuries with provided higher non invasive radiological modalities for assessment of injury (2). However the feasibility and safety of such an approach especially in a limited resource setup , skilled man power and non availability of intensive care units and advanced imaging/instrumental technique like CT, angiography Etc like rural setups.

II. THE AIMS AND OBJECTIVES OF THE STUDY

II.1**)** To assess blunt trauma to abdomen by plain radiographs and ultrasonography and usefulness

II. 2) To evaluate the sensitivity, specificity, accuracy and negative predictive value of plain radiograph and ultrasonography in blunt abdominal trauma.

II.3) To provide information that could accurately determine choice of management (operative versus non-operative).

III. MATERIALS AND METHODS

A prospective study was conducted over a period of (November 2011 to September 2013) on 100 patients. They were evaluated with plain radiographs and Routine real-time ultrasound scanner (Philips iu22) with correlated CT (Siemens somatom 6 slice) or post operative findings in cases where ever laparotomy will perform. Patients having solid organ injury, hemoperitoneum and air under diapharam are subjected to CT scan or laparotomy where ever needed. Data for the study will be collected from teaching combined hospitals attached to Bangalore Medical College and Research Institute, Bangalore.

Statistical evaluation includes the sensitivity, specificity, accuracy and negative predictive value of plain radiograph and ultrasonography in blunt abdominal trauma. AAST grading of solid organ

injuries were used for classification and grouped into low grade inuries include grade I and II , high grade injuries include III,IV and V for management purpose.

III.1) INCLUSION CRITERIA:

Patients presenting with blunt abdominal injury.

1. Clinical suspicion of intra-abdominal injury.

2. Haemodynamically stable patient.

3. Multi-trauma patient.

III.2) 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.
- Head injury patients with Glasgow coma scale of <12.

After conventional radiography and sonography patients were monitored clinically.

Clinically and haemodynamically stable patients (as indicated by hourly recording of normal vital signs, urine output of 30-50 ml/hr) for 6 hours normal findings on radiological and sonological evaluation, were chosen for CECT abdomen .

Patients were taken for laparotomy based on one or more of the following findings

- Clinical deterioration with increasing abdominal distension.
- Unexplained sustained hypotension (Systolic BP < 90 mmHg) and not responding to IV fluid infusion.
- Signs of continuing intraabdominal haemorrhage with Drop in Hb% by > 1.5 gm% or progressively falling haematocrit on hourly examination.
- Free air on erect abdominal radiograph.
- Gross free peritoneal fluids on abdominal USG with no solid organ injury.

IV. RESULTS

In this study the youngest patient was 4 years old and oldest was aged 72 years (Table 1). 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 (Table 2). One patient with isolated pancreatic injury was involved 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.
- Most of the male patients involved in road traffic accident were in the 21-30 years of age group.
- 17 patients (11%) were in the pediatric age group out of which 11 were involved in road traffic accident and 6 had fall from height.

In this study out of 100 patients 96 were positive for solid organ injury and 4 had mesenteric injury. 39 cases were posted for operative procedures depending on progressive clinical complications like free air under diaphragm, gross hemoperitoneum and high grade solid organ injury in clinically unstable patients. Out of 5 deaths in this study, 4 deaths were post operative secondary to post operative complication. Splenic injury was most common accounting for 50% in this study. Majority had 27(54%) were grade II injuries. (Table 3)

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. 6 patients had intestinal injuries were detected all 6 cases of intestinal perforation on plain abdominal radiographs.

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.

Low grade hepatic injuries accounted for 23 out of 27 and resolved well and had uneventful hospital stay which was detected on ultrasonography.9 cases of high grade injury underwent surgery .

Renal injuries were the 3rd most commonly injured organ (TABLE 4) accounted for (20%) cases. Out of which 15 were grade I and II injuries, 2 were grade III and 1 was grade IV injury. In Grade IV injury nephrectomy was performed based on ultrasound and CT confirmation. Low grade injuries were managed conservatively, out of these 2 were operated for other associated solid organ injury.

5 cases of pancreatic injury were diagnosed which showed grade I and II injuries (TABLE 4). 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.

