

**SPECTRUM OF RADIOLOGICAL FINDINGS ON MDCT ABDOMEN AND PELVIS IN PATIENTS OF BLUNT ABDOMINAL TRAUMA****<sup>1</sup>Dr. Neha Dubey\* and <sup>2</sup>Dr Abhijit Kishorkumar Sankhla**<sup>1</sup>Senior Resident/ Registrar Department of Radiodiagnosis & Imaging Ananta Institute of Medical Sciences & Research Centre Udaipur.<sup>2</sup>Senior Resident/ Registrar Department of Radiodiagnosis & Imaging Ananta Institute of Medical Sciences & Research Centre Udaipur.**\*Corresponding Author: Dr. Neha Dubey**

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**ABSTRACT**

**Background:** Evaluating patients who have sustained blunt abdominal trauma (BAT) remains one of the most challenging and resource-intensive aspects of acute trauma care. Missed intra-abdominal injuries continue to cause preventable deaths. **Aims & Objective:** To analyse spectrum of MDCT findings in cases of blunt abdominal trauma presenting to the emergency radiology department. **Materials and Methods:** 92 cases of blunt abdominal injury admitted in during the period of June 2018 to Dec 2018 were included in the study after taking written informed consent. All these patients were thoroughly investigated. CT Scan was done for all hemodynamically stable patients. Recorded data included age, sex, type of injuries and scan results. Organ injuries were graded using the OIS (Organ Injury Scale) guidelines. **Results:** The study comprised of 92 patients having blunt abdominal injury. Majority of the patients were in the age group of 21-40 years. Most common organ injured was liver (34.78%), kidney (15.22%), spleen (10.87%), bowel injuries (8.70%) and pancreatic injuries (6.52%). **Conclusion:** In this study CT scan was highly useful in diagnosis of blunt abdominal trauma. OIS (organ injury scale) grading, quantification of hemoperitoneum and anatomical site of organ injury predict the management protocols in the majority of our patients.

**KEYWORDS:** Blunt Abdominal Trauma; CT Scan; liver; Hemoperitoneum.**INTRODUCTION**

The care of trauma patients is demanding and requires speed and efficiency. Blunt Abdominal Trauma usually results from motor vehicle collisions, assaults, recreational accidents, or falls. Men tend to be affected slightly more often than women. Evaluating patients who have sustained blunt abdominal trauma remains one of the most challenging and resource-intensive aspects of acute trauma care. Missed intra-abdominal injuries continue to cause preventable deaths. Neurological impairment due to the traumatic event itself or to concomitant factors such as intoxication markedly limits the usefulness of the clinical examination.

The most commonly injured organs are the liver, kidney, spleen, retroperitoneum, small bowel, bladder, colon, diaphragm, and pancreas. Computed tomography (CT) scan remains the criterion standard for the detection of solid organ injuries. CT scan of the abdomen can reveal other associated injuries, notably vertebral and pelvic fractures and injuries in the thoracic cavity. CT scans, unlike diagnostic peritoneal lavage (DPL) or Focused Assessment with Sonography for Trauma (FAST)

examinations, have the capability to determine the source of haemorrhage. Over the last decade, Computed Tomography (CT) has gained widespread clinical acceptance in evaluation of haemodynamically stable patients with blunt abdominal trauma. CT not only allows comprehensive evaluation of presence and extent of injuries to solid organ, retroperitoneum, bowel, mesentery and associated haemorrhage but also allows surgeons to reach vital decisions regarding the need of surgery. Accurate diagnosis with CT has played a key role in the increasing trend towards non-operative management of many visceral injuries.

Moreover, routine use of CT has substantially reduced the number of additional radiographic studies as well as the need of Diagnostic peritoneal lavage.<sup>[1]</sup> CT also plays major role in follow up of the patients with blunt abdominal trauma, determining injury resolution or progression and development of associated complications.<sup>[2]</sup> The advent of Multi Detector Computed Tomography (MDCT) is a major advancement in evaluation of patients of abdominal trauma by offering decreased scanning time, increased resolution owing to

thinner collimation and reduced partial volume and motion artifacts. MDCT scans rapidly during vascular, parenchymal, excretory phases with optimal contrast enhancement. The volumetric data acquired can be used to obtain high resolution multiplanar reformations (MPR), maximum intensity projection (MIP) and three-dimensional (3-D) reconstruction images. These views help in displaying complex injuries and also increasing diagnostic capability, accuracy and confidence of the radiologist immensely. MDCT has major role on number of patients with solid organ injury and non-operative management.<sup>[3]</sup>

### AIM

To analyse spectrum of MDCT findings in cases of blunt abdominal trauma presenting to the emergency radiology department.

