Original Research Article

Role of Computed Tomography in Blunt Abdominal Trauma Evaluation at a Tertiary Care Centre in Rural Setup

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Abstract

Background: Blunt abdominal trauma (BAT) remains one of the commonest causes of morbidity and mortality. Immediate evaluation of the patient is needed for proper management. Computed Tomography (CT) remains the most accurate investigation with sensitivity between 92 to 97% and a specificity of 98%. The ability of CT to show in detail the location and degree of injury, source of hemorrhage and mesenteric or bowel injuries make it the investigation of choice in BAT patients.
Materials and methods: In the present study, 100 patients with recent blunt abdominal trauma (within 3 days of presentation) were evaluated prospectively over a period of 15 months in Mamata general and super specialty Hospitals using a 16 slice Siemens CT machine and IV contrast.
Results: Among the 100 patients evaluated, 80 were males and the rest females. The moat common age group with BAT was 41 to 50 years. Road traffic accidents were the moat common cause of BAT. Among the 100 patients, CT was able to identify and grade hemoperitoneum in 96 of them, with 12 patients having an additional pneumoperitoneum component. A total of 36 patients had polytrauma i.e., presenting with an injury in more than one organ. 32 patients had bowel injuries, 8 patients had mesenteric hematomas, 6 patients had vascular injuries, 4 patients had urethral injuries and 2 patients had urinary bladder injuries. Overall the sensitivity of CT to identify intra-abdominal injuries was 96% and specificity was 98%.
Conclusion: Imaging with MDCT helps in rapid diagnosis of patients with blunt abdominal trauma. It also helps in determining the prognosis of the patient and in aiding the attending doctor in deciding

the management of the patient. CT has the advantage of better visualization of retroperitoneum and its organs, posterior urethra and urinary bladder. Extending the field of view (FOV) to include the chest can help in diagnosing associated lung contusions or alveolar hemorrhages. Special CT procedures like retrograde urethrography or cystogram can help in diagnosis of urethral or urinary bladder injuries.

Key words

Blunt abdominal trauma, Hemoperitoneum, Solid organ injury, Hemo-pneumoperitoneum.

Introduction

Trauma remains one of the most common causes of admission to the emergency room (ER) till date, of which blunt injury to the abdomen constitutes a major percentage. The management of a patient with blunt abdominal trauma (BAT) depends on their stability and grade of internal organ injury. The common causes for BAT include road traffic accidents, fall from height and physical assault. Men tend to be more commonly affected as compared to women. The organs to be injured include spleen, liver, retroperitoneum, small bowel, kidneys, bladder, colorectum and pancreas, in the order of frequency.

Physical examination most of the times may not be an accurate guide to the degree of the injury since the patient may be disoriented due to influence of alcohol or brain injury. The various investigations used to aid in the diagnosis of internal organ injury include focused assessment with sonography for trauma (FAST), Diagnostic peritoneal lavage (DPL) and computed tomography (CT). FAST and DPL can be performed within minutes in the ER, but sometimes critical and/or minute findings may be missed.

CT is considered as the most accurate investigation with sensitivity between 92 to 97% and a specificity of 98% [1, 2]. The ability of CT to show in detail the location and degree of injury, source of hemorrhage and mesenteric or bowel injuries make it the investigation of choice in BAT patients. The disadvantages of CT include time taken for the procedure, cost, adverse reactions to intravenous iodinated contrast media and limited sensitivity in identifying diaphragmatic, pancreatic injuries.

Aim and objectives

- To accurately identify the organ injury and grade the blunt abdominal injury according to AAST classification.
- To identify and quantify hemoperitoneum in blunt abdominal trauma (according to Federle and Jeffrey system).
- To identify the cause of hemoperitoneum in blunt abdominal trauma.
- To compare CT findings with surgical findings during emergency laparotomy for blunt abdominal trauma.
- To analyze the sensitivity, specificity of CT as a prognostic tool for the further management of blunt abdominal trauma.

