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Original Research Paper

Radiodiagnosis

MULTIDETECTOR COMPUTED TOMOGRAPHY IN EVALUATION OF CHEST TRAUMA

Dr. Sakina Hasanji Kaydawala — 3rd Year Resident, Department of Radiodiagnosis, V.S General Hospital, Ahmedabad.

Dr. Chhaya J Bhatt* — Professor, Department of Radiodiagnosis, V.S General Hospital, Ahmedabad. *Corresponding Author

Dr. Falguni R Parakh — 3rd Year Resident, Department of Radiodiagnosis, V.S General Hospital, Ahmedabad.

ABSTRACT

Chest trauma is a significant cause of mortality. It may be blunt or penetrating.

Multidetector computed tomography (MDCT) is the best modality available to evaluate trauma. Herein, we aimed to present MDCT findings in patients chest trauma admitted to our department.

Methods A total of 150 patients admitted to the emergency department of our hospital between March 2018 and July 2018 with a diagnosis of chest trauma who underwent MDCT evaluations were included in the study.

Results Most of the patients injured were males (83.3%) in a younger age group with road traffic accidents being the most common cause. Rib fractures were the most common injury with a prevelance of 60%. Pulmonary contusions were the most common lung parenchymal injury found in 56.6%

Fractures of the bony thorax and pulmonary contusion was higher in the blunt trauma group, whereas the prevalence of hemothorax, was in h penetrating trauma than in blunt trauma.

Conclusion MDCT images yields a high degree of sensitivity and specificity in detecting chest injuries.

KEYWORDS : multidetector computed tomography, blunt trauma, penetrating trauma.

INTRODUCTION

Thoracic injuries are the third most common cause of trauma related morbidity and mortality, following head and extremity injury{1}. Radiological imaging plays an important role in the diagnosis and management of chest trauma. Multidetector computed tomography (MDCT) has now become one of the best modalities to evaluate patients with thoracic injury.{2} With the advent of multiplanar and volumetric reformatted CT images, the evaluation of even minor injuries has become more accurate. Another advantage of MDCT is its fast acquisition time. The scanners which are available now take only a few minutes to scan the entire chest which saves valuable time in emergency situations so that the patient management becomes prompt. Communication between the radiologist and the referring clinician has improved leading to better patient management and improved clinical outcomes of the patient{3}.

Portable chest radiography is the first-line imaging method used for the emergency evaluation of a polytrauma patient. The primary goals of chest radiography is to look for life threatening conditions such as a tension pnuemothorax as well as to confirm proper tube placements in the chest or mediastinum. However, MDCT has been proven to demonstrate significant lesions even if the initial radiography was normal {4,5}. Literature shows that blunt chest trauma causes about 25% trauma related deaths{6} Most blunt traumas are secondary to motor vehicle crashes (63%–78%), and the remaining are caused by falls from heights (10%–17%). { 7,8,9,10,11,12}

Herein, we aimed to present the MDCT findings in patients with blunt and penetrating chest trauma admitted to our department.

MATERIALS AND METHODS:

Retrospective study of 150 patients admitted to the emergency department of our hospital was carried out , between March 2018 and July 2018, with a diagnosis of chest trauma who underwent an MDCT evaluation. Patient demographics, including age, gender, and type of injury, were obtained from the hospital's medical records.

The scans were performed with a 16 MDCT Philips brilliance scanner and a 64 MDCT seimens somatom scanner. The CT scans were obtained with end-inspiration state, as far as possible, in a supine position. Chest CT scans were performed from the thoracic inlet to the upper abdomen. The parameters of the scans for the seimens scanner were as follows: 0.75 mm-collimation; pitch, 1.4; reference effective tube current time product of 100 mAs with automatic tube current modulation (ATCM); tube voltage of 100 kV (BMI<25) or 120 kV (BMI≥25).

The parameters of the scan for the Philips machine 0.75 mm-collimation; pitch, 1.063; reference effective tube current time product of 150 mAs with automatic tube current modulation (ATCM); tube voltage of 100 kV (BMI<25) or 120 kV (BMI≥25).

Coronal and sagittal multi planar reformatted images were reconstructed with 3-mm slice thickness without gap. All CT scans were reconstructed using a soft filter kernel.

All images were obtained from the picture archiving and communication system (PACS) and evaluated at the work station.

This study does not include contrast enhanced CT scans.

