Turkish Journal of Emergency Medicine 15 (2015) 116–121

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Turkish Journal of Emergency Medicine

journal homepage: http://www.elsevier.com/locate/TJEM

Retrospective analysis of whole-body multislice computed tomography findings taken in trauma patients

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ARTICLE INFO

Article history:
Received 25 September 2014
Received in revised form
10 December 2014
Accepted 26 December 2014
Available online 30 December 2015

Keywords:
Emergency
Trauma
Whole-body multislice computed tomography

ABSTRACT

Objectives: Using whole-body multislice computed tomography (MSCT) excessively or with irrelevant indications can be seen in many centers. The aim of this study was to analyze retrospectively the MSCT findings in trauma patients admitted to the emergency department.

Methods: Records of the patients who have applied to the emergency department due to blunt trauma in a 12 month period and whose whole body MSCT images have been taken, were evaluated using the "Nucleus Medical Information System".

Results: The most frequent type of trauma was traffic accidents in 61.4%, falling down from the height in 22.4%, and motorcycle accidents in 11.4% of patients. Of the patients, 25.2% were discharged from the emergency, while 73.8% were hospitalized. At least one CT findings associated with trauma was present in 61.4% of our patients. Pathological findings in MSCT were most frequently detected in the head and face (35.3%) and thoracic (28.6%) regions, respectively. The most common finding in the head and face region was fractures. The most common pathological findings in the thoracic region were pulmonary contusion and rib fractures. A significant relationship was detected between trauma type and spinal MSCT result ($p < 0.001$). In a large percentage of the patients, MSCT findings were normal in the abdominal region and genitourinary system. Vertebral fractures were most frequently detected in the thoracolumbar region.

Conclusions: In our study, our rate of negative CT was found to be 38.6%, which is a higher ratio compared to other studies conducte on this topic.

1. Introduction

Today, trauma is one of the basic health problems in every country irrespective of socioeconomic development. It is the third leading cause of death among all age groups and the most common cause of death in healthy persons aged 1–44 years worldwide.[1] Thus, management, diagnosis and treatment of trauma victims is of great importance.

There are evidences that clinical findings may be either suspicious or misleading in 20–50% of blunt multitrauma cases.[2,3] Therefore, rapid and reliable imaging modalities are needed. The use of computed tomography (CT) has recently gained importance in the early phase of trauma management. Advances in MSCT technology have made a significant impact in diagnosis of the patients.[4,5] Whole body CT is regarded as an accessible, useful, and rapid tool in the management of trauma patients. In primary emergency, other traumatic injuries that can easily be overlooked should also be controlled.[5–7]

MSCT is a useful technique for evaluation of brain, lung, liver, kidney, spleen, and retroperitoneum and has a high sensitivity, specificity, and accuracy for detection of pathologies in these organs.[8] CT images of intra-abdominal injuries may direct clinicians to conservative management and prevent unnecessary laparotomic procedures. MSCT is of great importance in management of cases of vertebral trauma. It is possible to show fractures missed by plain

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Peer review under responsibility of The Emergency Medicine Association of Turkey.

http://dx.doi.org/10.1016/j.tjem.2015.11.004

films.[9,10] On the other hand, MSCT has some disadvantages including high cost, requirement of considerable time for evaluation, and the risks of radiation. Moreover, there are some unclear points concerning the appropriate patient groups (lack of evidence-based information etc.) and indications (high-energy trauma victims, hemodynamic stability, and clinical indications) for MSCT. Hence, MSCT is overused or misused in many centers.[7,11]

The aim of this study was to retrospectively examine the whole body MSCT in trauma patients presenting to emergency department. We aimed to determine the rate of ordering whole body MSCT and detection of pathologic findings; we also attempted to determine which body regions had injuries detected on MSCT.

2. Materials and method

2.1. Study design

Our study was a retrospective descriptive study that screened data of patients who presented to Mersin University (MEU) Health Research and Application Center, Emergency Department with blunt trauma and who underwent MSCT between 1 June 2012 and 31 May 2013.