Out of 81 cases presented with hemoperitoneum 12 cases had gross hemoperitoneum(TABLE 5), 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.

V. DISCUSSION

The most common modes of blunt abdominal trauma are motor vehicle collisions, fall from height, assaults, and sports injuries (3). Considerable forces are usually required to injure the solid and hollow viscera in the abdomen.

Three basic mechanisms explain the Injury to the abdominal organs i.e. deceleration, external compression, and Crushing injuries (4). Sudden deceleration movement of mobile organs against fixed organs that causes tears at the points of fixation, such as vascular pedicles and mesenteric attachments. In crushing injuries, massive forces crush the abdominal contents between the abdominal wall and the spine or bones of the chest wall. Sudden increase in intra abdominal pressure, possibly resulting in rupture of hollow viscera. Most commonly injured abdominal organs and structures are the spleen, liver, kidneys, small bowel and/or mesentery, bladder, diaphragm, pancreas, and major vessels (5) and multiple organs are often affected simultaneously. Many factors determine the specific organ of injury: the energy delivered at the time of impact, the part of the body struck first, the body habitus, height of fall and, in the case of motor vehicle accidents site of impacts injures , the organs near to the site of impact. Knowledge of common patterns of injury , site of impact and anatomical structure adjacent to site of impact and the associations of the organs involved are helpful when evaluating clinically and interpretation of imaging studies(6).

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 third decade of life, the productive age group. Thus decision of management of blunt abdominal trauma to reduce morbidity and mortality is crucial.

Chest injury was predominant accounting for (15%).The plain radiographs showed left rib fractures (Fig 1) which are more commonly associated with splenic injuries which can be assessed for splenic injury by USG for grading and management.

Plain abdominal radiographs accurately diagnosed all 6 cases of intestinal injury in the present study, thus helpful in early assessment of hallow visceral injury and repair of perforation bypassing CECT with combined USG for solid visceral organs injury for repair. Hallow viscous injury shows free air dooms of diaphragram (Fig.2) Mohapatras et al (7) in their study showed that Plain abdominal radiography accurately diagnosed all 3 cases of intestinal injury. Our study in agree with Mohapatras study.

In patients with pelvic fractures, extra peritoneal bladder ruptures were more common than intraperitoneal tears (7). An extraperitoneal rupture was unlikely in the absence of a pelvic fracture(Fig.3); it thus appears that the compressive force that deforms and fractures the pelvic bones and ligaments exerts a shearing force on the bladder base resulting in an extraperitoneal injury. Intraperitoneal bladder rupture was more common without pelvic fractures and most likely resulted from sudden compression of a distended bladder.

Plain radiographs showed pelvic fractures (Fig 3) and USG showed free fluid. CECT showed contrast extravasation indicating bladder rupture and pelvic fractures. The combination of ultrasound and plain radiographs for pelvic displaced fractures can be useful in suspicion of bladder rupture. With clinical assessment of hematuria and pelvic fracture further imaging and management of bladder rupture.

USG, on the other hand, is safer simpler to perform, simpler to perform in Children, relatively cost-effective, rapid to find significant haemoperitoneum (Fig.4) and simultaneously evaluates the thorax, pleural collection and retroperitoneium in addition to the abdomen (8, 9) and helpful in unstable patients. A recent trial by Boulanger et al (10) in 1999 revealed that a USG (FAST)-based algorithm for blunt abdominal trauma was more rapid, less expensive and portability.

Over all 36% of hepatic injury(Fig 5) in our study were documented out of these 27 were managed conservatively which included 4 high grade injury (all were grade III) and 9 cases were operated 7 cases had grade III and 2 grade IV. Hepatorraphy was done in operated cases. One case of grade I missed on USG and 3 cases upgraded to grade III from grade II on CECT. All these upgraded patients were managed

conservatively with clinical monitoring. USG showing grade II injuries needs close clinical monitoring.

26 of splenic injuries (Fig.6,7) required operative intervention, in 9 cases splenectomy was performed in grade IV and V injury(Fig 8) cases. Organ salvage i.e splenorraphy was done in 17 cases. One case of Grade I splenic injury missed on USG and 4 cases upgraded on CECT, clinical observation needed in grade II injuries.