RESULTS :

The results obtained from the study are as follows:

TABLE 1
The causes of chest injury

	Causes	Number of patients (%)
Blunt injury (*n*=99, 66%)	Road Traffic accidents	71 (47.3)
	Medicolegal cases	14 (9.3)
	Falls	8 (5.3)
	Occupational injuries	5 (3.3)
Penetrating injury (*n*=51, 34%)	Stab wounds	33 (22)
	Gunshot wounds	11 (7.4)
	Foreign body	8 (5.4)

TABLE 2: Gender distribution:

Gender	Number	Percentage
Males	128	85.3%
Females	22	14.7%

Different types of injury in chest trauma:

TABLE 3: Lung parenchymal injury

Lung parenchymal injury	Number	Percentage
Pulmonary contusions	85	56.6%
Pulmonary lacerations	31	20.6%
Lung herniation	3	2%

Out of the 85 patients with pulmonary contusions, 40 patients had right sided, 35 pateints had left sided contusions and 10 had on both sides.

TABLE 4: Plueral injury:

	Number	Percentage
Haemothorax	93	62%
Pneumothorax	77	51.3%
Hydropnuemothorax	67	45.2%

TABLE 5 :Mediastinal injury:

Structure	Number	Percentage
Tracheal injury	0	0
Bronchial injury	1	0.6%
Hemopericardium	1	0.6%
Pnuemomediastinum	34	22.7%
Diaphragm	3	2%
Vessel injury	0	0

TABLE 6: Bony thorax and other chest wall injury :

Structure	Number	Percentage
Rib fracture	90	60%
Scapular fracture	11	7.3%
Sternal fracture	7	4.8%
Thoracic vertebral fracture	32	21%
Clavicle fracture	10	6.6%
Subcutaneous emphysema	95	63.3%
Chest wall haematoma	90	60%

Out of the 90 (60%) patients with rib fractures, 54 (60%) had right-sided rib fractures and 36 (40%) had left-sided rib fractures and 7% had bilateral rib fractures on MDCT images.

TABLE 7: Abdominal organ injury:

Organ	Number	Percentage
Liver	12	8%
Spleen	10	6.6%

TABLE 8: Comparison of MDCT findings in blunt and penetrating trauma groups

Trauma findings	Blunt trauma (n=99)	Penetrating trauma (n=51)
Rib fracture (%)	48.4	17.3
Scapular fracture (%)	12.2	7.7
Clavicle fracture (%)	9.6	0
Thoracic vertebral fracture (%)	21	0
Sternal fracture (%)	4.8	0
Hemothorax (%)	30.9	48.1
Pneumothorax (%)	61.7	63.5
Pneumomediastinum (%)	9.0	11.5
Subcutaneous emphysema (%)	20.7	88.5
Pulmonary contusion (%)	62.2	32.7
Pulmonary laceration (%)	19.1	21.2
Bronchial lacerations (%)	1.1	3.8
Other vascular lacerations (%)	0.5	5.8
Diaphragmatic injury (%)	0.5	17.3
Abdominal organ laceration (%)	31.9	32.7

Rib fracture, clavicle fracture, thoracic vertebral fracture, and pulmonary contusion were reported to be higher in the blunt trauma group than in the penetrating trauma group. However, rates of hemothorax, subcutaneous emphysema, diaphragmatic injury, and other vascular lacerations were significantly higher in the penetrating trauma group than in the blunt trauma group. (table8).

DISCUSSION:

In our study of 150 patients, we found that vehicular accidents was the commenst cause of blunt traumas (66%),similar to previous studies [1–5]. In chest trauma, associated extrathoracic injuries complicate the presentation and management of the patients, resulting in increased mortality and hospital stay. The ratio of associated injuries was similar to the literature in this study (35%).

Rib fractures:

Rib fracture was the most common injury, found in 60% of chest trauma patients. The figure was slightly higher to what has been reported in the literature of 30-50%{1-5}.

Fractures of the first three ribs may be associated with injury of the brachial plexus or subclavian vessels. Fractures of the fourth up to the eighth ribs are the most common, while fractures of the last four ribs are usually associated with intra-abdominal injury.

Scapular fractures:

Scapular fracture is reported in the literature to be rare, occurring in only 3.7-7.9% of the patients {1-4}. Our study confirms this finding with the number of chest trauma patients with scapular fracture being 7.3%.{1–5} The ratio of patients with scapular fractures in the blunt and penetrating groups was 12.2% and 7.7%, respectively.