The medical records of 294 patients who applied to emergency department and underwent whole body MSCT for trauma for a period of 12 months were obtained and analyzed using the "Nucleus Medical Information System". Eighty-four patients were excluded owing to missing medical data or inadequate image quality. A total of 210 patients equal to or above the age of 18 were included in the final analysis.

Our study was approved by MEU Medical Faculty, Ethics Committee Chairmanship on 10/04/2014 with the approval No 2014/80. The first-time emergency applications were taken into consideration during a 12-month period. The reported MSCT findings, medical data (age, sex, time of emergency department application, trauma mode/mechanism (traffic accident, fall from a height, motorcycle accident etc.), the interventions applied at the emergency department (surgical or conservative), final diagnoses and the patient outcome (hospital admission, discharge etc.) were recorded. While recording MSCT findings human body was grouped into 6 regions: 1) head and face, 2) thorax (ribs, clavicle, and scapula included), 3) abdomen, 4) genitourinary system and retroperitoneum, 5) vertebrae, 6) pelvis.

2.2. Imaging protocol

All blunt trauma victims underwent a MSCT that included whole body from the uppermost tip of head to the lower edge of pelvis. The CT imaging was performed with the 64-slice CT device (Aquilion Toshiba Japan). The imaging protocol included the axial images of head, facial bones, cervical vertebrae, thorax, abdomen, and pelvis. Thoracic, abdominal, and pelvic CT imaging were performed with a contrast material whereas cerebral and cervical CT imaging were carried out without contrast use. Contrast material was injected by an automatic CT injector (Ulrich Missouri CT injection system). A non-ionic contrast material at a dose of 100 ml for an average patient weighing 80 kg was administered via a forearm vein at an infusion rate of 2.5 ml/s. Following the bolus injection of the contrast material the imaging was initiated after waiting for 45–50 s for thorax and 70–75 s for abdominopelvic region. Nonionic contrast materials, Ultravist (Iopromide) 300 mg/ml and Xenetix (Iobitridole) were used for contrast studies. Oral contrast was not administered in any patient. The images were analyzed in bone, soft tissue, and lung windows; vertebrae and other bones were evaluated in coronal and sagittal planes. A late phase imaging was performed when an abnormal finding was spotted in genitourinary system during abdominopelvic imaging. All MSCTs were reported by radiologists. The radiology reports were retrospectively recorded on the Picture Archiving and Communication System (PACS) connected to the Nucleus Medical Information System.

2.3. Statistical analysis

In the statistical evaluation of the data to be obtained from the studies, the categorical variables were expressed in frequency and percentage. They were analyzed using the cross table statistical methods, namely the Chi-Square and Likelihood Ratio tests. When more than 2 categories were present, paired ratio comparisons were performed for the significant relationships. A p value less than 0.05 was considered statistically significant.

3. Results

During the study period a total of 50.707 patients applied to the emergency department (excluding repeated applications). A total of 3878 patients underwent CT for various indications (including non-traumatic indications). The blunt trauma victims totaled 639 and 294 (46%) of them underwent whole body MSCT.

The analysis of the demographic variables of the study population revealed that among 210 patients 161 were male and 49 were female. The age range was 19–79 years and the mean age was 38.4 ± 15.4 years. Of all patients, 39.5% (n = 83) applied to the emergency department between 18:00–23:59 and 32.4% (n = 68) between 12:00–17:59. Trauma mechanisms included traffic accident in 61.4% (n = 129), fall from a height in 22.4% (n = 47), and motorcycle accident in 11.4% (n = 24). The interventions were surgical in 41% (n = 86) and conservative in 59% (n = 124). An analysis of the short-term outcome of the patients revealed that 25.2% (n = 53) were discharged. Among those who were admitted to hospital, 58.1% (n = 122) were admitted to regular ward and 15.7% (n = 33) to intensive care unit. Two (1%) patients died at the emergency department (Table 1). Of 210 patients whose MSCT images were analyzed, 129 (61.4%) had at least one finding related to trauma, 81 (38.6%) had no relevant findings. Among 129 patients diagnosed to have a pathological finding on MSCT, the most common pathologies were located to head region at a rate of 35.3%

Table 1
Basic datas of trauma patients scanned with MSCT.

