ORIGINAL RESEARCH PAPER
Volume - 10 | Issue - 12 | December - 2021 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

ROLE OF COMPUTED TOMOGRAPHY IN EVALUATION OF BLUNT INJURY ABDOMEN

Radio-Diagnosis

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ABSTRACT

Objectives: The purpose of our study was to assess the role of multi slice computed tomography (CT) in the evaluation of patients with blunt injury abdomen and describe the frequency, type of injury to visceral organs and aid in accurate management of the patients.

Subjects And Methods: The study included 31 patients suspected of blunt abdominal injury referred from emergency unit of PESIMSR, Kuppam. All the patients subjected to contrast enhanced multi slice (CT) in axial cuts and images are transferred to workstation then coronal and sagittal reconstruction obtained . Data included were age, sex, mode of injury and scan results. Organs injures were graded according to AAST organ injury scale guidelines.

Results: There were 26 male and 6 female patients having blunt injury abdomen. Majority of the patients between the age group of 18 to 40. Most common mode of injury was road traffic accident (RT). Most commonly injured organ was spleen (18) followed by liver (17) followed by kidney injury (10). Hemoperitoneum is seen in most of the individuals (27). Pelvic bone fracture was seen in 6 patients,rib fracture seen in 5 patients and spinal fracture seen in 3 patients. Pancreatic body contusion was seen in one individual. Paralytic ileus and pneumoperitoneum seen in one each. Vascular injury was seen in 7 patients with IVC thrombus (1 patient) and portal vein thrombus (1 patient). Adrenal hematoma was seen in 4 patients.

Conclusion: Contrast enhanced multi slice CT is a useful modality in identifying organ injury in blunt injury abdomen. Most commonly involved organ being spleen, liver and kidney. Majority of the trauma is due to RTA.

KEYWORDS

Solid organ injury, AAST organ injury scale ,trauma ,liver, spleen ,kidney , hemoperitoneum and computed tomography scan.

INTRODUCTION:

Injury or trauma has been defined as damage to the body caused by an exchange with the environment energy that is beyond the body's resilience. It is the leading cause of death in persons under 45 years of age, with 10% of these fatalities attributable to abdominal injury. More than half of these fatalities are the results of motor vehicle accidents. Other common causes are falls, assaults and civilian violence, sports injuries, industrial accidents, armed conflict and injuries caused by domestic or wild animal. The Indian fatality rates for trauma are 20 times that for developed countries [2]. About 30% of such deaths are thought to be preventable. Swift recognition of injury with prompt and appropriate treatment to reduce morbidity and mortality is the goal of modern trauma care and hence accurate diagnosis is essential. Identification of serious intra-abdominal pathology is often challenging and notably inaccurate because of associated injuries, for example, head injury and polytrauma.

Diagnosis of blunt abdominal injury is based on clinical examination, X-ray abdomen, diagnostic peritoneal lavage (DPL), ultrasonography (USG), focused assessment with sonography for trauma (FAST), and computed tomography (CT) scan. Assessment of hemodynamic stability is the most important initial concern in the evaluation of a patient with ne abdominal trauma. In the hemodynamically unstable patient, a rapid evaluation for hemoperitoneum can be accomplished by means of DPL or the FAST. DPL has proven sensitive in ascertaining the presence of intraperitoneal hemorrhage and bowel perforation. However, it is unable to evaluate the retroperitoneum and is an invasive procedure with possibility of serious complications such as injury to major vessels, bowel or bladder. Abdominal USG is an efficient method assessing patients with blunt abdominal trauma. It can be performed quickly in the emergency department without interruption of resuscitation and can be repeated whenever diagnostic uncertainty exists. Radiographic studies of the abdomen are indicated in stable patients when the physical examination findings are inconclusive.

CT scan is most reliable investigation to diagnose hollow or solid organ injury. Its advantages include superior definition of injury, leading to grading of the injury and sometimes the confidence to avoid or postpone surgery. Its disadvantages include the time taken to acquire image so cannot be used to evaluate unstable patients and financial consideration limits its use in all cases. The accuracy of CT in hemodynamically stable blunt trauma patients has been well established. Sensitivity between 92% and 97.6% and specificity as high as 98.7% have been reported in patients subjected to emergency. Hence, the current study is carried out to assess the role of CT scan in an observational manner.

MATERIALS AND METHODS:

An observational hospital based study conducted from April 2019 to July 2021 in PES institute of Medical Sciences and Research Teaching Hospital, Kuppam, Andhrapradesh .The study includes thirty one patients with blunt abdominal trauma referred for CT scan of abdomen. The study was done employing a General Electric (GE), 16 slice helical CT scanner. The results were tabulated in Microsoft Excel and statistical analysis was done using (SPSS) Statistical Package for the Social Sciences. The categorical data was analyzed using percentages.

Study Design: An observational study.

Inclusion Criteria:

Patients who were presented to emergency unit with blunt trauma abdomen requiring no emergency treatment were included.