Of the 5 pancreatic injuries documented in the present study, 4 were explored managed non-operatively. Of these 2 cases of grade I injuries (Fig 9) were missed on ultrasonography. Less number of cases for statistical calculation. However in suspected cases of pancreatic injuries CECT helpful in further management.

Renal injuries were the 3rd most commonly injured organ accounted for (20%) cases. All were detected by USG Out of which 15 were grade I and II injuries, 2 were grade III and I was grade IV injury (Fig 10). 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. Before posting for nephrectomy in high grade injuries CECT needed for confirmation.

Though hepatosplenic injuries still remain the most common solid organ injury in blunt abdominal injury, with use of Abdominal ultrasonography showed sensitivity of 96%, specificity of 100%, and accuracy of 100% in diagnosing abdominal solid visceral injuries. Mohapatras et al (2) in their study showed that abdominal sonography had a sensitivity of 89% , specificity 100% and accuracy 100% in diagnosing solid organ injuries. Our study closely correlating with Mohapatras s et al for solid abdominal organ injury.

4 deaths of 39 operated cases mostly due to chest and wound infections. One Non-operative death out of 72 cases conservative management was recorded secondary to other co-morbid condition and other associated injuries. Thus solid organ injuries with low grade injuries (AAST- I and II) can be managed conservatively with close clinical monitoring of clinical vitals based on USG and plain radiographs which has high sensitivity. Low grade injures involving more than two solid visceral organs need surgical exploration. With high grade injuries needed clinical monitoring and surgical exploration.

The postoperative mortality was higher compared to that in the non-operative group and was directly or indirectly attributable to the immediate intraabdominal injury. This was because the injuries mandating surgical intervention were generally of greater severity than those managed non-operatively and were more likely to be associated with polytrauma and/or hemodynamic instability.

VI. FIGURES

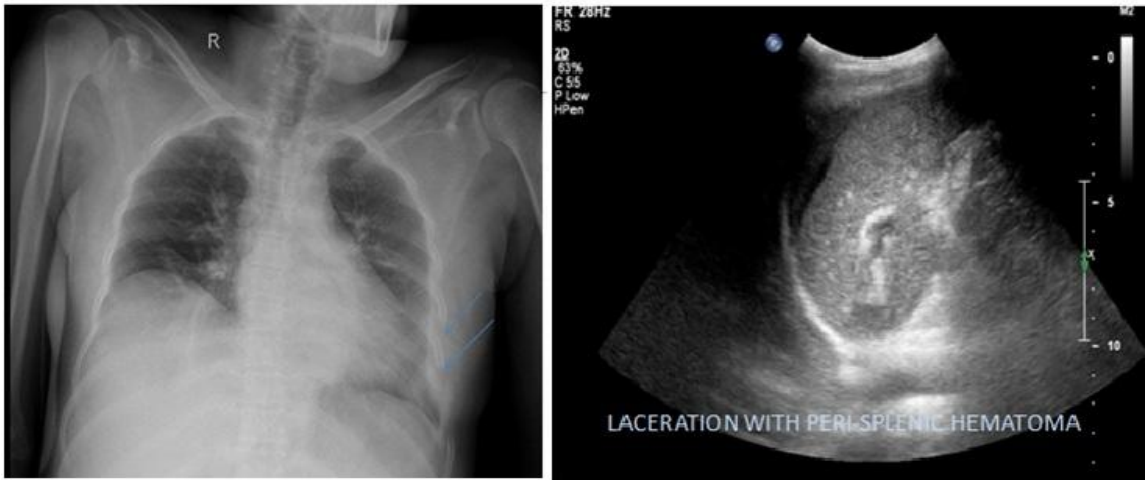

Fig 1. Left: Chest radiograph AP view showing left lower rib fractures. Right: Ultrasonography of spleen – sub capsular hematoma and laceration grade II. In the same patient.

Fig 2. Left: Plain Radiograph Of Erect Abdomen – Free Air Under Right Doom Of Diaphragm. Right: Oral Contrast Extravasation and Air Pockets in Peritoneum Indicating Bowel Injury.