Datas	Number (n)	(%)
Sex		
Male	161	76.7
Female	49	23.3
Application time		
06:00–11:59	27	12.9
12:00–17:59	68	32.4
18:00–23:59	83	39.5
24:00–06:00	32	15.2
Trauma mechanism		
Traffic accident	129	61.4
Falls from height	47	22.4
Assault	5	2.4
Motorcycle accident	24	11.4
Diğer	5	2.4
Type of intervention		
Surgery	86	41.0
Conservative	124	59.0
Result		
Discharge	53	25.2
Hospitalization (service)	122	58.1
Admission (ICU)	33	15.7
Death	2	1

(n = 74). It was followed by thoracic region (28.6%, n = 60). The genitourinary system was the region with the least number of abnormal findings (2.3%, n = 3) (Fig. 1).

While 64.7% (n = 136) of the patients had no pathology in head & face region, 35.3% (n = 74) had an abnormal finding in the same region. The most common pathological MSCT finding in head & face region was fracture. Fractures were detected in face bones (26%) and calvarium/base of skull (20.1%). The most common intracranial MSCT finding was SAH (11.7%). No thoracic pathology was detected in 71.4% of the patients (n = 150) whereas 28.6% (n = 60) had an abnormal finding. The most common thoracic abnormal findings were pulmonary contusion (27.6%) and rib fracture (20%). No abdominal pathology was present in 92.3% (n = 194) patients while 7.7% (n = 16) had an abnormal finding. The most common abdominal pathologies were hemoperitoneum (23.1%), liver contusion (23.1%), and splenic hematoma (15.4%). Among all patient group, 98.5% (n = 207) had no genitourinary pathology while 1.5% (n = 3) had an abnormal finding in that region. The most common genitourinary pathology was renal contusion with a rate of 50%. No pelvic pathology existed in 92.8% (n = 195) patients while an abnormal finding was detected in 7.2% (n = 15) patients. The most common pelvic pathology was fracture (83.3%). No vertebral pathology was detected in 84.7% (n = 178) of the patient population whereas 15.3% (n = 32) had an abnormal finding. The most common vertebral pathology was fracture. The fractures were located to thoracic vertebrae in 30.6%, lumbar vertebrae in 30.6%, and cervical vertebrae in 27.8% (Table 2).

The analysis of the relationship between MSCT and time of emergency department presentation revealed that there was a significant relationship between vertebra and pelvic tomography results only. While the number of the patients with normal vertebral findings was significantly higher in the emergency department presentations between 18:00–23:59 ($p < 0.001$), the number of patients with abnormal findings in pelvis was significantly higher in the presentations between 12:00–17:59 ($p = 0.037$) (Table 3). The mode of trauma was significantly related only to vertebral MSCT findings. Fall from a height was significantly more common in those having an abnormal vertebral tomography result ($p < 0.001$) (Table 4).

Thirty-four patients (16.2%) were more abnormal findings in two different body regions when multidetector CT results analyzed (Table 5). Fourteen patients (7%) had multiple abnormal findings in three compartments. In two patients (1%) head, thorax and abdomen, 1 patient (0.5%) in the head, thorax and vertebrae, 8 patients (4%) in the head, thorax and vertebrae, 1 patient (0.5%)in the head, abdomen and genitourinary, 1 patient (0.5%) in the

Table 2
Abnormal findings according to the region in the trauma patients undergoing whole body MSCT.

