

## ORIGINAL RESEARCH

## Role of MDCT in Evaluation of Blunt Abdominal Trauma

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**Abstract**

**Background:** This study was conducted to evaluate the role of solid organ and hollow viscous injury in blunt abdominal trauma patients using multi-detector computerized tomography, accurately diagnose the type of injury at the earliest and help the clinician in management, study the grades or severity of solid organ injuries, and correlate CT findings in trauma patients with management strategies followed either operatively or conservatively.

**Methods:** This was a hospital-based prospective study conducted among 69 patients who underwent CT evaluation in the Department of Radio Diagnosis, S.C.B. Medical College, Cuttack, over a period of two years from November 2020 to October 2022, after obtaining clearance from the institutional ethics committee and written informed consent from the study participants.

**Results:** Hemoperitoneum (85.5%) was the most common finding in blunt abdominal trauma. Pain in the abdomen was the most common clinical symptom, followed by guarding and rigidity. Among solid organ injuries, the spleen was the most frequently injured organ. Among splenic injuries, intraparenchymal hematoma was the most common type of splenic injury, followed by subcapsular hematoma. Among hepatic injuries, liver laceration was the commonest lesion. The right lobe of the liver involves 70% of cases. Renal injury is noted in 17.39% of cases of BAT; subcapsular hematoma and contusion contribute 25 each, and renal laceration occurs in 50% of cases. 7.49% of patients had pancreatic injuries, of which 40% were pancreatic contusions and 60% were pancreatic lacerations. The most common associated injury was fractures, followed by head and chest injuries, which were found more often with blunt trauma.

**Conclusion:** The sensitivity of a CT scan in determining the type of lesion is 100%. MDCT imaging gives accurate diagnostic pathology of the various intraabdominal organ injuries in BAT, thereby helping the clinicians undertake conservative or surgical management.

**Keywords:** MDCT, Blunt Abdominal Trauma.

## Introduction

Traumatic injury has been there since the evolution of mankind; there is no age or sex predilection for traumatic injury, but it mostly involves active personnel, which involves the first four decades, which makes it the most common cause of death in this age group. Each year 60 million people around the world over lose their lives due to trauma and this number is increasing year by year. In developed or developing countries, about one sixth of the patients admitted to hospitals are due to trauma, even the emergency department has a special trauma centre in every hospital.

Trauma can be penetrative or blunt. As trauma is a vast aspect, our study considered various aspects of blunt abdominal trauma. Blunt abdominal trauma is an intra-abdominal injury secondary to blunt forces and it can cause damage to internal organs, resulting in internal bleeding, contusion, or injury to the bowel, spleen, liver, kidney, and vessels. As it's a wide surface force, it may involve multiple organs unlike penetrative trauma. Blunt abdominal trauma, also called wide impact trauma, accounts for the majority of injuries. Today the most common causes of blunt abdominal trauma are: motor vehicle accidents, assaults, home- and work-related accidents such as crush injuries, blast injuries, falls from height, and falls of heavy objects over the abdomen. Delay in diagnosis and treatment of abdominal injuries substantially increases morbidity and mortality in trauma patients due to bleeding from solid organs, vascular injury or infection from perforation of a hollow viscus organ, so imaging plays a great role in early detection of these injuries grading them, and thus leading to appropriate management be it conservative or surgical. Physical examination is often unreliable, especially when there is an associated head injury, spinal cord injury, or drug ingestion, and intra-abdominal injuries may be missed in 16 to 45% of patients.<sup>[1,2,3]</sup> Multi-detector CT (MDCT) allows for complete scanning in a single breath-hold, and faster scanning speeds and narrow collimation increase contrast opacification in the mesenteric, retroperitoneal, and portal vessels, as well as in parenchymal organs. This improves the identification of organ injury and, additionally, sites of active arterial bleeding. Breath holding may not be possible in trauma settings, and the speed of multi-slice scanning further reduces breathing-related motion artefacts. CT is the diagnostic tool of choice for the evaluation of abdominal injuries due to blunt trauma in hemodynamically stable patients.<sup>[4]</sup> CT scans can provide a rapid and accurate appraisal of the abdominal viscera, retroperitoneum and abdominal wall.<sup>[5]</sup> In addition, an abdominal CT scan can assist with coexisting thoracic injuries and unsuspected pelvic and spinal fractures.<sup>[6]</sup> The use of CT in the initial and follow-up evaluations of trauma victims has played a pivotal role in decreasing the rates of unnecessary exploratory laparotomies and increasing conservative non-operative management of abdominal injuries.

In this study we wanted to evaluate the role of solid organ and hollow viscous injury in blunt abdominal trauma patients using multi-detector computerized tomography, accurately diagnose the type of injury at the earliest and help the clinician in management, study the grades or severity of solid organ injuries, and correlate CT findings in trauma patients with management strategies followed either operatively or conservatively.

