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EVALUATION OF PENETRATING TRAUMA TO THORAX USING MULTI-DETECTOR COMPUTED TOMOGRAPHY: A PROSPECTIVE STUDY IN 30 PATIENTS

Radiology

Manik Mahajan* Lecturer, Department of Radio-Diagnosis & Imaging, Government Medical College, Jammu *Corresponding Author

Poonam Sharma Consultant Pathologist, Atulaya Healthcare, Jammu

ABSTRACT

Introduction: Emergency practitioners and radiologists routinely encounter patients with penetrating thoracic trauma. Multi-Detector computed tomography is an accurate means of evaluating patients with penetrating trauma. MDCT is also accurate in identifying diaphragmatic rupture and thus predicting the need for operative intervention.

Objectives/Aims: To evaluate usefulness of MDCT in detection of thoracic injury in patients with penetrating trauma and to evaluate CT findings for signs of diaphragmatic rupture.

Materials and Methods: MDCT scans were obtained in 30 hemodynamically stable patients with penetrating injuries to thorax. All patients underwent MDCT of the thorax for any signs of injury. Positive findings included hemothorax, rib fractures, pneumothorax, diaphragmatic injury, lung contusions, lacerations and mediastinal haematoma. Nine patients with positive MDCT finding were operated including six patients with diaphragmatic injury and findings corroborated.

Results: On MDCT, the most common injury was hemothorax (76.7%) followed by contusion (70.0%) and pneumothorax (53.3%). Diaphragmatic injury was seen in 30 % cases. Nine patients were operated upon, including 6 patients with diaphragmatic rupture. All these six patients had evidence of diaphragmatic injury on surgery. Two patients, one each with chest wall injury and thoracic aortic injury died. Sensitivity of MDCT in diagnosing diaphragmatic injuries was 100%.

Conclusions: MDCT is the modality of choice for rapid assessment of emergency chest trauma patients and provides accurate assessment with respect to diaphragmatic injury.

KEYWORDS

Injury, Thoracotomy, Trauma, Diaphragm, Hemothorax

INTRODUCTION

Emergency practitioners and radiologists routinely encounter patients who suffer from penetrating thoracic trauma. Penetrating trauma is increasing because of the growth of violence in our society. Stab wounds are encountered three times more often than gunshot wounds, but have a lower mortality because of their lower velocity and less invasive tract. Thoracic injuries are significant causes of morbidity and mortality in trauma patients. These injuries account for approximately 25% of trauma-related deaths in the United States [1]. Thoracic trauma has an overall fatality rate of 10.1%, which is highest in patients with cardiac or tracheobronchial-esophageal injuries [2]. Imaging plays a significant role in the diagnosis and management of chest injuries. Conventional radiography is the first line imaging modality used in chest trauma. However it has limited sensitivity and specificity. Multi-Detector computed tomography (MDCT) is a highly accurate means of evaluating penetrating thoracic injuries. MDCT may demonstrate significant disease in patients with normal initial radiographs [3] and is shown to change management in up to 20% of chest trauma patients with abnormal initial radiographs [4]. It is also valuable in the diagnosis of fractures of the thoracic cage to exclude thoracic aortic injury, which otherwise requires catheter aortographic examinations.

MATERIAL AND METHODS

This prospective study was carried out in a tertiary care centre in north India. Thirty hemodynamically stable patients presenting with penetrating thoracic trauma to thorax were included in the study. Patients presenting with blunt trauma, hemodynamically unstable patients and patients with iodine allergy were excluded from the study. All patients were subjected to plain radiographs of the chest. MDCT examination was carried out using SOMATOM plus 4 volume zoom machine. First plain scan was done followed by intravenous administration of 100 ml of non ionic Iodinated contrast media at the rate of 3ml/sec. Diluted gastroscan was used as oral contrast agent whenever suspicion of oesophageal injury was there. Multiplanar reconstruction was done in Sagittal and Coronal planes. Images were read in lung parenchyma, soft tissues and bone windows and reviewed by tow radiologists.

OBSERVATIONS

30 hemodynamically stable cases of penetrating trauma to thorax were included in the study. Before radiological evaluation, a detailed history regarding mode of injury and duration since trauma was taken. MDCT was done in all cases and radiological diagnosis was compared with operative findings wherever possible.

Maximum cases were found in the age group of 21-30 years followed by 31-40 years age group. Majority of cases were males (90.0%, 27/30). Gunshot wounds were the commonest mode of injury in our study (63.3%) followed by stab wounds. Hemothorax was the commonest findings seen in 76.7% (23/30) cases followed by lung contusion (70%, 21/30). Pneumothorax was seen in 53.3 % cases (16/30), lung laceration in 13.3 % cases (4/30) and rib fractures in 23.3% cases (7/30). Single case of Hemomediastinum was also seen (Table 1). Diaphragmatic injury was seen in 30.0% (9/30) cases, left hemidiaphragm in five and right hemidiaphragm in four cases. The discontinuous diaphragm sign was the commonest sign and was observed in 77.8% (7 of 9). Collar sign (Figure 1) was also seen in 5 cases. In the case of hemomediastinum, findings of mediastinal hematoma, active leak of contrast, pericardial effusion and tear in the arch of aorta were seen on MDCT (Figure 2). Operative intervention was performed in 12 patients, including 6 patients with diaphragmatic rupture. All six patients had evidence of diaphragmatic injury on thoracotomy. Two patients, one each with chest wall injury and thoracic aortic injury died. Sensitivity of MDCT in diagnosing diaphragmatic injuries was 100%.