MSCT findings	n*	%	Total (n)
Head/Face			74
Epidural hemorrhage	6	3.9	
Subdural hemorrhage	10	6.5	
SAK	18	11.7	
Contusion	12	7.8	
Cerebral edema	17	11	
Calvaria Fraktur	31	20.1	
Fraktur facial bones	40	26	
Pneumocephalus	10	6.5	
Subgaleal hematoma	10	6.5	
Thorax			105
Hemothorax	14	13.3	
Rib fractures	21	20	
Pneumothorax	17	16.2	
Pulmonary contusion	29	27.6	
Clavicle fracture	11	10.5	
Scapular fracture	7	6.7	
Pneumomediastinum	3	2.9	
Aortic rupture	1	1	
Other	2	1.9	
Abdomen			26
Hemoperitoneum	6	23.1	
Splenic hematoma	4	15.4	
Splenic laceration	3	1.5	
Liver heamatoma	1	3.8	
İntestinal perforation	1	3.8	
Pneumoperitoneum	1	3.8	
Aortic rupture	1	3.8	
Liver laceration	6	23.1	
Other	3	11.5	
Genitourinary			6
Kidney laceration	1	16.7	
Retroperitoneal hematoma	1	16.7	
Reanal infarction	1	16.7	
Renal contusion	3	50	
Pelvis			18
Fracture	15	83.3	
Dislocation	1	5.5	
Other	2	11.2	
Spine			36
Cervical fracture	10	27.8	
Cervical dislocation	1	2.8	
Thoracic fraktür	11	30.6	
Lomber fracture	11	30.6	
Sacrum fracture	3	8.3	

*Because of the multiple symptoms in a person stands out more than the total number of patients total number of findings.
n (%)*= number of findings (% of findings).

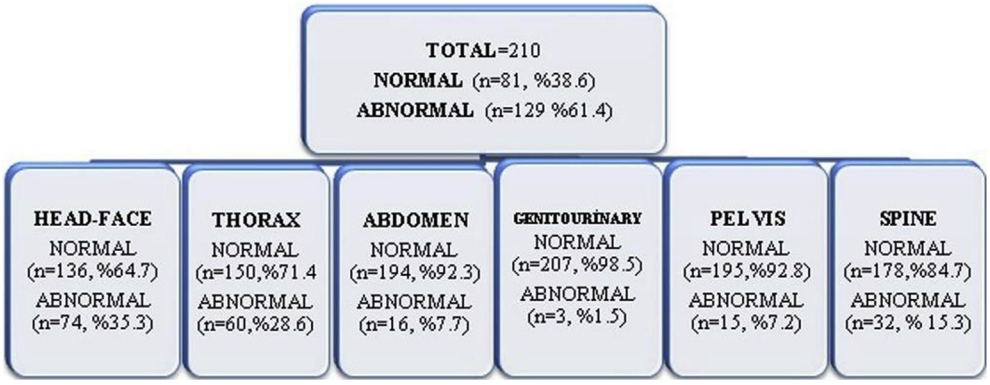

Fig. 1. Distribution of the body of the MDCT findings.

Table 3
The relationship between emergency application time with MSCT findings.

Findings		06:00–11:59 n (%)	12:00–17:59 n (%)	18:00–23:59 n (%)	24:00–06:00 n (%)	Total n (%)	P
Head	Normal	14 (10.3)	47 (34.6)	56 (41.2)	19 (14)	136 (100)	0.360
	Abnormal	13 (17.6)	21 (28.4)	27 (36.5)	13 (17.6)	74 (100)	
	Total	27 (12.9)	68 (32.4)	83 (39.5)	32 (15.2)	210 (100)	
Thorax	Normal	15 (10)	52 (34.7)	58 (38.7)	25 (16.7)	150 (100)	0.173
	Abnormal	12 (20)	16 (26.7)	25 (41.7)	7 (11.7)	60 (100)	
	Total	27 (12.9)	68 (32.4)	83 (39.5)	32 (15.2)	210 (100)	
Abdomen	Normal	24 (12.4)	63 (32.5)	77 (39.7)	30 (15.5)	194 (100)	0.912
	Abnormal	3 (18.8)	5 (31.3)	6 (37.5)	2 (12.5)	16 (100)	
	Total	27 (12.9)	68 (32.4)	83 (39.5)	32 (15.2)	210 (100)	
Genitourinary	Normal	27 (13)	68 (32.9)	81 (39.1)	31 (15)	207 (100)	0.296
	Abnormal	0 (0)	0 (0)	2 (66.7)	1 (33.3)	3 (100)	
	Total	27 (12.9)	68 (32.4)	83 (39.5)	32 (15.2)	210 (100)	
Pelvis	Normal	24 (12.3)	59 (30.3)	81 (41.5)	31 (15.9)	195 (100)	0.037
	Abnormal	3 (20)	9 (60)	2 (13.3)	1 (6.7)	15 (100)	
	Total	27 (12.9)	68 (32.4)	83 (39.5)	32 (15.2)	210 (100)	
Vertebra	Normal	18 (10.1)	56 (31.5)	80 (44.9)	24 (13.5)	178 (100)	<0.001
	Abnormal	9 (28.1)	12 (37.5)	3 (9.4)	8 (25)	32 (100)	
	Total	27 (12.9)	68 (32.4)	83 (39.5)	32 (15.2)	210 (100)	