Materials and methods

This was a prospective study done over a period of 18 months, from June 2018 to November 2019 at Mamata General and Super Specialty Hospital, a tertiary care center. A total of 100 patients with history of recent (within 3 days of presentation) blunt abdominal trauma were evaluated using Siemens SOMATOME Scope-16 slice CT machine.

Inclusion criteria

- Patients presenting with history of blunt injury to the abdomen within 3 days of trauma. There was no age restriction applicable, and patients of both genders were included in the study.

Exclusion criteria

- Patients who underwent emergency damage control surgery for abdominal trauma.
- Patients with allergy to IV contrast media.
- Patients with history of abdominal trauma requiring mechanical ventilator support excluded from the study.

Study design: Prospective observational study.
The CT parameters used:
Scanning length: from xiphisternum to proximal 1/3rd of thigh
Slice thickness: 1.5 mm, with 0.5 mm increment
Pitch factor: 1
kVp: 130 kV
mAs: 25 mA

IV contrast media used: 100 ml, omnipaque, given either manually or with pressure injector.
Phases taken: plain, arterial or early phase, venous phase, delayed phase (for excretory function of kidneys, ureteric course and urinary bladder evaluation).

Additional imaging with CT guided retrograde urethrography (RGU) or cystogram done in cases with suspected injuries of urethra or urinary bladder (**Figure – 1 to 7**).

Figure - 1: Axial CECT image showing liver laceration and contusion, splenic laceration, right adrenal hematoma and hemoperitoneum.

Figure - 2: CECT images in Coronal and axial sections showing liver contusion, splenic laceration, right renal contusion-laceration and right adrenal hematoma with right abdominal wall contusions.

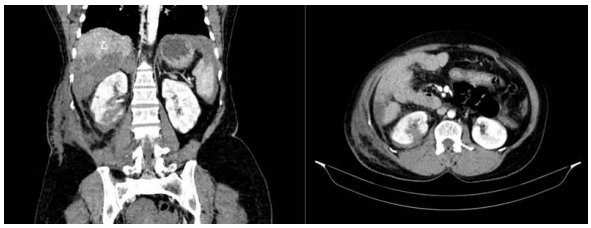

Figure - 3: CECT images in sagittal and axial sections showing active extravasation of contrast into the hemoperitoneum due to splenic injury.

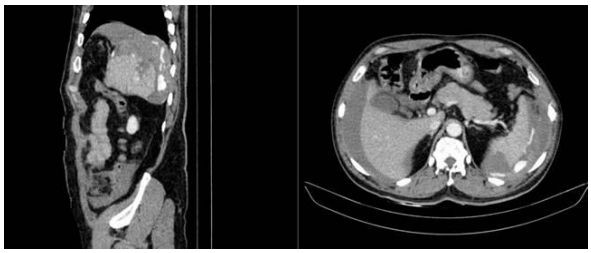

Figure - 4: Axial CECT image showing shattered spleen with hemoperitoneum.

Figure - 5: Axial image in bone window after contrast administration through urethra (CT-RGU) demonstrating extravasation of contrast into perineum and fracture in left inferior pubic ramus.

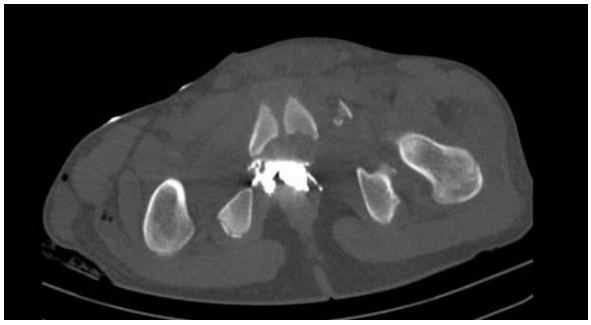

Figure - 6: CECT images in coronal and axial sections showing right lateral abdominal wall dehiscence with herniation of bowel loops through it.