### MATERIALS AND METHODS

The prospective study was conducted in Ananta institute of medical science and research centre Udaipur Rajasthan from June 2018 to Dec 2018. Patients reporting to the emergency, with suspected abdominal injuries and evaluated for the same by CT abdomen and pelvis were included in the study.

#### Inclusion criteria

- Patients with clinically suspected abdominal trauma with uncertain abdominal signs reporting to casualty department.
- Patients with pelvic fractures.
- Hemodynamically unstable patients who later become stable following fluid/blood replacement and other resuscitative measures were also taken up.

#### Exclusion criteria

- Patients who were haemodynamically unstable and were directly taken up for surgery.
- Patients with penetrating trauma.
- Cases where the intra venous contrast was contraindicated.

Out of 100 patients 92 full filled the inclusion criteria and rest of the 8 patients were excluded from the study.

All the eligible 92 subjects were included in the study, hence no sampling was done. All the patients included in the study underwent CT imaging using 64 slice multidetector (brilliance 64 philips). CT Images were acquired in arterial phase (25 - 30 secs), Porto-venous phase (60-70 secs) following intravenous contrast administration of 80 - 100 ml. Delayed excretory images were acquired at 10 - 15 minutes for evaluation of the urinary tract. Descriptive analysis of various abdominal injuries was presented as frequencies and percentages.

### OBSERVATIONS AND RESULTS

Ninety-two (92) hemodynamically stable patients sustaining blunt abdominal trauma referred from the casualty were included in the study. Each patient underwent contrast enhanced MDCT examination of the whole abdomen. The data for this prospective study was collected and was subjected for analysis and clinical correlation. The study group comprised of patients ranging from 10 to 70 years of age. Majority of the patients were in the age group of 21 to 40 years accounting for 54% (50/92) of cases. The mean age in the study was  $33.13 \pm 14.48$  years. Out of 92 patients 74 were males and remaining 18 were females. The male to female ratio in the study group was around 4:1. Pattern of different organ injuries on MDCT is summarized in Table 1.

#### Hepatic Injury

The liver was the most commonly injured organ accounting for 34.78% (32/92) of injuries. More than 50% of hepatic injuries were grade II and grade III injuries. Hepatic injuries were associated with; injuries to other abdominal organs in 18.75% (6/32) of cases, rib fractures in 50% (16/32) patients more commonly on right side and injury to lungs either in form of lung contusion, pneumothorax, atelectasis or pleural effusion in 31.25% (10/32) patients (Table 2).

#### Splenic Injury

The spleen was the third most commonly injured organ after liver and kidney accounting for around 10.8% (10/92) of injuries. Grade II injuries constituted around 80 % of splenic injuries.

The splenic injuries were associated with injuries to other intra-abdominal organs in 40% (4/10) of cases, injuries to lungs either in form of lung contusion, atelectasis, or pleural effusion in 20% (2/10) of patients. None of the case was associated with rib fracture (Table 3).

#### Renal Injury

The kidneys were second most commonly injured solid organ 15.2% (14/92). Cases with right renal injury occurred in 57% (8/14) and left renal injury in remaining 43% (6/14) of patients with renal trauma. Renal injuries were associated with injuries to other intra-abdominal organs in 57% (8/14) of cases, most commonly liver in cases of right renal injury and spleen in cases of left renal injury. Grade III and grade IV injury was seen in 43% and 57% of cases respectively. There was no case with grade I and II injury (Table 4 and 5).

#### Pancreatic Injury

The pancreatic injuries were observed in around 6.52% (6/92) cases. Sixty six (66%) percent of pancreatic injuries were grade II injuries and 33.3% were grade I. The pancreatic injuries were associated with injuries to; liver in 66.6% (4/6) of cases, injuries to kidneys in 66.6% (4/6) of cases involving right and left kidney

separately and injuries to spleen in 33.3% (2/6) of cases (Table 6).