Exclusion Criteria:

Patients who were unstable and require emergency treatment according to Advanced Trauma Support (ATLS) and patients who refuse to give consent were excluded.

All routine blood investigations were done. These includes hemoglobin, total count, differential count, blood urea, serum creatinine, liver function test, red blood cells, blood grouping. Urine, routine, and microscopic examination, chest and abdominal X-ray, and USG were done. If vital signs of patient were found stable, other related X-rays were done according to site of injury. CT scan was advised for patient in whom USG was suggestive of any abnormality or there is any clinical doubt in hemodynamically stable vital signs.

Technique Of CT Scan Study

The scan was done perpendicular to the sagittal plane of the patient in

the supine position. A serial axial scans were performed from domes of diaphragm to the level of pubic symphysis by employing 5 mm sections. The conscious patients were instructed not to move during scanning to avoid motion artifact. Pre contrast scan was done to all patients followed by post contrast enhanced scan. The patients received 100-150 ml (2ml/kg body weight) of contrast agent (Iohexol,350 mg/ml) which was given intravenously by means of automated injector at an injection rate 3.5 ml/s. Antecubital vein (larger peripheral vein) is used as the access route of 18-20 gauge intravenous needle. Abdominal CT scans were acquired during arterial phase (25-30 sec) and during portal venous phase(70 -80 sec) after contrast administration. Delayed scan for renal injury patient for assessment of collecting system involvement. The scan was done at 5 min after contrast administration. When necessary sagittal and coronal images were acquired using the maximum intensity projection (MIP) and multiplanar reconstruction (MPR) techniques.

RESULTS:

A total of 31 patients were studied. Blunt abdominal injury was most common in age group of 20 -40 years (81%), with male to female ratio of 4:1. Most common cause of injury is road traffic accident (RTA) (83.9%). Most common organ injury was Spleen (58.1%) followed by Liver (54.8%), bowel and mesentery injury (6.5%), Renal (32.9%), Adrenals (12.9%) Pancreas (3.2%), Bladder (12.9%), Vascular (19.4%), Bones (35.5%) and Spine (6.5%).

As it is evident from Table 1, the majority of the patients belong to age group of 15 to 30 years (45.2%) and 31-40 years (35.5%) with mean age of 32.1 years. Male predominance in all groups with male: female ratio of 4:1. It is evident from Table and chart 3, that RTA (93.5%) is most common cause of blunt injury abdomen followed by fall (6.5%), assault (3.2%). It is evident from Table 4, 5 & 6, 25 cases of Grade II & III solid viscus injury are most common severity involved followed by grade IV & V which had 10 cases, grade I were seen in 7 cases.

As it is evident from Table 4 and chart 4, spleen (51.8%) was most commonly injured viscera in total followed by liver (54.8%) table 5 and chart 5, and renal (32.3%) table 6 and chart 6, Adrenals (12.9%) table 7 and chart 7, Bladder (12.9%) , table 8 and chart 8. Hemoperitoneum was seen 87.1% of the cases, table 9 and chart 9.

Table 1 : Showing Age Distribution Of Patients.

Age in years	Number of patients	%
<20	7	22.6
20-30	7	22.6
31-40	11	35.5
>40	6	19.4
Total	31	100.0

Mean ± SD: 32.13±14.04

Table And Chart 2: Showing Gender Distribution Of Patients.

Gender	Number of patients	%
Female	6	19.4
Male	25	80.6
Total	31	100.0

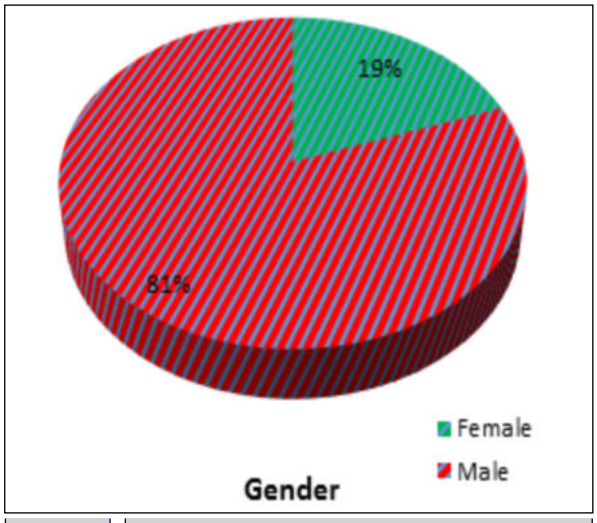
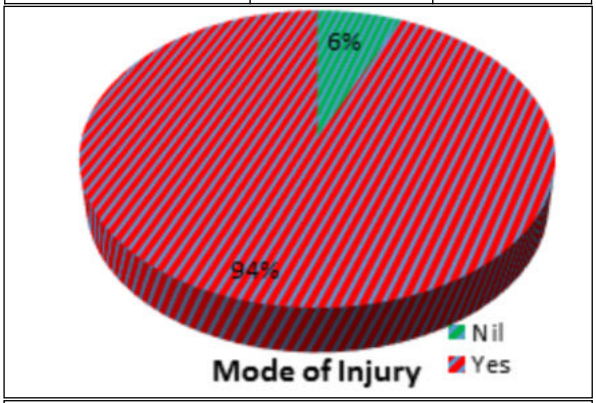


Table And Chart 3: Showing Mode Of Injury.

