ORIGINAL ARTICLE

Evaluation of Blunt Chest Trauma with Multidetector Computed Tomography

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ABSTRACT

Background: Chest trauma is a major cause of morbidity and mortality worldwide. It can be either in the form of blunt trauma or penetrating injury. Proper and prompt imaging with multidetector computed tomography (CT) can help evaluate the diversity of imaging findings associated with the blunt thoracic injury. **Methods:** A tertiary level hospital-based retrospective cross-sectional study was done. A total of 129 patients with thoracic trauma who underwent CT were evaluated using different window settings and algorithms. Data were entered in a predesigned pro forma, and analysis was performed using IBM SPSS version 20. **Results:** The most common age group with blunt thoracic injury was 20–40 years of age. Male patients were 3 times more commonly involved than female patients. Imaging findings showed pleural, parenchymal, mediastinal, tracheobronchial, diaphragmatic, and mediastinal vascular injuries. Overall, the most common finding associated with blunt thoracic trauma was rib fracture. Pulmonary contusion was the most common parenchymal finding and hemothorax was the most common pleural finding associated with the blunt thoracic trauma. Mediastinal vascular injuries, diaphragmatic injuries, and tracheobronchial injuries were relatively rare. **Conclusion:** Blunt trauma to the chest leads to significant mortality and morbidity worldwide. The imaging modality of choice for patients with chest trauma is multidetector CT due to its wide availability, rapid access, and use of standardized protocols. Multidetector CT can help in evaluating various forms of chest injuries and can guide in the proper management of the patients.

Key words: Blunt chest trauma, hemothorax, pneumothorax, pulmonary contusion, pulmonary laceration

INTRODUCTION

Chest trauma is a major cause of morbidity and mortality worldwide. It can be either in the form of blunt trauma or penetrating injury. Blunt chest trauma is the third most common injury in polytrauma patients with only head injury and extremity injury surpassing it.[1] It is directly responsible for approximately 25% of all trauma-related deaths.[2] Blunt trauma to the chest can occur due to road traffic accidents, fall from heights, or following blows from blunt objects and explosive devices.[3] Multidetector computed tomography (CT) is the imaging modality of choice for the evaluation of chest trauma patients as it is easily available, fast and provides multiplanar reformatted and volume-rendered images. In this study, we have attempted to assess the myriad of imaging findings in patients with blunt trauma to the chest with the help of multidetector CT.

METHODS

Our study was a tertiary level hospital-based retrospective cross-sectional study. It was carried out at Grande International Hospital, Kathmandu, Nepal, in 2020 by retrieving the records and collecting the data retrospectively. Ethical approval was taken from the Institutional Review Board. All trauma patients undergoing CT for the evaluation of the blunt chest injuries or multisystem injuries between January 2016 and January 2020, that is, a total of 129 patients were included in the

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study. Non-contrast CT imaging of the chest was done on a multidetector CT scanner. CT angiography was done in patients with clinical suspicion of mediastinal vessel injury or cardiac injury. Tube voltage of 120 kVp and variable tube current-time product (mAs) based on automatic exposure control was applied. Due to the time constraints, ECG gating was not done in any of the cases. Reconstruction in soft tissue, lung, and bone window was done for every case. Multiplanar reconstructions and volume-rendered images were obtained using the thin section axial acquisition. Data were then entered in a predesigned pro forma and analysis was performed using SPSS.

RESULTS

The age of the patients ranged from 2 years to 78 years of age. The most common cause of blunt trauma to the chest was road traffic accidents (80.6%), followed by fall from heights (12.4%). The most common age group with blunt traumatic injury was 31–40 years of age (41% of the study population), followed by 21–30 years of age (28% of the study population) [Figure 1]. Males were more commonly involved than females (3:1) [Figure 2].