Table 4
The relationship between trauma mechanism with MSCT findings.

Findings		Traffic accident n (%)	Falls from height n (%)	Assault n (%)	Motorcycle accident n (%)	Other n (%)	Total n (%)	p
Head	Normal	77 (56.6)	35 (25.7)	5 (3.7)	16 (11.8)	3 (2.2)	136 (100)	0.095
	Abnormal	52 ((70.3)	12 (16.2)	0 (0)	8 (10.8)	2 (2.7)	74 (100)	
	Total	129 (61.4)	47 (22.4)	5 (2.4)	24 (11.4)	5 (2.4)	210 (100)	
Thorax	Normal	90 (60)	32 (21.3)	5 (3.3)	20 (13.3)	3 (2)	150 (100)	0.203
	Abnormal	39 (65)	15 (25)	0 (0)	4 (6.7)	2 (3.3)	60 (100)	
	Total	129 (61.4)	47 (22.4)	5 (2.4)	24 (11.4)	5 (2.4)	210 (100)	
Abdomen	Normal	120 (61.9)	42 (21.6)	4 (2.1)	23 (11.9)	5 (2.6)	194 (100)	0.613
	Abnormal	9 (56.3)	5 (31.3)	1 (6.3)	1 (6.3)	0 (0)	16 (100)	
	Total	129 (61.4)	47 (22.4)	5 (2.4)	24 (11.4)	5 (2.4)	210 (100)	
Genitourinary	Normal	128 (61.8)	45 (21.7)	5 (2.4)	24 (11.6)	5 (2.4)	207 (100)	0.526
	Abnormal	1 (33.3)	2 (66.7)	0 (0)	0 (0)	0 (0)	3 (100)	
	Total	129 (61.4)	47 (22.4)	5 (2.4)	24 (11.4)	5 (2.4)	210 (100)	
Pelvis	Normal	118 (60.5)	44 (22.6)	5 (2.6)	23 (11.8)	5 (2.6)	195 (100)	0.690
	Abnormal	11 (73.3)	3 (20)	0 (0)	1 (6.7)	0 (0)	15 (100)	
	Total	129 (61.4)	47 (22.4)	5 (2.4)	24 (11.4)	5 (2.4)	210 (100)	
Vertebrae	Normal	114 (64)	32 (18)	5 (2.8)	24 (13.5)	3 (1.7)	178 (100)	<0.001
	Abnormal	15 (46.9)	15 (46.9)	0 (0)	0 (0)	2 (6.3)	32 (100)	
	Total	129 (61.4)	47 (22.4)	5 (2.4)	24 (11.4)	5 (2.4)	210 (100)	

Table 5
The distribution of patients with abnormal findings at the same time the two parts of the body.

	Head	Thorax	Pelvis	Total
Thorax	18 (%8.6)	0	0	18 (%8.6)
Abdomen	3 (%1.4)	3 (%1.4)	0	6 (%2.8)
Genitoürinary	0	1 (% 0.5)	0	1 (%0.5)
Pelvis	2 (%1)	0	0	2 (%1)
Vertebrae	2 (%1)	3 (%1.4)	0	7 (%3.3)
Total	25 (%12)	7 (%3.2)	2 (%1)	34 (% 16.2)

*Because of the multiple symptoms in a person stands out more than the total number of patients total number of findings.
n (%)*= number of findings (% of findings).

thorax, abdomen, and pelvis,1 patient (0.5%) in the thorax, abdomen and vertebrae were detected as abnormal findings.