Mode of Injury	Number of patients (n=31)	%
Nil	2	6.5
Yes	29	93.5
Assault	1	3.2
Fall from height	2	6.5
RTA	26	83.9



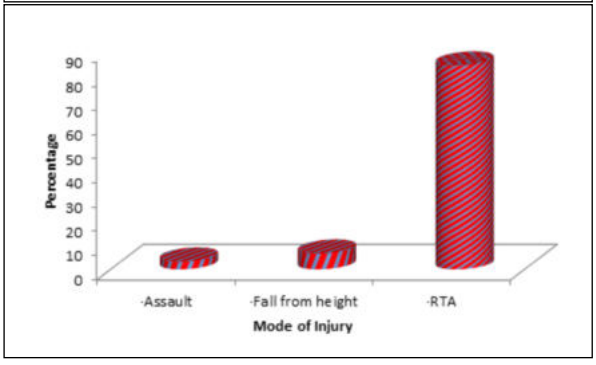
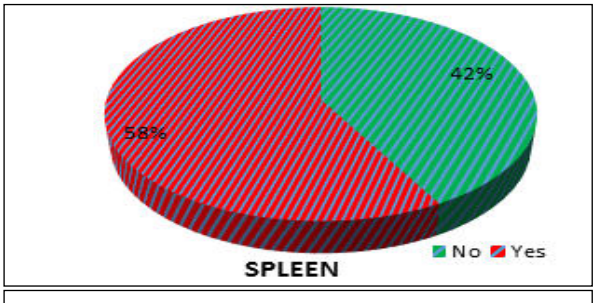
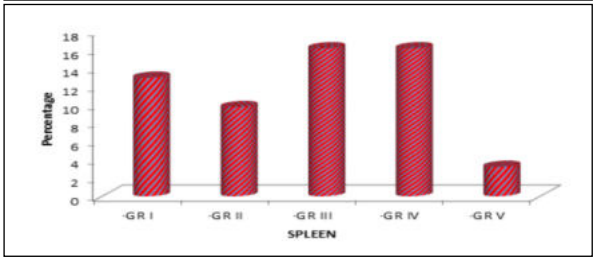


Table And Chart 4: Showing Distribution Of Spleen Injury Patients.

Spleen injury	Number of patients (n=31)	%
No	13	41.9
Yes	18	58.1
GRADE I	4	12.9
GRADE II	3	9.7
GRADE III	5	16.1
GRADE IV	5	16.1
GRADE V	1	3.2





Figures 1 - 4 : Contrast Enhanced Axial CT Images Showing Splenic Injury.

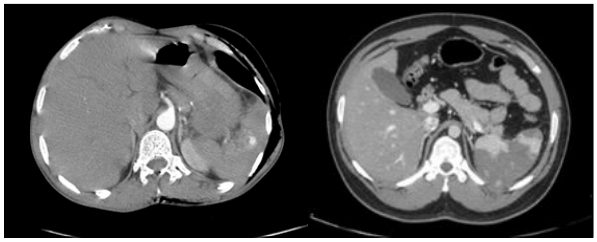


Figure 1. Active contrast extravasation in splenic Injury.

Figure 2. Splenic Grade IV Injury.

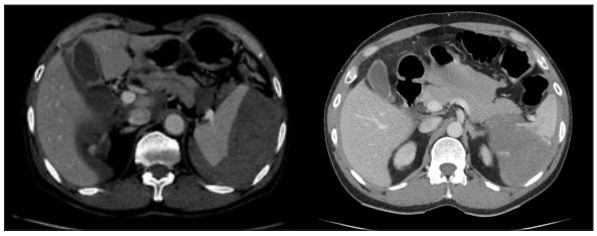
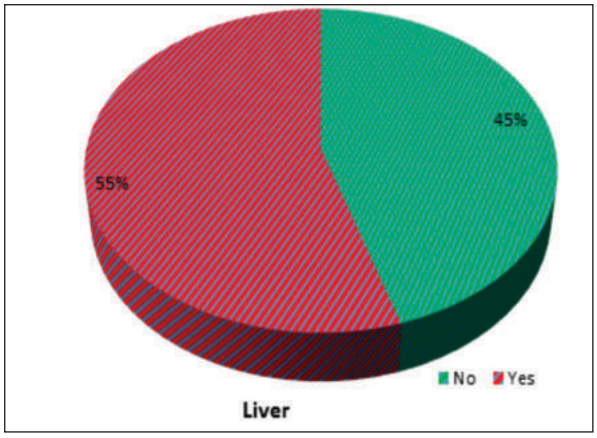