#### Bowel and mesenteric injuries

Bowel and mesenteric injuries were seen in around 13.04% (12/92) of cases. Four (8/12) patients had bowel injury, whereas only two (4/12) patients had mesenteric injury. The mesenteric hematomas were associated with hemoperitoneum without solid organ injuries in 100% (4/4) patients. One case was operated and was found to have mesenteric injury preoperatively, which was not detected by MDCT (Table 7).

**Table 1: Pattern of organ injuries on MDCT.**

| Organs involved          | No of cases | Percentage% |
|--------------------------|-------------|-------------|
| <b>Solid organs</b>      |             |             |
| Liver                    | 32          | 34.78       |
| Spleen                   | 10          | 10.87       |
| Kidneys                  | 14          | 15.22       |
| Pancreas                 | 6           | 6.52        |
| Adrenals                 | 6           | 6.52        |
| <b>Hollow viscera</b>    |             |             |
| Bowel                    | 8           | 8.70        |
| Urinary bladder          | 6           | 6.52        |
| Urethra                  | 4           | 4.35        |
| <b>Others</b>            |             |             |
| Mesenteric injury        | 4           | 4.35        |
| Retroperitoneal hematoma | 10          | 10.87       |
| Parietal wall injury     | 10          | 10.87       |
| Multiple organs          | 16          | 17.39       |

**Table 2: Hepatic Injury Grading.**

| Injury grade | No of cases | %     |
|--------------|-------------|-------|
| Grade I      | 2           | 6.25  |
| Grade II     | 6           | 18.75 |
| Grade III    | 12          | 37.50 |
| Grade IV     | 10          | 31.25 |
| Grade V      | 2           | 6.25  |
| Total        | 32          | 100   |

**Table 3: Splenic injury grading.**

| Injury Grade | No of cases | %   |
|--------------|-------------|-----|
| Grade I      | Nil         | 0   |
| Grade II     | 8           | 80  |
| Grade III    | 2           | 20  |
| Grade IV     | Nil         | 0   |
| Total        | 10          | 100 |

**Table 4: Renal involvement in blunt trauma abdomen.**

| Kidney involved | No of cases | %     |
|-----------------|-------------|-------|
| Left kidney     | 6           | 42.86 |
| Right kidney    | 8           | 57.14 |
| Total           | 14          | 100   |

**Table 5: Renal injury grading.**

| Injury grade | No of cases | %     |
|--------------|-------------|-------|
| Grade I      | Nil         | 0     |
| Grade II     | Nil         | 0     |
| Grade III    | 6           | 42.86 |
| Grade IV     | 8           | 57.14 |
| Grade V      | Nil         | 0     |
| Total        | 14          | 100   |

**Table 6: Pancreatic injury grading.**

| Injury grade | No of cases | %     |
|--------------|-------------|-------|
| Grade I      | 2           | 33.33 |
| Grade II     | 4           | 66.67 |
| Grade III    | Nil         | 0     |
| Grade IV     | Nil         | 0     |
| Grade V      | Nil         | 0     |
| Total        | 6           | 100   |

**Table 7: Type of Bowel involved in blunt trauma.**

| Bowel     | Perforation | %   |
|-----------|-------------|-----|
| Small     | 4           | 50  |
| Large     | 2           | 25  |
| Not known | 2           | 25  |
| Total     | 8           | 100 |



**Fig. 1: Contrast enhanced CT showing grade II splenic laceration.**



**Fig. 2: Contrast enhanced MDCT suggested grade V injury along free fluid in Perihepatic region & pelvis suggesting hemoperitoneum.**



**Fig. 3: Grade IV Renal Injury.**



**Fig. 4: Impression of mesenteric hematoma was made on basis of MDCT findings.**

## DISCUSSION

The present study was undertaken to evaluate the role of Multi detector computed tomography (MDCT) in management of clinically stable patients with blunt abdominal trauma by comparing management plan prior to MDCT scan with management plan after MDCT scan and to correlate CT findings with surgical findings in operated cases of blunt abdominal trauma and clinical outcome in conservatively managed cases. In the present study, comprising (92) clinically stable patients with blunt abdominal trauma, more than 54% of the patients were in the age group of 21 to 40 years. The male to female ratio was 4:1. The most common mode of injury was road traffic accident (69.5%) followed by fall from height (17.3%). Bony injuries (including ribs, pelvis and spine) were the most common associated injury (80%) followed by chest injury (atelectasis, pleural effusion, contusion, and pneumothorax) which was seen in 23.9% of cases.