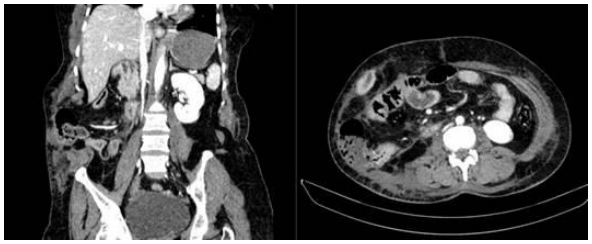

Figure - 7: Axial CECT image showing mesenteric hematoma with associated hemoperitoneum with pneumo component (arrow).

Results

A total of 100 cases with BAT were referred to the department of radiodiagnosis and underwent CT. Contrast enhanced CT was most commonly done, with only a single case undergoing plain CT in view of raised renal parameters. Among the 100 cases, 80 were males and the rest 20 females. Age wise distribution of cases was as per **Table – 1**.

Table - 1: Age wise distribution of cases (n=100).

Age of patient (in years)	No. of cases
<20	4
20 – 30	30
31 – 40	26
41 – 50	35
> 50	9

The most common cause for BAT was road traffic accidents with 83 cases, remaining cases had a fall from height and a physical assault with 7 cases and 3 cases respectively.

Of the 100 cases, a total of 96 cases were positive for hemoperitoneum, which was quantified according to Federle and Jeffrey system [3]. Distribution of cases with hemoperitoneum was as per **Table – 2**.

Table - 2: Distribution of cases with hemoperitoneum (n=96).

Quantity of hemoperitoneum	No. of cases
Small (fluid in one peritoneal space, 100-200ml)	18
Moderate (fluid in two or more spaces, 250-500ml)	50
Large (fluid in all spaces or pelvis fluid anterior/ superior to urinary bladder, >500ml)	28

An additional pneumoperitoneum component along with hemoperitoneum was seen in 12 patients, and was associated with bowel perforation. 3 cases showed hemoperitoneum on surgery which was done in patients who were unstable despite CT findings being normal.

36 of the total 100 cases showed polytrauma, with injuries noted in more than one organ. Most commonly injured organs in order of frequency were spleen, liver, bowels, kidneys, adrenal, mesentery and pancreas.

The grading of injuries was done according to the AAST system. The AAST classification ranges from grades 1 through 5, 1 being the least severe and grade 5 being the most severe.

All the 20 patients with renal injuries and 12 patients with adrenal injuries showed involvement of the right sided organ and were all associated with liver trauma (**Table - 3**).

4 patients had pancreatic injuries, 3 among them had grade 2 injuries and one case of grade 4 injury was seen.

Table - 3: Distribution of cases according to organ injured and their grading.

Organ injured	Total no.	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
Liver	28	0	8	12	8	0
Spleen	52	0	12	24	12	4
Kidney	20	4	8	8	0	0
Adrenal	12	--	--	--	--	--

Table - 4: Distribution of cases with bowel injuries.

Bowel injured	Type of injury	No. of cases
Duodenum	Wall contusion	4
Jejunum	Wall contusion	5
Jejunum	Wall perforation	3
Ileum	Wall contusion	4
Ileum	Wall perforation	4
Ascending colon	Wall contusion	7
Ascending colon	Wall perforation	5

Distribution of cases with bowel injuries was as per **Table – 4**.

Among the 32 patients with bowel injuries, 12 cases showed perforation and thus had hemo-pneumoperitoneum.

8 cases of mesenteric hematomas were noted, with 2 cases showing additional features of sub-acute intestinal obstruction, suggesting vascular injury.

Total of 6 cases showed vascular injury, with 4 among them being injury to splenic hilum (in patients with shattered spleen) and 2 cases of mesenteric hematoma.

Lateral abdominal wall hematoma and dehiscence with bowel herniation was seen in 1 patient.

One case of liver injury also showed contusions in lower lobe of right lung.

Posterior urethral injuries associated with perineal hematoma and pelvic bony injuries were seen in 4 cases. 2 cases of extraperitoneal urinary bladder rupture were seen. These cases were confirmed by performing CT guided retrograde urethrography (CT-RGU) and cystograms, which showed active extravasation of the given contrast into the perineum or peri cystic space.

The sensitivity of CT to detect intra-abdominal injuries was 96%, specificity of 98%.