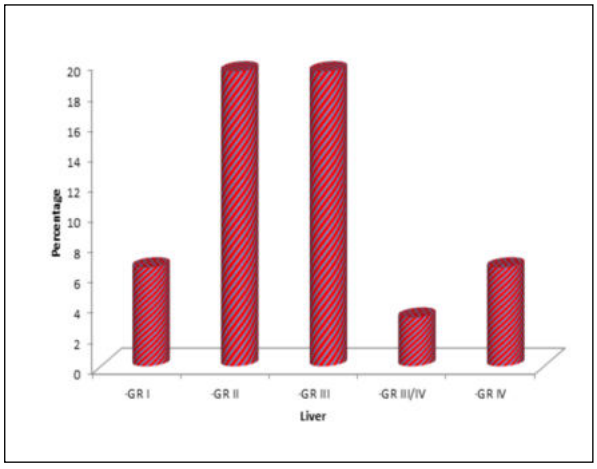
Figure 3. Splenic subcapsular hematoma (grade III splenic injury)

Figure 4 . Shattered spleen with surrounding hemoperitoneum (grade V splenic injury)

Table And Chart 5: Showing Distribution Of Liver Injury.

Liver injury	Number of patients (n=31)	%
No	14	45.2
Yes	17	54.8
GRADE I	2	6.5
GRADE II	6	19.4
GRADE III	6	19.4
GRADE IV	1	3.2
GRADE V	2	6.5





Figures 5 - 6 : Contrast Enhanced Axial CT Images Showing Liver Injury.

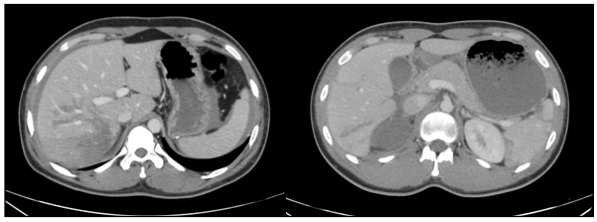
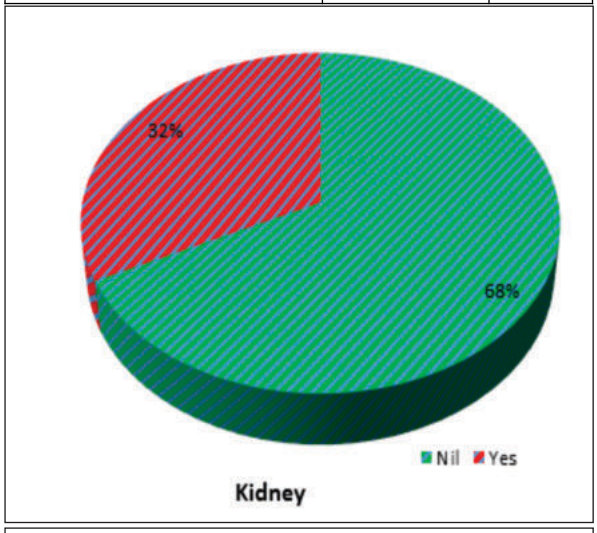


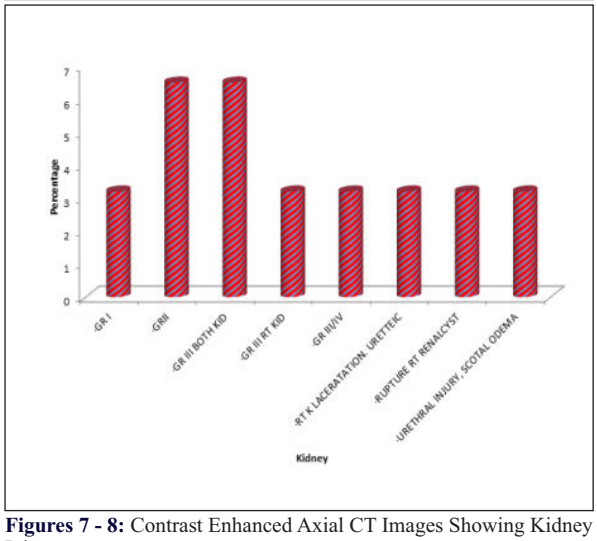
Figure 5. Mutiple Liver Contusions And Lacerations (Grade III Liver Injury)

Figure 6. Liver and splenic lacerations (grade IV liver injury and grade III splenic injury) No Contrast In Right Kidney Due To Occlusion Of Right Renal Artery.

Table And Chart 6: Showing Distribution Of Kidney Injury.