## Materials & methods

This was a hospital-based prospective study conducted among 69 patients who underwent CT evaluation in the Department of Radio Diagnosis, S.C.B. Medical College, Cuttack, over a period of two years from November 2020 to October 2022, after obtaining clearance from the institutional ethics committee and written informed consent from the study participants.

## Inclusion Criteria

- Patients who are FAST positive and hemodynamically stable after suffering blunt

abdominal trauma either through road traffic accident, blunt weapon injury or other accidents.

- Patients of all age groups, and sex.

### Exclusion Criteria

- Patients who are hemodynamically unstable.
- Pregnant females.
- Patients who have had organ resection or any other surgery in the past will mostly distort solid organ anatomy, thus affecting the study.
- Patient having an abnormal renal function test or having an allergy to contrast.

### Statistical Analysis

Data was entered in MS Excel and analysed using SPSS software. Results were presented as tables.

### Results

Age Group	No. of Case	Percentage
1-10	1	1.44%
11-20	9	13.04%
21-30	25	36.23%
31-40	17	24.63%
41-50	10	14.49%
51-60	4	5.79%
61-70	1	1.44%
71-80	2	2.89%
Total	69 cases	100%
<b>Age Distribution</b>		
Sex	No. of Case (69)	Percentage
Male	59	85.50%
Female	10	14.49 %
Total	69	100%
<b>Sex Distribution</b>		

**Table 1: Demographic Distribution**

The peak incidence of 36.23% was present in the 3rd decade and the second peak of 24.63% was in the 4th decade of life. A male predominance of 85.5% was noted.

Cause of Trauma	Number (N =69)	Percentage
RTA	41	59.42%
History of Assault	11	15.94%
Fall from height	5	7.24%
Blast injury	2	2.89%
Total	69	100%
<b>Cause of Blunt Abdominal Trauma</b>		
Clinical Finding	Number of Case (N =69)	Percentage
Pain abdomen	60	86.95%
Guarding and rigidity	23	33.33%
Vomiting	6	8.69%
Hematuria	10	14.49%
Abdominal distension	21	30.43%

<i>Clinical Presentation in BTA</i>		
<b>Type of Lesion</b>	<b>No. of Case (N =69)</b>	<b>Percentage</b>
Hollow viscous perforation	3	4.34%
Spleen	31	44.92%
Liver	20	28.98%
Kidney	12	17.39%
Pancreas	5	7.49%
Urinary bladder	1	1.44%
<i>Organ Wise Involvement in BTA</i>		
<b>Type of Lesion</b>	<b>No. of Cases (N =31)</b>	<b>Percentage</b>
Subcapsular hematoma	10	32.25%
Intraparenchymal hematoma	11	35.48%
Laceration	8	25.8%
Shattered spleen	2	6.45%
Total	31	100%
<i>Splenic Injury</i>		
<i>Table 2</i>		

Road traffic accidents were the commonest cause of blunt abdominal trauma (59.42%). Pain in the abdomen (86.95%) and guarding rigidity (33.33%) were the most predominant signs and symptoms of blunt abdominal trauma.

Among the solid organ injuries, the most common injured organ was the spleen (44.92%), followed by the liver (28.98%) in our study.

The most common type of splenic injury was intraparenchymal hematoma (35.48%) followed by subscapular hematoma (32.25%).

<b>Liver</b>	<b>No. of Case (N =20)</b>	<b>Percentage</b>
Subcapsular hematoma	3	15%
Intraparenchymal hematoma	8	40%
Laceration	9	45%
Total	20	100%
<i>Liver Injury</i>		
<b>Lobe of Liver</b>	<b>No. of Cases(N =20)</b>	<b>Percentage</b>
Right	14	70%
Left	4	20%
Both right and left lobe	2	10%
Total	20	100%
<i>Involvement of Lobe of Liver in Hepatic Trauma</i>		
<b>Kidney</b>	<b>No. of Cases (N=12)</b>	<b>Percentage</b>
Subcapsular hematoma	3	25%
Contusion	3	25%
Laceration	6	50%
Total	12	100%
<i>Kidney Injury</i>		
<b>Pancreas</b>	<b>No. of Cases (N=5)</b>	<b>Percentage</b>
Contusion	2	40%
Laceration	3	60%
Total	5	100%
<i>Pancreatic Injury</i>		
<i>Table 3</i>		

Liver laceration was the most common type of hepatic injury. The right lobe was the most common site of involvement (70%) in hepatic trauma. In our study, 12 patients had renal injuries, out of these, subcapsular hematoma and contusion were noted in 3 cases each (25%), and 6 cases of renal laceration were noted. In our study, 5 patients had pancreatic injury; out of these, pancreatic contusion were noted in 2 cases (40%) and pancreatic laceration in 3 cases (60%).