Discussion

CT has become the imaging modality of choice for the evaluation of a patient with blunt injury abdomen. Its various advantages include better visualization of the injury and its grade within an organ, quantification of hemoperitoneum, better evaluation of retroperitoneum and its organs (pancreas, kidneys, adrenals and great vessels), evaluation of mesentery and hollow viscera.

BAT continues to be the leading cause of morbidity and mortality in the world. The most common cause of BAT being road traffic accidents in our study, and correlates with a study done by Maria Daniela, et al.[4] and Visrutaratna, et al. [5], who also reported motor vehicle accidents as the most common cause with 79% and 75% respectively.

Males appear to be more commonly injured as compared to females as observed in studies done by Maria Daniela, et al. [4], Mazen Hamidi, et al. [6]. The age group in the present study ranged

from 16 years to 75 years, and the maximum number of patients injured were in the 4th and 5th decade. Maria Daniela, et al. [4] reported the majority of cases in their 3rd decade.

The correlation between the quantification of hemoperitoneum on CT and management of the patient was well correlated in our study, with most of the patients with moderate and large quantities undergoing laparotomy, and only 3 patients despite being normal on CT had to be operated based on their vitals status. This is in agreement with study done by Mazen Hamidi, et al. [6] and Taylor, et al. [7].

The most common injured organ was spleen, followed by liver according to studies done by Jansen JO, et al. [8]; Isenhour JL, et al.[9]; Cahir JG [10] and Visrutaratna P [5].

Urinary tract injuries contribute to 3-10% of total Intra- abdominal injuries, kidney being the most common as per Kawashima A, et al. [11]. The majority of (80%–90%) of cases with urinary tract injuries are secondary to blunt abdominal trauma, and most significant renal trauma is associated with injury to other major organs. however, almost 95%–98% of isolated renal injuries are considered minor injuries and can be managed conservatively because they usually heal spontaneously without complications. Lee YJ, et al. [12] recommended selective use of 5-minute delayed CT of the abdomen and pelvis to rule out leakage of contrast enhanced urine if renal pedicle injury is found. In the current study eight cases with renal injury were detected representing 16% of all cases, and as recommended by Lee YJ, et al. [12], delayed scan (after 5- minutes) was done for three cases with suspected collecting system involvement, two of them showed urinary contrast extravasation.

In our study a total of 8 cases with mesenteric injuries could be accurately diagnosed. But according to Peitzman, et al. [1] and Nolan B, et al. [13]; CT is notoriously inadequate for the diagnosis of mesenteric injuries and may also miss hollow visceral injuries. In patients at risk for mesenteric or hollow visceral injury, DPL is generally felt to be a more appropriate test.

The present study showed 4 cases of pancreatic injury, all of them in patients with car accidents, with seat belt or steering wheel injuries. 3 among them showed grade 2 injuries and a single case of grade 4 injury was noted. All the 4 cases were associated with other abdominal organ injuries, especially renal injuries. This agrees with Gupta A, et al. [14] and Linsenmaier U, et al. [15] who stated that pancreatic injuries are rare, occurring in around 2% of blunt trauma patients but may be associated with high morbidity and mortality. Pancreatic injuries are rarely isolated, and organ injuries most commonly associated.

Jürgen K. Willmann, et al. [16] noted that active hemorrhage in patients after blunt abdominal trauma is most frequently visible as a jet of extravasated contrast agent on MDCT. When extravasation is detected, immediate surgical or angiographic therapy is required. In our study 6% of cases were detected having injury associated with active bleeding.

Conclusion

The present study confirms that imaging with MDCT helps in rapid diagnosis of patients with blunt abdominal trauma. It also helps in determining the prognosis of the patient and in aiding the attending doctor in deciding the management of the patient. CT has the advantage of better visualization of retroperitoneum and its organs, posterior urethra and urinary bladder. Extending the field of view (FOV) to include the chest can help in diagnosing associated lung contusions or alveolar hemorrhages. Special CT procedures like retrograde urethrography or cystogram can help in diagnosis of urethral or urinary bladder injuries.

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