The most common CT finding associated with blunt chest trauma was rib fracture (75.9%) [Table 1]. Among the patients with rib fracture, 72% had one or two ribs fractures and only 28% had more than two ribs fractures. Fourth to eighth ribs were the most commonly involved among all [Figure 3]. The first three ribs fractures were noted only in high-speed collisions in motor vehicle accidents and were usually associated with multisystem injuries. Among the pleural space manifestations, hemothorax was noted to be more common than a pneumothorax. Overall, hemothorax was the second most common manifestation and was noted in 66.6% of the study population. The attenuation value of the hemothorax ranged from +32 HU to +76 HU. Pneumothorax was noted in 51.1% of the cases and was usually associated with a rib fracture. Among the pulmonary findings, pulmonary contusion was the most common of all. It was noted in 61.2% of the study population and presented as ill-defined, patchy, ground-glass areas of heterogeneous opacities or consolidation depending on the severity of involvement [Figure 4]. On the other hand, pulmonary laceration was present in only 20.1% of the study population. About 15.5% of the patients with blunt trauma to the chest had spinal injuries [Figure 5]. The tracheobronchial injury was relatively uncommon and was noted in only 1.5% of the cases. Diaphragmatic injury and mediastinal vascular injury were the least common findings and were present in only 0.7% of the study population each [Table 1].

DISCUSSION

Trauma causes an estimated 10% of deaths worldwide and is the third common cause of death after malignancy and vascular disease.[4] About 20% of trauma-related deaths are caused by blunt thoracic trauma. The most common cause of blunt thoracic trauma is road traffic accidents. Fall from heights, physical assaults, and explosions are other less common causes of blunt thoracic injury. As in other traumas, blunt thoracic trauma is the most common in the young population between 20 and 40 years of age. Males, because of their greater exposure, are more frequently involved in thoracic trauma as compared to females.

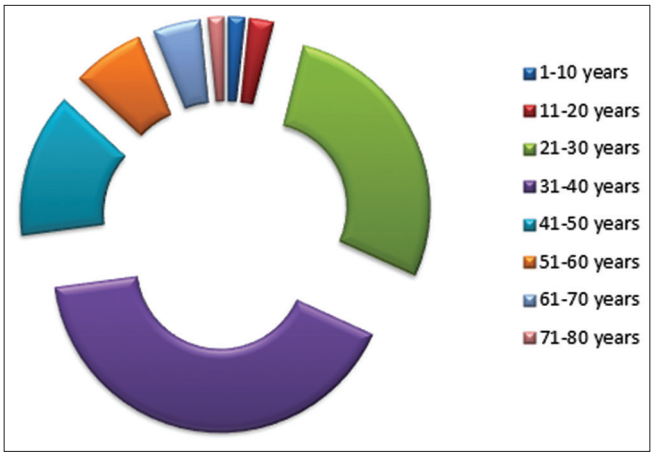

Figure 1: Age distribution of the study population

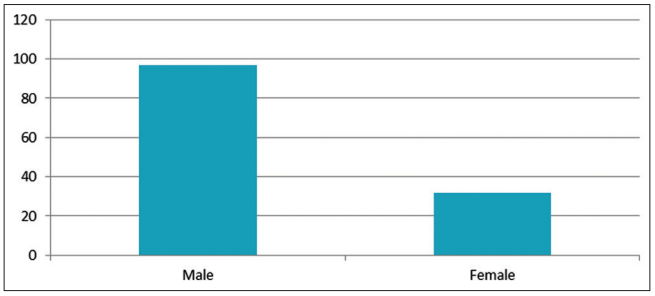

Figure 2: Distribution of study population according to gender

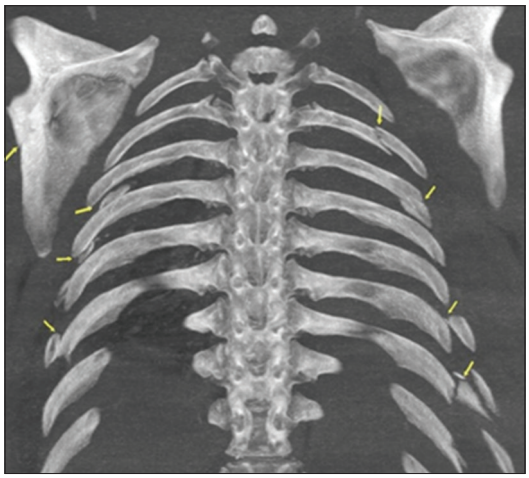

Figure 3: Non-contrast computed tomography chest with reconstructed MIP image demonstrate multiple bilateral ribs fracture (yellow arrows) in a patient following road traffic accident

