Studying The Role Of Computed Tomography In Selective Management Of Blunt Abdominal Trauma Patients In A Single Tertiary Care Centre In Northern India

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Citation

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Abstract

Background: Trauma is the leading cause of death in persons under 45 years of age with nearly 10% of these fatalities attributable to abdominal injuries. Our study was entailed to evaluate the usefulness of computed tomography in detection of intra-abdominal injury in stable patients with blunt abdominal trauma and to provide information that could accurately determine the choice of management (operative versus non-operative), thereby reducing negative laparotomy rates.
Materials and methods: Over a period of two years from June 2010 to July 2012 this prospective study included 100 patients of all ages and sex with blunt abdominal trauma who were hemodynamically stable. All patients handled conservatively were followed throughout their stay in hospital, and, when required, underwent a follow-up CT scan. The imaging diagnosis was compared with the necessity of laparotomy.
Results: The mean age of patients was 28.35 years (range 4-70). Males were found more vulnerable to abdominal trauma (72%) with a male-to-female ratio of 2.6:1. The most common cause of abdominal injury was road traffic accident (59%) followed by fall from height (26%). Out of 100 patients, 83 patients had an intra-abdominal injury. Fifty six patients out of these 83 were managed non-operatively and 27 patients were operated (including one with negative laparotomy). The spleen was the most common solid organ injured (39.7%). Out of 33 injured splenic patients, 19 were managed non-operatively and 14 were operated. The liver was the second most common organ injured (27.7 %). Out of 100 patients, 17 had normal CECT scan and their stay in hospital for observation was uneventful. Fifty-six patients (majority) were managed conservatively after CECT had picked up an injury and only 27 were operated.
Conclusion: Computed tomography can gauge the extent of internal injury, grade it and this information can be used to select patients and manage them non-operatively, thus reducing non-therapeutic laparotomies to a great extent.

INTRODUCTION

Trauma is the leading cause of death in persons under 45 years of age with 10% of these fatalities attributable to abdominal injuries [1]. Indian statistics reveal a disproportionate involvement of the younger age group (15-25) [1]. The incidence is on rise for the last decade because of an increase in working population, number of vehicles on roads and rapid industrialization.
The Indian fatality rates for trauma are 20 times higher as compared to developed countries [2]. About 30% of such deaths are preventable [1]. Two important advances in past decade have been the development of emergency medical services and widespread use of CT to examine trauma patients [3,4].
In hemodynamically stable patients the diagnostic modality of choice is CT scan [5]. It is non-invasive, easy to perform and has been shown as highly sensitive, specific and accurate. The use of CT has helped to decrease the total number of negative non-therapeutic laparotomies performed [6]. The isolated finding of free fluid in CT does not warrant laparotomy if no solid organ injury is present [7].
CT is the modality of choice in the hemodynamically stable patients with non-penetrating trauma for evaluation of intra-abdominal injury or hematuria [7]. The current study was performed in SMHS Hospital, a tertiary care hospital of northern India, over a period of two years from June 2010 to July 2012, on 100 hemodynamically stable patients with suspicion of grievous intra-abdominal injury, who presented to the emergency department .The objective of this prospective clinical study was to evaluate the usefulness of computed tomography in detection of intra-abdominal injury in stable patients with blunt abdominal trauma so as to

determine the choice of management (operative versus non-operative), thereby reducing negative laparotomy rates.

PATIENTS AND METHODS

The study group included patients of all ages and sex with blunt abdominal trauma who were hemodynamically stable. Indications for admission were either the detection of a significant abdominal injury requiring treatment or a suspicion of such an injury and need for further investigation or follow-up. Suspicions were raised by the injury mechanism and energy; by clinical findings such as pain expressed spontaneously or elicited by palpation (tenderness), signs of peritoneal irritation, significant bruising, laceration or hematoma of abdominal wall, by laboratory findings such as drop in hemoglobin, or when the initial assessment of patient was considered unreliable. After preliminary ultrasonography examination as a baseline investigation, patients selected fit for abdominal CT were scanned. Decision for CT was taken in the Emergency Department, depending on hemodynamic stability of the patient, with objective criteria to assess the individual organ injury in addition to detecting free intra-peritoneal fluid.
The inclusion criteria in hemodynamically stable trauma patients were:

1. Clinical suspicion of intra-abdominal injury.
2. Multi-trauma patients.
3. A positive ultrasonography study.

Hemodynamically unstable patients and those with signs of peritonitis were excluded from the study.

Scanning Protocol

The initial CT extended from the diaphragm to the symphysis pubis, with a pitch of 1.0, 5-10 mm collimation, reconstructed at 5-8 mm intervals, and was repeated after bolus intravenous non-ionic contrast medium administration. Adults were given a total of 100-150 ml of 60% iodinated solution, while in children 2-3ml/kg of 60% contrast material was used. Axial scans with 1-cm cuts were obtained from the diaphragm to the femoral heads after intravenous infusion of contrast medium after a delay of 70 seconds.