Kidney injury	Number of patients (n=31)	%
Nil	21	67.7
Yes	10	32.3
GRADE I	1	3.2
GRADE II	2	6.5
GRADE III BOTH KIDNEYS	2	6.5
GRADE III RIGHT KIDNEY	1	3.2
GRADE III/IV LEFT KIDNEY	1	3.2
RIGHT KIDNEY LACERATION WITH URETERIC INJURY	1	3.2
RUPTURE RIGHT RENAL CYST	1	3.2
URETHRAL INJURY, SCROTAL ODEMA	1	3.2





Figures 7 - 8: Contrast Enhanced Axial CT Images Showing Kidney Injury.

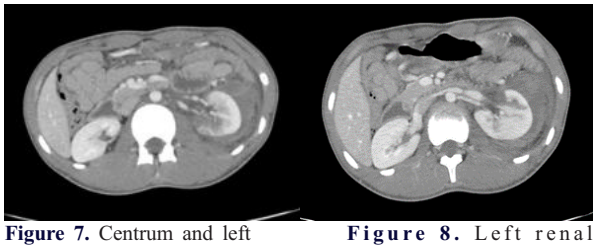


Figure 7. Centrum and left renal subcapsular hematoma (grade III / IV left renal injury) with large perinephric hematoma.

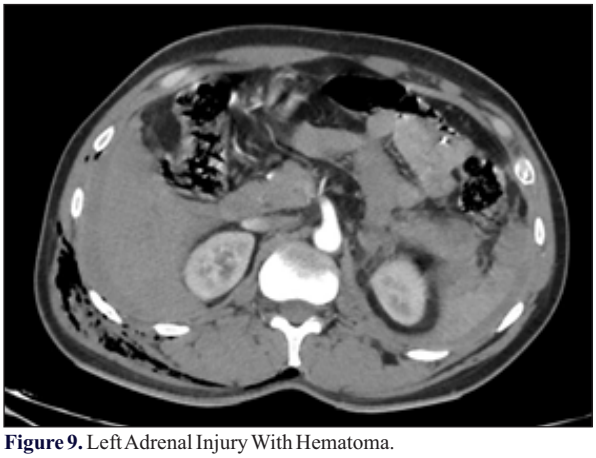
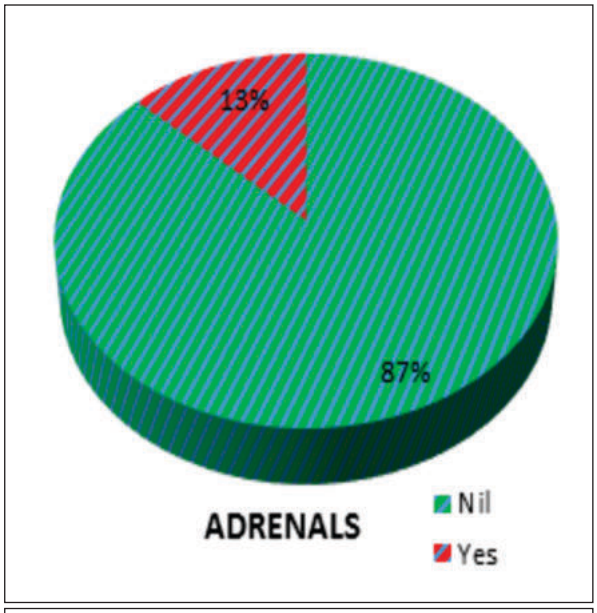


Figure 8. Left renal laceration (grade III/IV left renal with large perinephric hematoma.

Table And Chart 7: Showing Distribution Of Adrenal Injury.

Adrenal Injury	Number of patients (n=31)	%
Nil	27	87.1
Yes	4	12.9
LEFT ADRENAL HEMATOMA -GRADE III	1	3.2
RIGHT ADRENAL HEMATOMA-GRADE III	1	3.2
RIGHT ADRENAL IRREGULAR HEMATOMA-GRADE IV	1	3.2
RIGHT ADRENAL RUPTURE- GRADE V	1	3.2



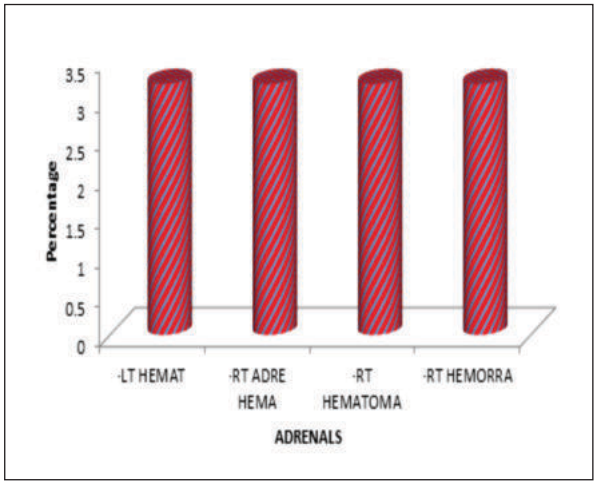
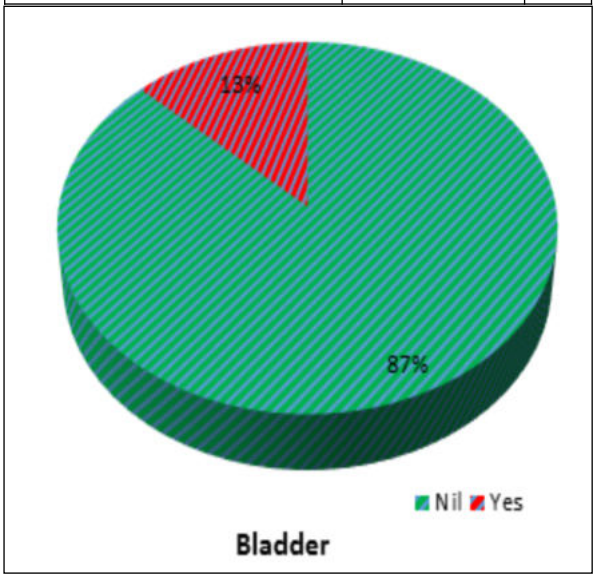