Sternal fractures:

Sternal fractures have been reported in 3%–8% of blunt chest trauma cases.(1–4). The main mechanism is deceleration injury or a direct blow to the anterior chest wall. It is difficult to detect sternal fractures on chest radiographs and even on axial CT images. However, sagittal and coronal MDCT reformats are significantly superior in detecting sternal fractures. No case of sternal fracture was detected in our penetrating chest trauma group. [16].

Thoracolumbar vertebral fractures:

Our study reported 21% thoracolumbar vertebral fractures in the blunt trauma group, consistent with the literature. This number was reported to be 27.9% in a study by Turkalj et al {13} that included 62 patients.

Sagittal and coronal reformatted images, have benefitted the evaluation of sternal and vertebral fractures ,which were difficult to evaluate on axial scans alone. Volume-rendered images were very useful in evaluating cases with multiple rib fractures.

Subcutaneous emphysema:

A 15%–34% prevalence of subcutaneous emphysema in the blunt trauma group has been reported in the literature{.12,13} This was similar to that observed in our blunt trauma group that had a subcutaneous emphysema prevalence of 20.7%, while in the penetrating trauma group, the prevalence was 88.5%.

Lung parenchymal injuries:

Pulmonary contusion is the most common lung injury in patients with blunt chest trauma, with a prevalence of 17%–70%, and is seen more commonly than pulmonary laceration.{5,10} The prevalence of pulmonary contusion was 62.2% in the blunt trauma group, which is significantly higher than the penetrating group (32.7%). Pulmonary laceration was detected in similar frequencies in both groups.

Herniation of the lung parenchyma is an uncommon occurrence in chest trauma, and it can occur through a congenital or a traumatic chest wall defect such as multiple rib fractures or sternoclavicular or costochondral dislocations. It was seen in 2% of the cases in our study.

Hemothorax and pneumothorax:

Hemothorax is a common finding and may be present in up to half of

the cases.{9} In our study, it was higher in the penetrating trauma group with a ratio of 48.1%. Trauma-related pneumothorax has been reported in a wide range of patients (15%–50%) and mostly caused by rib fractures leading to lacerations.{1,5,13} It was detected with similar rates of 62% and 63% in blunt and penetrating trauma groups, respectively, in our study. Hydropneumothorax was reported in 45% in our study.

Pnuemomediastinum:

The prevalence of pneumomediastinum in blunt trauma is 10% in the literature,{9} which is similar to the value of 9.6% reported in our cohort.

Diaphragmatic injury:

Diaphragmatic injury occurs in 0.16% to 5% of blunt trauma cases {1}. It is three times more common on the left side than on the right side, and the main mechanism is thought to be the sudden increase in intra-abdominal-thoracic pressure against a fixed diaphragm. The most common site of rupture is at the posterolateral surface, at the site of embryonic diaphragmatic fusion. In our study, the number of patients with injury to the diaphragm was reported to be 2% , more in the penetrating trauma group than in the blunt trauma group. All the three cases have been reported to have a left sided diaphragmatic injury.

Tracheobronchial injury:

Tracheobronchial injuries are rarely seen in clinical practice because of high prehospital mortality. They have been reported in 0.2%–8% of patients with blunt chest trauma.{1,5, 13-15}. We reported just one case of right main stem bronchial injury in a 9 year old male patient with blunt trauma to his chest with a complete transection of the right main stem bronchus.

Oesophageal injury:

Esophageal injury is extremely rare, because the esophagus is well protected in the mediastinum. Most esophageal injuries occur from penetrating chest traumas with a prevalence of 1%–1.6%.{1,13}. We did not detect any cases of esophageal injury in our study.

Mediastinal vessels injury:

Vessel injury when suspectec should be complimented by a contrast study. Plain HRCT thorax was performed in all patients in our study. None of the patients in our study underwent a contrast study.

Cardiac injury:

A case of hemopericardium was reported in our study .The patient was found to have a right atrial and right ventricular rupture on surgery. Cardiac injuries are the most lethal in chest trauma patients. They are more common in penetrating trauma. They may range from a small focal contusion to a frank rupture of the heart, which is rare (<2%), affecting mainly the right atrium [17].

CONCLUSION :

MDCT plays a crucial role in detection of all stages of injuries on all types of chest trauma. It is the best available modality in today's scenario to evaluate the degree of chest trauma, helping in prompt management of the patients thereby reducing the associated mortality and morbidity of the patients.

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