4. Discussion

MSCT has become the first preferred imaging modality in trauma patients owing to its applicability, rapidity, and high sensitivity.[6,12,13] Its main disadvantage is a high level of radiation exposure, making the use whole body MSCT debated in trauma patients.[13,14] Therefore, it should be aimed to minimize the effects of radiation and delays in treatment. It should also be a primary aim to use MSCT in appropriate patients and for appropriate indications. A retrospective study used whole body CT in 32% of 4621 patients who suffered major trauma (injury severity score 16).[15] In a study by Wurmb et al. whole body MSCT was used in 70% of 126 patients suffering blunt multitrauma.[11] We obtained whole body MSCT in 46% of 639 patients presenting to emergency department after trauma. Although our overall MSCT acquisition rate was similar to that reported in the literature, our study was a retrospective study that included not only high-energy multitrauma patients, but all blunt trauma victims, and this was a serious limitation of our study. In our study, 76.7% of the MSCT-scanned patients were male and 23.3% were female and their mean age was 38.4 ± 15.4 years. These figures were in agreement with the literature data and appear to be related to a higher trauma rate in male gender. In a study employing MSCT the age range was reported 20–55 years and the mean age was 34.6 years.[6] A domestic study reported a mean age of 35.3 ± 15.04 years and 954 (75.4%) patients were male and 313 (24.6%) were female.[16] The trauma etiology plays an important role in the assessment of multitrauma patients. Ahvenjärvi et al reported that the most common trauma etiologies were traffic accidents (82.5%), fall from a height (7.5%), and motorcycle accidents (2.5%).[2,6] A study from Turkey revealed that the most common trauma etiologies were in-vehicle traffic

accident (34.6%, n = 445) and out-of-vehicle traffic accidents (21.23%, n = 269) (Durdu et al., 2014). In a number of domestic studies Pekdemir et al.[17] reported a trauma rate of 8.5% and Akoğlu et al.[18] 3%. In compliance with the literature, 61.4% of our patients were brought to emergency department after a traffic accident. Furthermore, the great majority of patients applied to the emergency department between 12:00–23:59. This may be related to traffic density during the day hours. In our study, however, the rate of falls from a height was higher than previously reported (22.4%). This may be related to a higher percentage of people working in construction sector in Turkey.

The time to stabilization and definitive treatment was 47 min in whole body MSCT trauma protocol, while it goes up to 82 min in conventional CT protocol.[19] In addition, the duration of hospital stay is reportedly shorter in MSCT protocols.[19,20] Hutter et al. reported a mortality rate of 23.3% in MSCT protocol and 9.7% in conventional CT protocol.[20] In a study by Gupta et al. 1812 of 2804 imaging procedures were considered necessary by both emergency physicians and trauma surgeons and a critical pathology was detected in 123 (7%) imaging procedures. They concluded that CT had an important role for treatment planning, mortality, and morbidity in multitrauma patients.[21] In our study 25.2% of patients undergoing MSCT were discharged from the emergency department and 73.8% were hospitalized. Two (1%) patients died. In addition, forty-one percent of patients underwent surgery, 59% underwent conservative treatment.

Ahvenjärvi et al. reported in two separate studies that MSCT had a positivity rate of 62–74% in high-energy blunt trauma patients.[2,6] Sampson et al. reported a negativity rate of 13.8%. Among the patients having a positive scan, 43% had cerebral injury, 40% had pneumothorax and mediastinal, 24% had cervical and thoracolumbar injury, 22% had pelvic injury, and 23% had abdominal injury.[12] In our study 61.4% of patients undergoing MSCT had at least one finding related to trauma whereas 38.6% had no trauma-related finding. An abnormal head & face, thoracic, abdominal, genitourinary, pelvic, and vertebral finding was present in 35.3%, 28.6%, 7.7%, 1.5%, 7.2%, and 15.3% of patients, respectively. Despite these figures, even a slight delay in detection of injuries in any of these compartments/regions is of utmost significance due to the vital importance of the anatomical structures in each of them. Nevertheless, we recommend clinicians to be more selective and decide MSCT according to certain clinical rules in trauma patients.