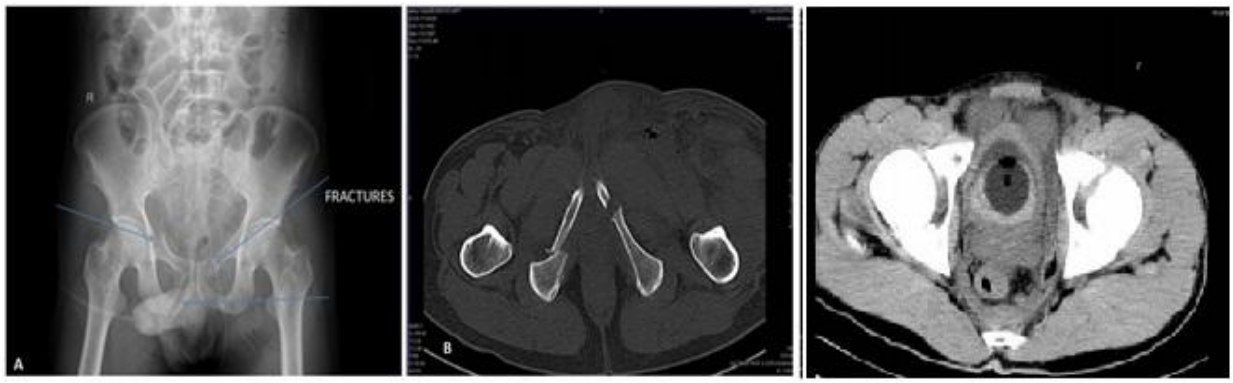

Fig 3. Left: Plain Radiograph of Pelvis- Multiple Pelvic Fractures. Middle: Axial Ct Image of Pelvis Showing Fractures of Same Patient. Right: Axial CT showing Hemorrhagic Content in Bladder – bladder wall injury

Fig 4. Left: Ultrasonography showing free fluid with internal echoes in right iliac fossa- hemoperitoneum. Right: Axial CECT Section of Pelvis – High Dense Collection In Pelvis - Hemoperitoneum

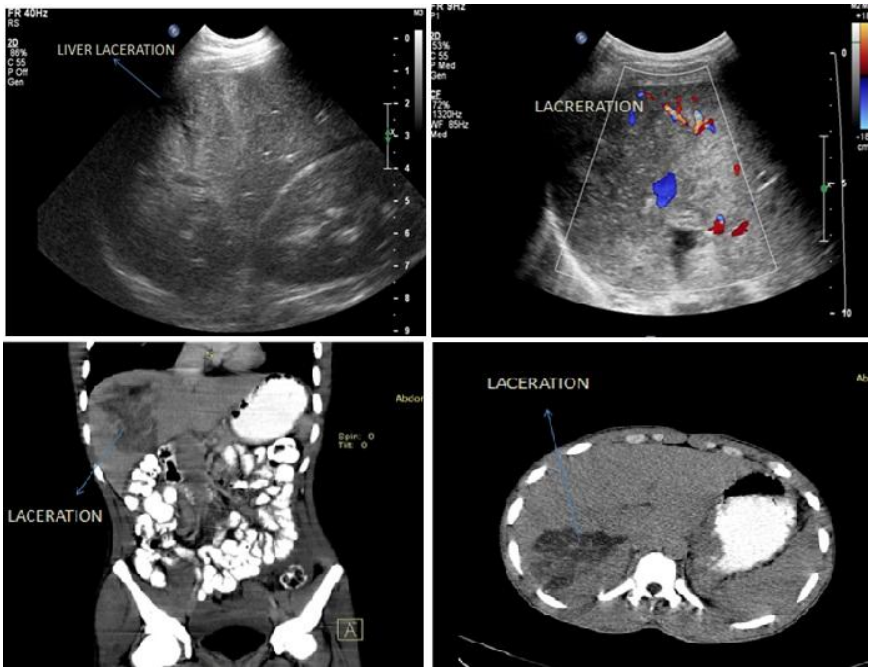

Fig 5. Left Upper : Ultrasonography of Liver- Liver Laceration And Contusion- Grade II. Left lower: Coronal Reformatted CECT Image Of Abdomen Showing Non Enhancing Hypo dense Laceration And Contusion Of Liver. Right upper: Ultrasonography Of Liver With Doppler Showing Laceration .Right lower: Axial CECT Image Of Abdomen – Liver Laceration