<b>Liver</b>	<b>20</b>	<b>17</b>	<b>85%</b>
Kidney	12	11	91.66%
Pancreas	5	5	100%
Urinary bladder	1	1	100%
Total		59	
<b><i>Distribution of Hemoperitoneum Associated with Blunt Abdominal Trauma</i></b>			
<b>Hemoperitoneum (N=59)</b>	<b>No. of Cases</b>		<b>Percentage</b>
Mild	34		57.62%
Moderate	14		23.72%
Severe	11		18.64%
Total	59		100%
<b><i>Severity of Hemoperitoneum</i></b>			
<b>Organ System</b>	<b>No. of Case (N =69)</b>		<b>Percentage</b>
Fractures	19		27.53%
Head Injury	9		13.04%
Chest Injury	7		10.14%
<b><i>Associated Injuries with Blunt Abdominal Trauma</i></b>			
<b><i>Table 4</i></b>			

Hemoperitoneum was a common finding, with all injuries almost present in all cases of HVP, bladder rupture, and pancreas trauma.

The most common associated injury was fractures (27.53%).

### Discussion

MDCT is an indispensable tool for diagnosis of blunt abdominal trauma, as it is difficult to completely and effectively diagnose it clinically, especially in comatose patients with multiple injuries where timely management is required to reduce blood loss. In such a critical scenario, the diagnosis modality has to be accurate and rapid.

MDCT apart from the diagnosis of organ injury essentially, ascertains whether laparotomy is needed or not.

MDCT is non-invasive and accurate in depicting the extent of injury to the solid viscera in BAT and shows direct or indirect signs of bowel injury.

### Advantages

Excellent at identifying solid organ injury

- Retroperitoneal injuries are well assessed.
- Quantifies the amount of free fluid in the abdomen.
- Identifies intra-organal lesions missed by DPL/ultrasound.

### Disadvantages

- High cost.
- Time consuming.
- Specialized personnel and equipment are required for the study.

- Poor in the detection of GI tract injuries.

In this study, a total of 69 cases of blunt abdominal trauma were evaluated by MDCT in the department of Radiodiagnosis S.C.B Medical College, Cuttack. Standard textbooks were used for reference and findings were correlated with previous studies.

Age distribution of patients with a history of blunt abdominal trauma. In our study, the youngest patient's age was 6 years and the eldest was 73 years. The present study reveals that all age groups are affected, but the majority of cases were detected in young people within 21-40 years (60.86%). This data correlates with the study of Novelline RA, Rhea JT, Rao PM et al. 1999<sup>[7]</sup>

Sex distribution of patients included in the present study. In our study, there were 59 male and 10 female patients, so an overall male predominance (85.5%) over females was found. this finding is in accordance with Zefer et al. 2002<sup>[8]</sup> who suggested that the majority of blunt trauma abdomen patients are male (90%). The higher incidence of male could be attributed to the more outdoor nature of their occupation, alcohol addiction and involvement in violence in males compared to females.

Modes of trauma in our study. In this study, road traffic accidents were the commonest cause of injury. Out of 69 cases, in 41 cases (59.42%), motor vehicle accidents were responsible for trauma, followed by injury caused by assault (15.94%). This is in accordance with Ong CL, Png DJ, et al.<sup>[9]</sup> who stated that the most common cause of abdominal trauma is road traffic accidents followed by stab wounds and falls from heights. Walled K. Rajab et al. 2006 stated that road traffic accidents (RTA) are the leading cause of blunt abdominal trauma (BAT). In this study, 38 patients out of 56 patients (68%) had BAT due to RTA.

Enumerate the spectrum of clinical features found in patients with abdominal trauma. Pain in the abdomen (86.95%) and guarding rigidity (33.33%) were the most predominant symptoms and signs in our study, followed by abdominal distension. which is in accordance with the study of S.Mohapatra et al. 2003 which stated that the most common symptom of BAT was abdominal pain (77.8%). In their study, 56 cases out of 72 showed pain in the abdomen. Out of 8 patients with renal injury, 6 presented with a history of hematuria.

Different types of lesion or injury are seen in blunt abdominal trauma. This study shows the spleen was the most frequently injured organs (44.9%) followed by the liver (28.98%) among solid organ injuries. Similar findings have been reported in an extensive study on abdominal trauma patients done by Becker CD, Menta G, Schmidlin F et al., 1998.<sup>[10]</sup>

Different types of splenic injuries occur in BAT. The spleen was the single most injured organ in blunt abdominal trauma in the present study. Spleen was injured in 31 cases (44.9%). Out of these intraparenchymal hematoma (35.48%) was the commonest type of splenic injury in BAT. The other injuries present were subcapsular hematomas, lacerations and the shattered spleen. This correlates well with the study of Reinhard Hoffmam et al., where intraparenchymal hematoma was the commonest type of injury (57%) in splenic trauma.