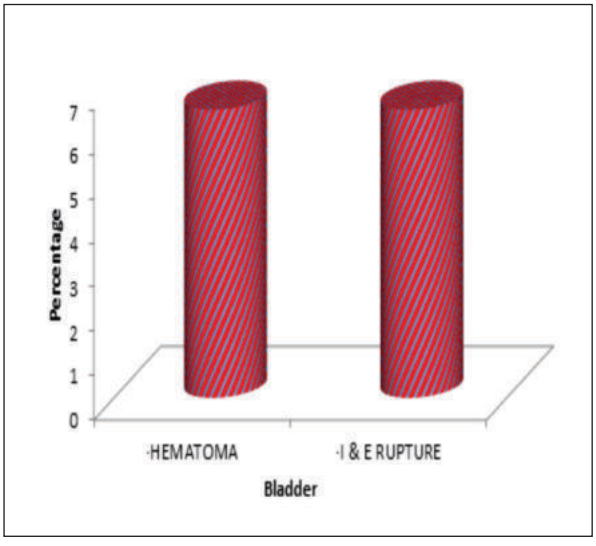
Figure 9:- Contrast Enhanced Axial CT Image Showing Adrenal Injury.

Figure 9. Left Adrenal Injury With Hematoma.

Table And Chart 8: Showing Distribution Of Bladder Injury.

Bladder Injury	Number of patients (n=31)	%
Nil	27	87.1
Yes	4	12.9
HEMATOMA	2	6.5
INTRA & EXTRA PERITONEAL RUPTURE	2	6.5





Figures 10 -11 : Contrast Enhanced Axial CT Images Showing Bladder And Urethral Injuries.

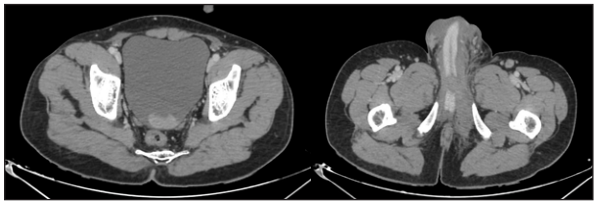


Figure 10. Hematoma In Bladder.

Figure 11. Urethral injury with hematoma.

Table And Chart 9: Hemoperitoneum

Hemoperitoneum	Number of patients (n=31)	%
Nil	4	12.9
Yes	27	87.1
LARGE	2	6.4
MILD	14	45.2
MODERATE	11	35.5

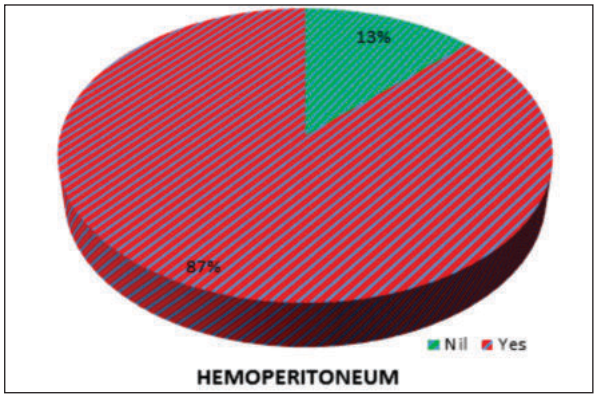
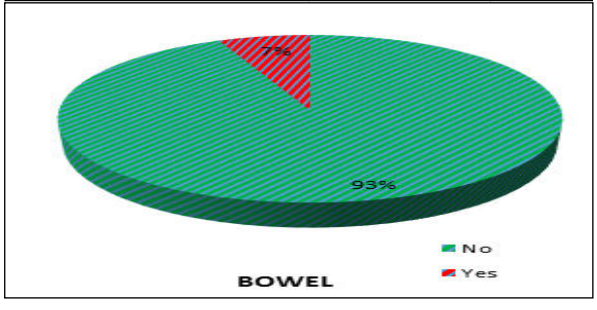


Figure 12 : Contrast Enhanced Axial CT Image Showing Hemoperitoneum.