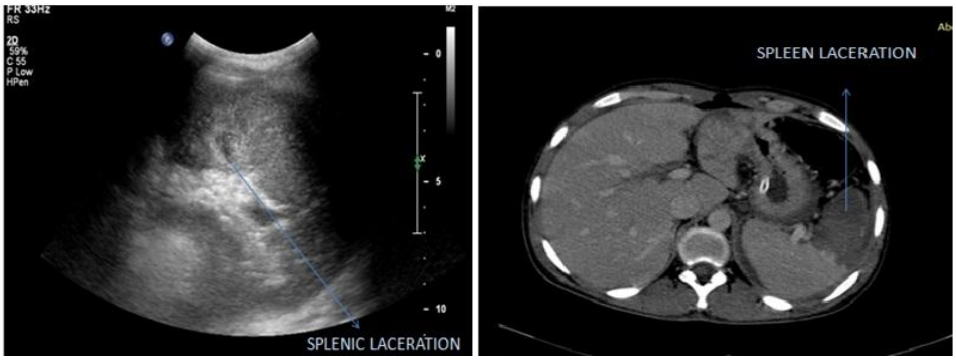

Fig 6. Left: Ultrasonography of spleen laceration with perisplenic collection. Right: axial CECT image of abdomen showing non enhancing splenic parenchyma , laceration and perisplenic collection

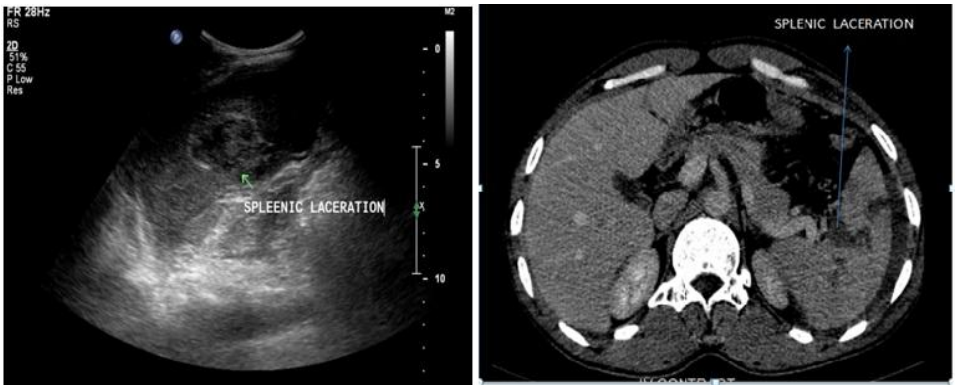

Fig 7. Left: Ultrasonography Of Splenic Grade II Laceration Extending From Medial Margin To Deep Into Parenchyma. Right: Axial CECT Image Of Abdomen Showing Splenic Grade II Laceration As Non Enhancing Linear Hypodense In Parenchyma.