Different types of liver injury in BAT. Hepatic injury was demonstrated in 20 patients (28.98%). out of which liver laceration was detected in 45% of cases, followed by intraparenchymal hematoma in 40% of cases and subcapsular hematoma in 15% of cases. The commonest lesion detected was a laceration in hepatic trauma. In the series R. Gruessneret et al. 1998<sup>[11]</sup> the major hepatic injuries were laceration and hematoma.

Involvement of the lobe of the liver in hepatic trauma. In our study, the right lobe was involved in 70% of cases Foley WD, Cates JD, Kellman GM, et al., 1987<sup>[12]</sup> had obtained similar results in their study.

Different types of renal injury. In our study, 17% of patients had renal injuries. Out of these, subcapsular hematomas and renal contusions were noted at 25% each and 50% of renal lacerations were noted. Renal laceration accounts for the maximum percentage of renal injury

in our study. This study contradicts with the study done by Baverstock R, Simmons M et al., 2001 which states that grade 1 renal injuries, which account for approximately 80% of renal injuries, are characterized by contusion and nonexpanding subcapsular hematoma.

Type of pancreatic injury in BAT. In our study, 7.24% of patient had a pancreatic injury, out of which 40% had a pancreatic contusion and 60% had pancreatic laceration. Show C, Fenlon HM et al., 2002 stated that pancreatic contusion and laceration were the most common types of pancreatic injury in blunt abdominal trauma which contradicts our study.

Percentage of hemoperitoneum associated with various organ injuries. Hemoperitoneum is an essential finding for pinpointing the organ involved. The density of fluid in the abdomen suggests its composition (ascites, bowel content bile vs. hemorrhage)

Recent hemorrhage (acute bleed) measures 30-45 HU. Clotted blood measures 45-70 HU

Old blood products, seroma or blood in anaemic patients measures <30 HU. Hemoperitoneum was present in almost all cases, making it an important indicator of blunt abdominal trauma. It was almost present in all cases of HVP, bladder rupture and pancreas trauma. Federle MP, Jeffrey<sup>[13]</sup> CT estimates of the extent of hemoperitoneum (small, moderate, or large) correlated well with clinical assessments and surgical findings. The severity of hemoperitoneum varies, with mild being the most common.

Associated organ injury. In our study, the most common associated injury in multiple trauma patients was fracture (27.53%) followed by head and chest injuries and found more often with road traffic accidents (RTA). A similar observation has been made by Davis et al. 1976 and Michal Krauss et al. 1984.<sup>[14]</sup>

The various management strategies for the following cases - In the spleen subcapsular hematoma and intraparenchymal hematoma were mostly conservatively managed and splenic laceration was mostly surgically managed. All cases of shattered spleen were managed surgically. In liver subcapsular hematoma, intraparenchymal hematoma, laceration was mostly managed conservatively. In hollow viscous perforation all cases were managed surgically.

In the kidney, all cases of subcapsular hematoma and contusion were managed conservatively but most renal laceration cases were managed surgically. Only one case of urinary bladder rupture was studied in our case and it was managed surgically to prevent further intraperitoneal extravasation. 60.86% of cases were managed conservatively, and rest were managed surgically, similar findings were noted by Nahid Nafissi 2018.<sup>[15]</sup> Most blunt trauma livers (80% in adults and 97% in children) are treated conservatively. Today, non-surgical management is the standard treatment for hemodynamically stable patients, with a success rate of around 85–98%. Various surgeries are associated with BTA, with the most common operation being splenectomy (40.74%). CT being 100% sensitive for both visceral and hollow viscous injury with specificities of 98.04% and 98.36% , respectively.

## Conclusion

It is concluded from the above study that, MDCT scan is the diagnostic modality for characterizing the lesions of abdominal trauma. It establishes the exact nature of the lesions, such as contusion, laceration, hematoma, fracture, avulsion etc. It also helps to evaluate retroperitoneal and vascular injuries more precisely. It helps the surgeon plan the treatment properly before any surgery is contemplated. The amount of imaging used to evaluate a trauma victim must be inversely proportional to the severity of the injury so as not to interfere with the patient's resuscitation. In this study, the sensitivity of the CT scan in determining the lesion type was 100%. MDCT imaging gives accurate diagnostic pathology of the various intraabdominal organ injuries in BAT, thereby helping the clinicians to undertake conservative or surgical management.

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