DISCUSSION

Trauma is the third commonest cause of death after malignancy and vascular disease. Trauma is the leading cause of death in the first four decades of life and is potentially the leading cause of loss of life years [5]. Penetrating injuries account for a large percentage of visits to emergency departments and trauma centres worldwide. Continuous advances in technology have made CT an indispensible tool in the evaluation of patients with penetrating thoracic injury. MDCT may depict the trajectory of a penetrating injury and help determine what type of intervention is necessary.

Maximum cases were found in the age group of 21-30 years with male to female ratio of 9:1. The males are more commonly involved than females because of the political rivalry, business conflicts and family disputes. The commonest mode of penetrating injury in our study was gunshot (63.3%) similar to study by Lomoschitz et al [6] who observed gunshot wounds in 66% cases.

Most frequent CT findings were hemothorax (76.7%) and lung contusions (70%). Pneumothorax was seen in 53.3% cases while rib fractures were seen in 23.3% cases (Table 1). De Melo ASA et al [7] also observed hemothorax and pneumothorax in 77.5% and 55% cases in their study. However they observed lung contusions as the most

common finding in their study (98.5%) patients.

Diaphragmatic injury was seen in 30.0 % (9/30) cases. Left hemidiaphragm was involved in five cases and right hemidiaphragm in four cases. Bodanapally MK et al [8] also concluded that left sided injuries are more common than right sided injuries. This phenomenon has been attributed to the protective effect of the liver on the right and to weakness of the left hemidiaphragm at points of embryonic fusion. Out of 9 patients in whom CT findings were suggestive of diaphragmatic injury, six were operated and findings were confirmed in all the patients. So in our study, MDCT had 100 % sensitivity, specificity and positive predictive in diaphragmatic injury. Similarly in the study by Shanmuganathan K et al [9], out of 6 patients with diaphragmatic injury reported on MDCT, 5 cases had evidence of diaphragmatic injury on thoracosocpy or laparotomy.

Bodanapally MK et al [8] described various CT signs of diaphragmatic injury:

Direct sign:

1. Direct discontinuity of diaphragm.

Indirect signs:

1) Collar sign
2) Intrathoracic herniation of viscera
3) Dependent viscera sign
4) Contiguous injury on either side of the diaphragm

In our study discontinuous diaphragm sign was the most common sign and was observed in 77.8 % (7 of 9) cases. Panda A et al [10] also concluded that discontinuous diaphragm sign was the most common sign in penetrating diaphragmatic injury.

Single case of aortic injury was seen in whom MDCT showed mediastinal hematoma, active leak of contrast, pericardial effusion and tear in the arch of aorta (Figure 2). On thoracotomy, two rents were present on aortic arch one on the convex aspect at the origin of innominate artery and other on concave aspect of aortic arch. Patient died after six hours of thoracotomy. Mirvis SE et al [11] concluded that CT of the chest is 100% sensitive and 99.7% specific for mediastinal hemorrhage. In our study, imaging support for clinical judgment helped surgeon avoid thoracotomy in 3 cases of diaphragmatic injury which were managed conservatively.

CONCLUSIONS:

Penetrating chest trauma can be life-threatening due to presence of vital structures in the thoracic cavity. Though management of trauma patients has not changed significantly over the years, imaging modalities like MDCT have allowed accurate diagnosis of the life threatening injuries. Findings in MDCT have a positive effect on the management of many patients with penetrating thoracic trauma and are an answer for the patients with non-diagnostic Ultrasound and X-rays.

Conflicts of Interest: Nil
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TABLES:

Table 1: MDCT Findings of chest injury (n=30)

MDCT finding	Number of patients	Percentage
Hemothorax	23	76.7
Contusion	21	70
Pneumothorax	16	53.3
Rib fractures	7	23.3
Diaphragmatic injury	9	30.5
Laceration	4	13.3
Hemomediastinum	1	3.3

Figure Legends:

Figure 1: Diaphragmatic injury due to gunshot
(A) Scout image showing herniation of stomach into left hemithorax (black arrow) with contralateral displacement of the mediastinum. (B) Axial CT showing stomach lying on left posterior ribs (black arrow) depicting "dependent viscera sign". (C) Sagittal and (D) coronal reconstruction images respectively showing focal discontinuity in left hemidiaphragm and a constriction at the level of entry into thoracic cavity "the collar sign" (white arrow in 'C').

Figure 2: Aortic injury due to gunshot
(A) Axial contrast enhanced CT scan of thorax showing a large mediastinal hematoma with active contrast leak from the arch of aorta (black arrow). (B) Rent is seen on the convex aspect of arch of aorta (black arrow).

Figures:

Figure 1:

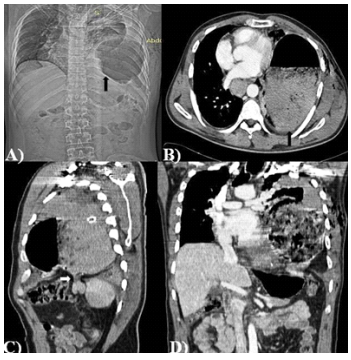

Figure 2:

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