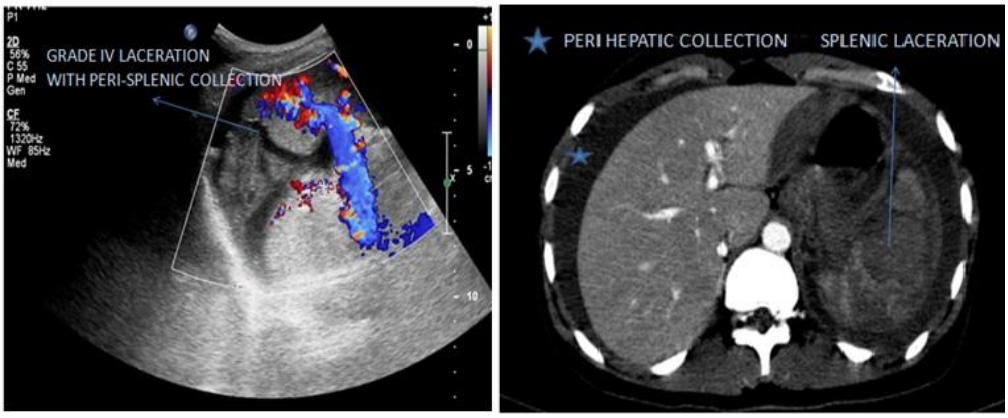

Fig 8. Left : Ultrasonography Of Spleen With Doppler Showing Laceration And Absent Color Up Take In Devascularised Segment Right: Axial CECT Image Of abdomen Showing Splenic Grade IV Injury With Peri Splenic And Peri Hepatic Collection

Fig 9. Ultrasonography of pancreas – grade II laceration through the head of pancreas.

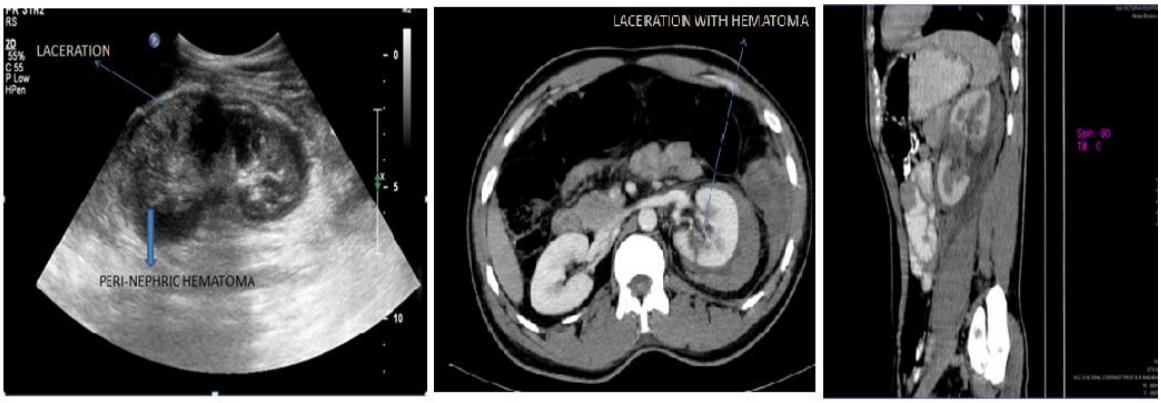

Fig 10. Left: Ultrasonography Of Kidney- Mid-Pole Laceration With Peri Nephric Hematoma.Middle: Axial CECT image of abdomen- left kidney laceration with perinephric hematoma. Right: CECT sagital reformatted image of abdomen showing renal laceration and perinephric hematoma.