The studies were interpreted at the time when the scans were performed by the radiology resident and his technical staff. The presence of clinically important injuries was verified by laparotomy if patients became hemodynamically unstable during their stay in hospital. All patients who were handled conservatively were followed throughout their stay in hospital, and when required also underwent a follow-up CT scan. The imaging diagnosis was compared with the necessity for laparotomy. Early or delayed laparotomy was considered necessary in the following situations:

1. when the signs of profound peritoneal irritation appeared
2. when active intraperitoneal bleeding or significant quantities of intraperitoneal fluid were seen
3. when free air was seen either intraperitoneally or retroperitoneally
4. when rupture of a hollow viscus was documented
5. when severe parenchymal injury was seen or
6. when the patient deteriorated with time.

However, the decision to operate was influenced but did not rely solely on CT findings.

OBSERVATIONS AND RESULTS

The study was conducted on 100 hemodynamically stable patients. The age of patients (table 1) ranged from 4 to 70 years. The maximum of the patients was in the age group of 20-30 years. Mean age was 28.35 ± 11.7 years.

Table 1

Age distribution of patients sustaining blunt abdominal trauma

Age Group	*No. of Trauma Patients*	*Percentage*
0-10	6	6%
10-20	12	12%
20-30	45	45%
30-40	21	21%
40-50	8	8%
50-60	5	5%
60-70	3	3%
$Mean \pm S.D. = 28.35 \pm 11.767$		

There were 72 males and 28 females in our study with a male to female ratio of 2.6:1.
Road traffic collision was the most common cause of blunt abdominal trauma followed by fall from height (59% and 26%, respectively). Assaults were responsible for 8% of cases. Other injuries included hits by animals and inadvertent injuries while operating machines. Chest injuries (rib fractures) were the most common injuries associated with blunt abdominal trauma patients. These were seen in 10% of cases. Abdominal pain was the most predominant symptom in patients presenting with blunt abdominal trauma (77%). Vomiting was present in only 13% cases.
The spleen was the most common organ injured (33 patients), followed by liver (23) and kidneys (15%). Bowel and mesenteric injury was seen in 5 patients. Adrenal

haematoma was picked up by CECT in one patient. The remaining organ injuries are shown in the table 2.

Table 2

Organ injuries in trauma patients picked on CECT examination who were managed non-operatively or underwent operative management

Category	*No. of Trauma Patients Managed Conservatively*	*No. of Patients Operated*
Spleen	19	14
Liver	17	6
Kidney	14	1
Gut	0	4
Bladder	2	1
Mesentery	0	1
Retroperitoneal	2	0
Pancreatic	1	0
Adrenal	1	0
Total	56	27

Out of 33 splenic injuries picked up by CECT, the majority, i.e. 19, were managed non-operatively. Seventeen out of 23 liver injuries were treated conservatively (73%). Only one renal injury was operated and all the gut or mesenteric injuries were operated.

CECT findings were corroborated by operative findings, except in one patient. The maximum number of patients (n=47) was having a grade of injury < IV and were managed non-operatively. All the 100 patients underwent abdominal CECT. Seventeen patients had a normal abdominal CECT and their stay in hospital was uneventful. In 83 patients CECT showed intraabdominal injury. Among these 83 patients, only one patient was false positive (table 3). The patient was interpreted as having a splenic injury on CECT but an actively bleeding mesenteric tear was found on laparotomy. Thus CECT wrongly interpreted the patient as a splenic injury, though laparotomy was indicated.

Table 3

Sensitivity and specificity of abdominal CECT in trauma patients

Screening Test	*No. of Trauma Patients*	*No. of Trauma Patients*
CECT Positive	82 (True Positive)	1 (False Positive)
CECT Negative	0 (False Negative)	17 (True Negative)
Sensitivity and Specificity		
Variable	*Value*	*95% Confidence Interval*
Sensitivity	100%	(0.9561, 1.0000)
Specificity	94.44%	(0.7270, 0.9986)
Positive Predictive Value	98.80%	(0.9347, 0.9997)
Negative Predictive Value	100%	(0.9347, 1.0000)

Abdominal USG showed injury in 66 patients, but 83 patients had a true intra-abdominal injury as detected by abdominal CECT (table 4).