Figure 12. Hemoperitoneum.

Table And Chart 10: Showing Distribution Of Bowel Injury.

Bowel injury	Number of patients (n=31)	%
No	29	93.5
Yes	2	6.5
CAECUM INJURY	1	3.2
PARALYTIC ILEUS	1	3.2



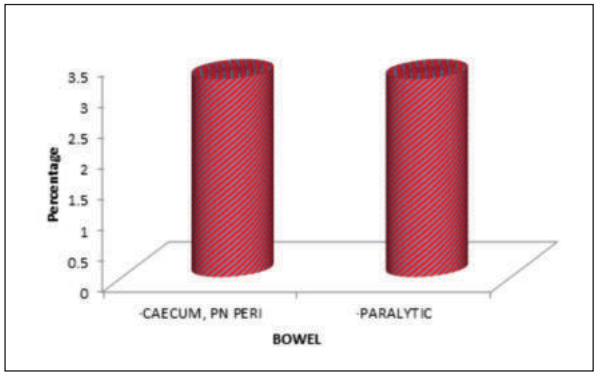


Table And Chart 11: Showing Distribution Of Pancreas Injury.

Pancreas injury	Number of patients (n=31)	%
No	30	96.8
Yes	1	3.2
CONTUSION OF BODY	1	3.2

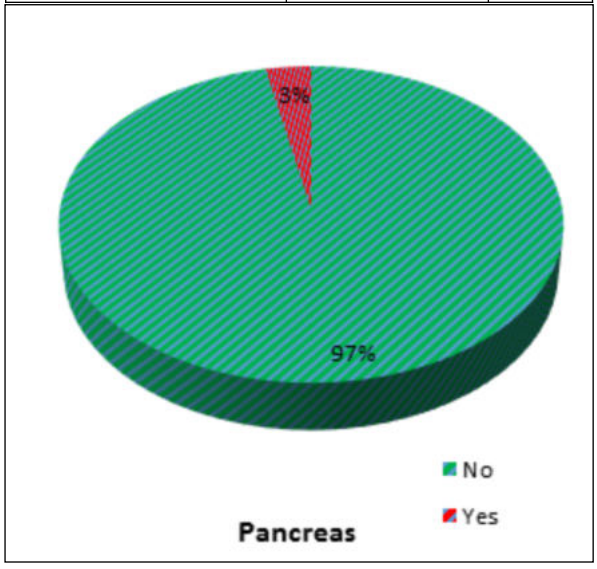


Figure 13 : Contrast Enhanced Axial CT Image Showing Pancreas Injury.

Figure 13. Contusion Of Body Of Pancreas.

DISCUSSION:

The evaluation of the patient with blunt trauma is one of the most difficult assessments in surgery.

CT has become increasingly valuable and is extensively used in early clinical management of blunt injury abdomen patient which is highly sensitive and specific method for detection of abdominal injuries. CT allows for complete scanning in a single breath hold and faster scanning speed and narrow collimation increase contrast opacification in mesenteric, retroperitoneal, and portal vessel, as well as

parenchymal organ; this improves identification of organ injury and additionally sites of active bleeding. CT is now best established as an accurate non-invasive technique for the detection of entire spectrum of various abdominal injuries help decide on management, especially on decision whether to treat conservatively.

Age Incidence

In the present study, 45.1% from 15 to 30 years and 35.50% from 31 to 40 years age group, whereas age of patients ranged from 6 to 60 years, with mean age being 32.1 years. In a study vikash et al[1] majority patient were between 16 to 30 years, Ghosh et al[2] they found the greatest number of patients in the age of 21-30 years; however, Gupta et al[3] in their study reported that highest number of patients was between 20 and 40 years age group with mean age being 31.0 years. The high incidence in these age groups mainly because they are mobile age group of society and more frequently at outdoors for study, occupational needs, and recreation.

Sex Incidence

Males were affected more than females in the blunt abdominal trauma in the present study. The overall ratio of the incidence in males to that in females was found to be 4:1. The preponderance to trauma of males is due to the fact that by virtue of their outdoor activities, they are more prone to trauma RTA. The most common cause of blunt abdominal trauma was RTA (83.9%)[5] in the present series. This finding is higher compared to other series indicating increased incidence of RTA in this part of the country, Vikas et al[1] reported 56.6% of cases due to RTA, Griswold and Collier[5] reported automobiles to be responsible for 52% of the blunt injury abdomen and Ghosh et al[2] found it to be 59.1%. Majority of victims of RTA were age group of 16-30 years (47.05%) followed by 31-45 years (26.47%).