VII.TABLES AND CHARTS

Table and Chart 1) Age Distribution of Patients

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

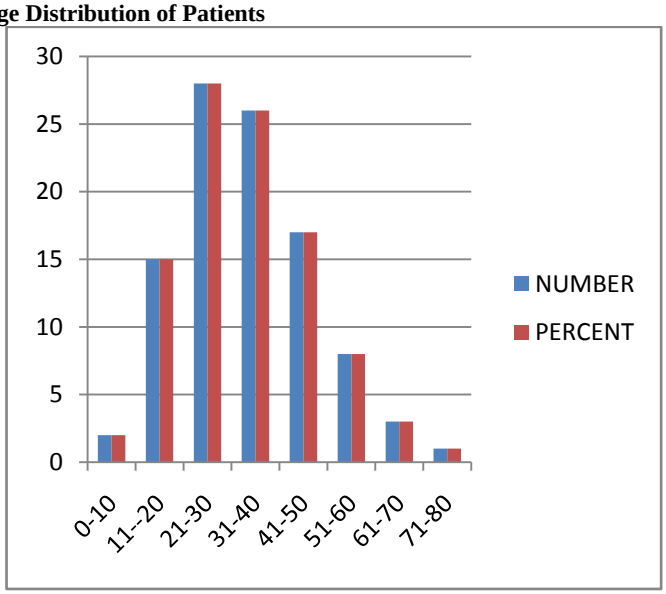

Table And Chart 2) Distribution of Mode Of Blunt Injury Abdomen

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

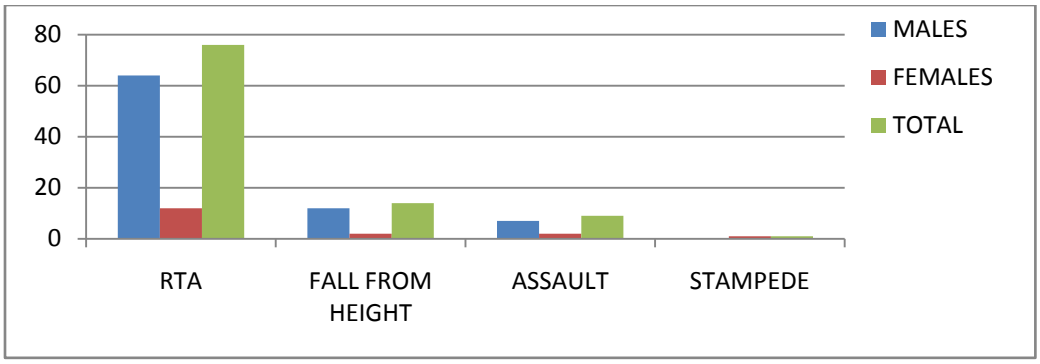

Table 3) Distribution Abdominal Visceral Injuries

ABDOMINAL VISCERAL ORGAN	NUMBER
LIVER	36
SPLEEN	50
PANCREAS	05
KIDNEY	20
BOWEL	06
URINARY BLADDER	02
MESENTRIC INJURY	04

Table and Chart 4) Grade Specific Solid Organ Injury With Management

INJURY GRADE	LIVER		SPLEEN		PANCREAS		KIDNEYS	
	CON	OPR	CON	OPR	CON	OPR	CON	OPR
I	01	00	05	00	02	01	05	01
II	22	00	16	11	02	00	10	01
III	04	07	03	14	00	00	02	00
IV	00	02	00	01	00	00	00	01
V	00	00	00	00	00	00	00	00
TOTAL	27	09	24	26	04	01	17	03

CON- CONSERVATIVE OPR- OPERATIVE

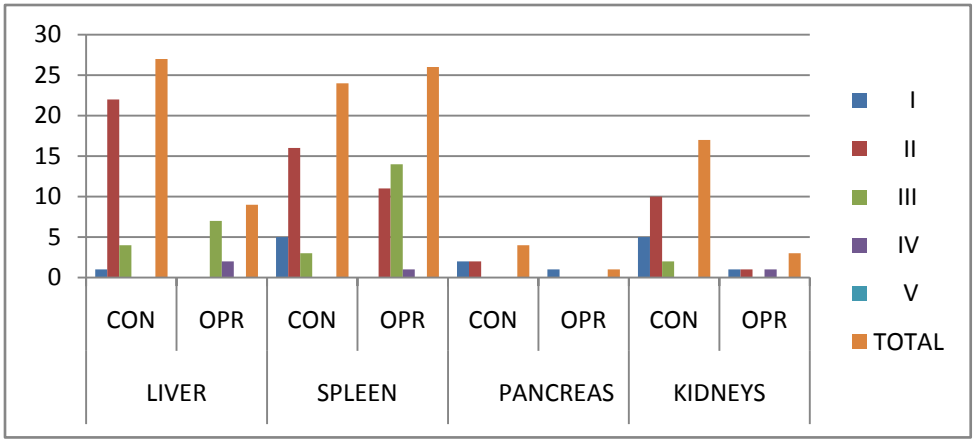

Table 5) Distribution of Hemoperitoneum

GRADE	NUMBER
MILD (+)	31
MODERATE (++)	38
GROSS (+++)	12

VIII. 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 diagnostic modalities lacking CT and ICU support skilled surgeons , angiography etc. thus with the use of basic conventional radiography and USG are helpful in management of blunt abdominal trauma is cost effective , time saving and easily available for further evaluation and management.

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