Table 4

Sensitivity and specificity of USG in blunt abdominal trauma patients

USG Findings	*No. of Trauma Patients*	*No. of Trauma Patients*
USG Positive	66 (TP)	0 (FP)
USG Negative	17 (FN)	17 (TN)
Sensitivity and Specificity		
Variable	*Value*	*95% Confidence Interval*
Sensitivity	79.52%	(0.6924, 0.8760)
Specificity	100%	(0.8051, 1.0000)
Positive Predictive Value	100%	(0.9457, 1.0000)
Negative Predictive Value	50%	(0.3246, 0.6754)

The significance between CECT and USG in detection of intra-abdominal injury in our series is shown in table 5. A P-value of 0.0094 was observed, so the test was significant.

Table 5

Comparison of USG with CECT in blunt abdominal trauma patients

Category	*Trauma Patients with Negative Findings*	*Trauma Patients with Positive Findings*
CECT	17	83
USG	34	66
	$P-value = 0.0094$	$d.f. = 1$
$Chi-square = 6.738$		

Twenty seven patients in our series were taken for surgery. CECT findings were corroborated by operative findings, except in one patient, in whom the laparotomy finding was different from the CECT finding.

DISCUSSION

The mean age of patients was 28.3 years (range 4-70). It was observed that no age group is exempted from traumatic injury of abdomen, but that it is more common in the second to third decade of life (with the age group of 20-40 years constituting 45% patients). This indicates that young adults are more prone to abdominal trauma probably because of more exposure to day to day hazards. A similar incidence was reported by Mohapatra et al. [8] in their 24-month study, which observed that three quarters of blunt trauma victims are in the first four decades of their lives, with the majority belonging to the age group of 21-30 years. It is also evident from this study that males are more vulnerable to abdominal trauma (72%) with a male to female ratio of 2.6:1. There was also male preponderance in the study by Grosfeld [9] et al. The most common cause of abdominal injury was road traffic accident (59%) followed by fall from height (26%). Emery et al. [10] reported that 51% had road traffic accident and 18% fall from height in their study.

Abdominal pain was the most common symptom observed in blunt abdominal trauma patients (77%). Abdominal tenderness was the most common sign observed (72%). In their study of 63 cases of blunt abdominal trauma, Gupta et al. [11] reported pain and vomiting as commonly presenting symptoms. The most common injuries associated with blunt abdominal trauma were chest injuries (rib fractures), in10% patients. Decreased hematocrit was seen in 24% of patients of blunt abdominal trauma. Radiography, as plain x-ray of abdomen and chest, was helpful in a small percentage of cases (16%) with some element of ambiguity to rule out an abdominal injury. FAST (Focused Abdominal Sonography in Trauma) was done in all the 100 patients and was able to pick up injury in only 66 patients. The sensitivity of ultrasonography was 79.52% and the specificity was 100%. The positive predictive value was 100%. The results were concordant with the studies performed by Rozycki et al. [12]. In their study on 1540 patients in whom FAST was done, sensitivity of USG was found to be 83.3% and specificity 99.7%.

CECT was the standard criterion, performed in all our patients. It was able to pick up injury correctly in 82%. It had a sensitivity of 100%, a specificity of 94.44% and a positive predictive value of 98.80. Out of 100 patients, 82 patients had an intra-abdominal injury. One patient was detected as positive on CECT, but had a negative laparotomy finding. Fifty-six patients out of these 83 were managed non-operatively and 27 patients were operated (including the one with a negative laparotomy).

The spleen was the solid organ most commonly injured. Out of these 33 patients, 19 were managed non-operatively and 14 were operated. The liver was the second most common organ injured (23 patients).

The majority of liver trauma patients were managed non-operatively. Morrison's pouch was the most common site of intraperitoneal fluid accumulation in liver trauma patients. Renal injuries were seen in 15 patients, out of which 14 could be managed conservatively. A scoring system devised according to the organ injury scale was applied to individual injuries and proved to be very useful in management.

Most of the organ injuries had a grade <3 and were managed non-operatively. Urinary bladder injuries were seen in 3 patients. CT could accurately diagnose 5 cases of bowel and mesenteric injury; all of them were operated. Two patients had retroperitoneal, one pancreatic and one adrenal injury and all these four were managed non-operatively. Out of 100 patients, 17 had negative CECT scan and their stay in hospital for observation was uneventful. They were discharged and no complication was seen. Fifty-six patients in whom CECT had picked up an injury were managed conservatively and only 27 were operated. Thus the majority of patients could be managed non-operatively. CECT based grading was a useful predictor for non-operative management. No complication was seen in patients on non-operative management.

Our study correlated well with that conducted by Peitzman et al. [13] who studied 120 patients in whom CT was accurate in 98.3% of patients and 86% of laparotomies were therapeutic .Wing et al. [14] also reported that CT is 96.8% sensitive and 97.6% accurate in reducing the number of negative laparotomies performed.

We therefore conclude that computed tomography can gauge the extent of internal injury and grade it, and this information can be used to select patients and manage them non-operatively, thus reducing non-therapeutic laparotomies to a great extent.

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