Mode Of Injury

RTA

In the present series, the incidence of RTA is quite high as stated by the Ministry of Road Transport and Highway, road accident in India 2011 and WHO,[7] road traffic injury case sheet March 2013, which denotes the fact that in India, motor vehicle population is growing at faster rate than the economic and population growth. Increase in motorization with expansion of road network has brought with increase in road accident rate. The factors contributing to the road accidents are excessive speed, defective roads, defective layout of cross road and speed breakers, disregard to the road signals illiteracy, fatigue, and alcoholism. Nearly all factors are present in this region.

Fall From Height

In the present study, the second most common cause of blunt injury abdomen was fall from height (6.5%). Ghosh et al[2] Kolkata, reported it to be 7% similar to our study. Vikas el al[1] reported in 33.3 % of the cases.

Most common age group affected in fall from height was 0-15 years, probably due to climbing at tree, defective terrace construction, lack of parapet from which children are prone to fall.

It is evident from our study that most patients are from Grade II and III solid organ injury, 25 cases of GradeII , 10 cases of Grade IV & V, 7 cases of Grade III injury were identified by CT scan by organ injury grading scale (AAST organ injury scale). 6 cases had multi organ injury.

Organ Injuries:

In the present study, Spleen injury is most common (58.1%) followed by Liver (54.8%), kidney (32.3%), adrenals (12.9%) and bladder (12.9%). Our study is shows higher incidence of organ injuries compared to others studies. Majority of them had hemoperitoneum (87%) in our case study.

Spleen

Blunt trauma accounts for 66-75% of all splenic traumas in adults and up to 97% in children (Wilson RH, Moorhead RJ, 1992).[12] Spleen is most frequently injured in blunt trauma (Hoyt et al. 2005).[13] (Khan et al. 2006)[14] report that in their series of 100 consecutive blunt abdominal trauma cases, 32% cases 14 had splenic injuries. Kumar et al. (2005) and Singh et al. [11] (2012) found that incidence of splenic trauma in their study was 22-36%. Vikash et al[1] reported 29.78% in their series as compared to our study (58.1%).

Liver

Despite being in a relatively protected location, the liver is the most frequently injured intra-abdominal organ (Patcher HL 1996). Smith et al. [11] found that 220 out of 969 (22.7%) cases with blunt abdominal trauma had hepatic injuries. In their study, Gupta et al. 4 reported that liver was the second most common organ in blunt injury abdomen (29.79%).

Vikash et al[1] reported 31.9% in their series as compared to our study (54.8%).

Kidney

Severe renal injury is however uncommon accounting for only 10-15% of patients injured (Fowler et al. 1982). Renal trauma occurs in 8-10% of all blunt injuries (Dobrowolski et al. 2002)[2]. J Vikash et al[1] reported 14.9% in their series as compared to our study (32.3%). Our study showed higher incidence of renal injury with higher grade involvement.

Adrenal

S Maqsood et al [23] reported adrenal injury in 6.2% of their cases. Our study revealed 12.9 % cases of adrenal injury.

Bladder

S Maqsood et al [23] reported adrenal injury in 6.5% of their cases, M Kumar et al [22] showed in 4.5%. Our study revealed 12.9% cases of bladder injury.

Bowel

Small bowel injury caused by blunt abdominal trauma is rare although it has been reported to be the third most common injury in blunt abdominal trauma[19]. The first case of intestinal rupture secondary to blunt trauma was reported by Samuel Annan in 1837.

In their series of 63 cases of blunt trauma abdomen, Gupta and Talwar (1995)[4] found that small bowel injuries incidence was 17.5%. However, according to Smith et al.,[11] small bowel injury following blunt abdominal trauma was 1.65%. Gohil and Palekar (2006)[20] found that incidence of small bowel injury in their study was 8%. Isolated jejunal perforation occurs in less than 1% of blunt trauma abdomen patients. Thomson (2005)[21] found that incidence of small bowel injury appears to be lower in children than in adults S Maqsood et al[23] reported bowel injury in 8.7 % of their cases, M kumar et al[22] showed in 17.02%. Vikash et al[1] reported in 19% of cases as against 6% in our study.

Hemoperitoneum

M Kumar et al [22] showed 89% of their cases had hemoperitoneum. Our study revealed 87% cases of hemoperitoneum.

CONCLUSION:

In our study of 31 cases CT abdomen was good in assessing visceral injury CT scan of the abdomen has largely replaced other imaging modalities in the evaluation of the hemodynamically stable patients of blunt injury abdomen. It is performed in patients where abdomen cannot be evaluated adequately by clinical examination because of altered mental status.

CT scan should not be performed in hemodynamically unstable patients and in patients with obvious signs of peritonitis or gas under right dome of diaphragm in X-ray abdomen who required immediate surgery. The use of CT scan in the examination of patient with blunt injury abdomen, along with a trend toward non-operative management of many abdominal injuries, has decreased the need for the exploratory surgery and reduced the frequency nontherapeutic laparotomies. In fact, the trend toward conservative, non-operative treatment of many liver, spleen, and kidney injury is due in part to the ability of CT not only define the injury but also exclude significant injury, thereby avoiding unnecessary surgery.

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