In a study by *Mohapatra et al.*,<sup>[4]</sup> blunt abdominal trauma accounted for 44% of all abdominal injuries. More than three fourth (3/4th) of the victims were in the first four decades of their lives. Male-Female ratio was 7:1. Road traffic accidents (RTA) were the most common etiology (62%) mostly involving pedestrians or two wheeler riders (combined, 47%). Chest injury was the most common associated extra-abdominal injury

(26%) followed by head injury and other bony injuries (21% each).

In the present prospective study, a statistically significant difference ( $p=0.052$ ) was found between the management plan decided before and after MDCT scan (guided by CT scan findings). The use of MDCT in initial triage of patients with blunt abdominal trauma results in decrease in number of unnecessary laparotomies and helps guiding management plan in virtually every patient with high success rate. In a study by *Wing and associates*<sup>5</sup> evaluating clinical impact of CT for blunt abdominal trauma, it was concluded that the use of computed tomography (CT) had a tremendous impact on the evaluation and management of blunt abdominal trauma. It is non-invasive, easy to perform, and has been shown to be highly sensitive (100%), specific (96.8%), and accurate (97.6%). The use of CT has helped decrease the total number of laparotomies performed for abdominal trauma as well as the number of negative and non-therapeutic laparotomies. In a retrospective study performed by *Udekwa et al.*,<sup>[6]</sup> to evaluate the use of computed tomography in the initial evaluation of hemodynamically stable blunt trauma patients, the sensitivity of CT for patients with visceral injury was 92.4%, specificity was 99.5%, and overall accuracy was 97.6%. False negative scans occurred in 1.9% of patients, with no deaths or major complications attributable to delay in diagnosis. Non-operative management was possible in 72% of patients with solid organ injuries. In the present study, among (68) patients with solid organ injuries, 76.4% (52/68) were managed conservatively. All patients of grade I injury were managed conservatively.

Out of 20 patients with grade II injuries 70% (14/20) were managed conservatively. All patients with grade III injuries were managed conservatively. Out of 18 patients with grade IV injuries 55.5% (10/18) were managed conservatively. 2 patients with grade V injury were operated. *Hackam et al.*,<sup>[7]</sup> and *Shapiro et al.*<sup>[8]</sup> in their studies regarding correlation between solid organ injury grading and management plan concluded that although useful for epidemiologic studies, CT grading of liver and spleen injuries based on morphology of wounds does not reliably predict the specific outcome in individual cases. In the present study, the liver was the most commonly injured organ accounting for 34.78% (32/92) of injuries, whereas in a study by *Boone et al.*,<sup>[9]</sup> liver was the second most commonly injured organ in the abdomen with damage occurring in 20-30% of blunt trauma overall. More than 50% of hepatic injuries were grade II and grade III injuries. Around 18.75% (6/32) of liver injuries were associated with injuries to other organs, most commonly right kidney 50% (6/12). One patient with liver injury had injury to right adrenal gland. There were associated rib fractures in 50% patients (16/32) with liver injuries, more commonly on right side which was seen in 83.3% cases (10/12). The associated rib fractures have also been reported by *Boone et al* who

found rib fractures in 33% of cases with hepatic injuries.<sup>[9]</sup> Five out of six i.e. 31.25% patients with liver injury had concomitant injury to chest either in form of lung contusion, atelectasis or pleural effusion. More than 50% of hepatic injuries were grade II and grade III injuries. The spleen was the third most commonly injured organ accounting for around 10.8% (10/92) of injuries whereas in a study by *Mirvis et al.*<sup>[10]</sup> the spleen was the most frequently injured organ accounting for around 40% of all solid organ injuries. Around 40% (4/10) of splenic injuries were associated with injuries to other organs. There were no associated rib fractures. Associated chest injuries were present in 20% (2/10) of patients, either in form of lung contusion, atelectasis, or pleural effusion. Grade II injuries accounted for around 80% of splenic injuries. In the present study 60% (6/10) patients with splenic injuries were managed non-operatively. The non-operative management was successful in 100% of patients with blunt splenic trauma i.e. none of the patients who were managed conservatively required delayed laparotomy.