Ahvenjärvi reported fractures (19%), contusion (14%), and intracranial hemorrhage (11%) as the most common MSCT findings in head & face region.[6] Sampson et al. reported that among 296 multitrauma patients the most common head & face findings were skull fractures and intracranial injuries (43%).[12] The most common MSCT findings in the head & face region were fractures in our study. The most common intracranial findings were SAH at a rate of 11.7%. It was observed in our study that CT was extremely sensitive in blunt thoracic injuries and more valuable than plain film in diagnosis of pneumothorax, lung contusion, and hemothorax. Some studies have recommended the use of thoracic CT during initial assessment in multitraumas and suspected chest injuries.[5,11] Previous studies have reported that the most common thoracic MSCT findings were pulmonary contusion, pneumothorax, and rib fracture.[12,22] In our study, on the other hand, the most common MSCT findings were pulmonary contusion and rib fracture. CT offers a non-invasive imaging opportunity in abdominal trauma. It also provides quite accurate results in solid organ, bowel, and mesenteric injuries. Furthermore, it offers a potential for conservative treatment of hepatic and splenic injuries.[2,12,22] Hassan et al. detected a positive finding in 126 (83.4%) of 151 patients undergoing MSCT for blunt abdominal trauma.[23] Many studies have detected MSCT findings most commonly in liver and spleen.[12,22] We, on the other hand, observed most commonly hemoperitoneum, liver and splenic injuries. The vital abdominal injuries detected on MSCT were surgically intervened.

Since MSCT has a specificity close to 100% in pelvic injuries, it is recommended in multitrauma patients.[24] Kessel et al. found that pelvic film did not alter the treatment protocol in multitrauma patients whereas abdominopelvic CT detected a pelvic fracture in 3.3% of the patients.[25] Tesval et al., in a multitrauma population, found that nearly 10% of all trauma patients had genitourinary injury of which 3% were renal injury.[26] In addition, CT imaging is also used for detecting other accompanying injuries. Renal contusion was the most common MSCT finding in genitourinary region.

According to the results of a study, plain films had a sensitivity of 52–87% while CT had a sensitivity of 98–99% in detecting spinal injuries.[27,28] The rate of a secondary fracture is high among patients having a high-energy blunt trauma and cervical fracture. A retrospective study using the data of the National Trauma Database of the United States, which was conducted on 80,000 blunt trauma victims having spinal fracture, found that 13% of patients with cervical spinal fracture had a secondary thoracic or lumbar fracture.[27,29] In our study the most common pathological MSCT finding in vertebral region was fractures. They were detected, in descending order, in thoracic, lumbar, and cervical vertebrae. Previous studies have suggested that CT images taken for thoracic and abdominal injuries were adequate for spinal fracture assessment. A retrospective study in 3537 blunt trauma patients, 99.3% of 236 (7%) patients with cervical, thoracic or lumbar fracture were diagnosed by CT images.[10] The cost effectivity analysis between CT and plain films revealed that although CT had a higher initial cost, the latter was balanced due to lack of need for repeating CT imaging. In addition, the number malpractice trials are reduced as a result of a lowered number of cases that were missed. All these factors collectively make CT more cost-effective.[28,30]

Our study was a retrospective study incorporating all blunt trauma patients. This represents an important limitation of our study. The retrospective studies inherently prevented us from accessing detailed clinical information in some patients.

This study may be a first step toward establishing an algorithm for the use of CT to reduce unnecessary tests and utilize resources more rationally. The negative CT rate was 38.6% in our study and that figure was higher than previously reported figures. The expertise and experience of emergency physician, intensity of emergency department, and malpractice concerns may alter the decision processes of physicians ordering MSCT in trauma patients. Although the use of whole body CT scanning may be suitable for high-energy trauma patients, it should not be randomly ordered since it has potential complications such as contrast toxicity, renal injury, and the risk of cancer in the long term. As the existing evidence is insufficient, clinical decision rules should be established via large-scale prospective studies to avoid excessive and in appropriate use of MSCT in blunt trauma patients.

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