In the present study, multiple organ injuries were seen in around 17.39% (16/92) of cases with liver and right kidney injured simultaneously in 37.5% (6/16) cases. Around 62.5% (10/16) patients with multiple organ injuries were managed conservatively unlike the study performed by *Pieper et al* who found that the patients in whom CT detects multi-organ "package" injuries (e.g. spleen and left kidney; left lobe of the liver; and pancreas) are more likely to undergo surgical intervention.<sup>[11]</sup>

In the present study, the kidney was second most common injured organ. Renal injuries were seen in 15.2% (14/92) of cases with right renal injury occurring in 57% (8/14) and left renal injury in remaining 43% (6/14). Around 57% (8/14) of renal injuries were associated with injuries to other organs, most commonly liver in cases of right renal injury and spleen in cases of left renal injury. In a study by *Smith et al.*<sup>[12]</sup> the kidneys were injured in 10% of patients with blunt abdominal trauma and were the most frequent urinary tract organ to suffer injury.

In the present study, grade III and grade IV renal injury was seen in 43% and 57% of cases respectively. There was no case with grade I and II injury. Among the 14 patients with renal injury 71.4% (10/14) were managed conservatively. Out of 8 patients with grade IV injuries 50% (4/8) were managed conservatively. All cases of grade III injury were managed conservatively. With the help of multi detector CT it was possible to accurately characterize the renal injuries and to rule out other associated injuries requiring urgent intervention as a result of which unnecessary laparotomy was avoided in a number of patients sustaining blunt renal trauma. Similar conclusions were drawn in a study by *Quinlan et al*<sup>[13]</sup> i.e. CT is recommended for detection and characterization of the grade of injury, for qualitative

assessment of renal function, and to rule out associated intraabdominal injury that may warrant immediate surgery.

In the present study, pancreatic injuries were observed in around 6.52% (6/92) cases, in contrast to a study by *Wong et al*<sup>[14]</sup> who found pancreatic injury to be relatively uncommon, occurring in less than 2% of blunt abdominal trauma patients. Sixty six (66%) percent of pancreatic injuries were grade II injuries and 33.3% were grade I. The pancreatic injuries were associated with injuries to liver in 66.6% (4/6) of cases, injuries to kidneys in 66.6% (4/6) of cases involving right and left kidney separately and injuries to spleen in 33.3% (2/6) of cases. In a study by *Bradley et al*<sup>[15]</sup> it was observed that isolated pancreatic injuries are rare, and associated injuries, especially to the liver, stomach, duodenum, and spleen, occur in over 90% of cases. In the present study, out of 6 patients with pancreatic injuries 66.6% (4/6) were managed conservatively. Out of 4 patients with grade II injuries 50% (2/4) were managed conservatively. Two (2) cases of grade I injury were managed conservatively.

In the present study, bowel and mesenteric injuries were seen in around 13.04% (12/92) of cases. The most common sign of bowel injury in this study was bowel wall thickening, extraluminal air, extravasation of oral contrast, mesenteric thrombosis and evidence of bowel ischemia. Eight (8/12) patients had bowel injury, whereas only four (4/12) patients had mesenteric injury. The mesenteric hematomas were associated with hemoperitoneum without solid organ injuries in 100% (4/4) patients.

## CONCLUSION

In this study CT scan was highly useful in diagnosis of blunt abdominal trauma. OIS (organ injury scale) grading, quantification of hemoperitoneum and anatomical site of organ injury predict the management protocols in the majority of our patients. Result of this study shows that CT scan is a superior diagnostic modality in the diagnosis and management of blunt abdominal trauma. The use of multi detector CT in initial triage of clinically stable patients with blunt abdominal trauma results in reduction in number of unnecessary laparotomies and helps guiding initial management in emergency department in virtually every patient with high success rate.

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