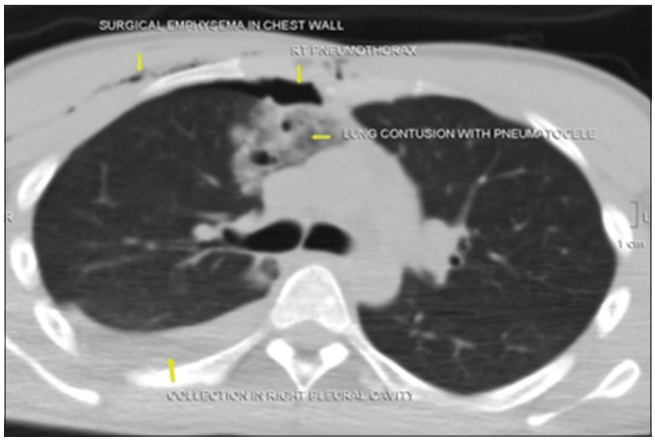

Figure 4: Non-contrast computed tomography chest axial view in a patient with blunt trauma to chest demonstrates pulmonary contusion in the right lung, right hemopneumothorax, and subcutaneous emphysema in the right chest wall

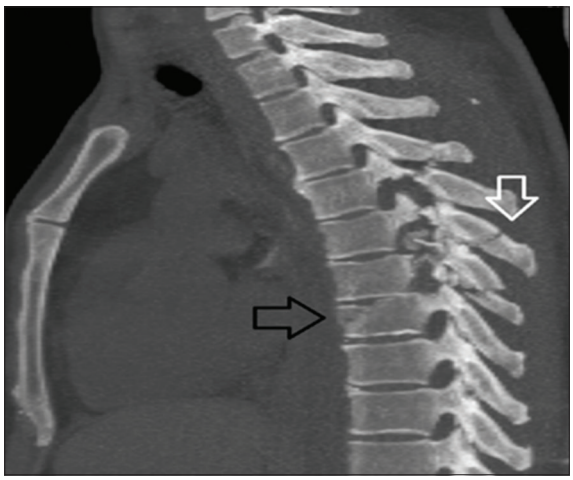

Figure 5: Non-contrast computed tomography chest bone window sagittal view demonstrates thoracic vertebral body fracture (black arrow). Associated posterior elements fracture (white arrow) is also noted

Table 1: CT findings in patients with blunt chest trauma

Findings	Number of patients (%)
Rib fracture	98 (75.9)
Hemothorax	86 (66.6)
Pulmonary contusion	79 (61.2)
Pneumothorax	66 (51.1)
Pulmonary laceration	26 (20.1)
Spinal injury	20 (15.5)
Tracheobronchial injury	2 (1.5)
Diaphragmatic injury	1 (0.7)
Mediastinal vascular injury	1 (0.7)

There are four main mechanisms of injury responsible for chest trauma. These include the direct impact to the chest, rapid acceleration/deceleration injury, thoracic compression, and blast injury. Multidetector CT is the gold standard imaging tool for the evaluation of chest injuries and trauma in general.[5] It is fast, easily available, and allows different algorithmic evaluation for the delineation of the injuries. In cases of patients with suspicion of vascular injuries, CT angiography should be done for the evaluation of the vascular injuries. Proper imaging evaluation can not only detect the injuries but can also prevent the complications associated with them. For example, it is important to look for and detect even minimal pneumothorax in the trauma patient, because, if these patients undergo positive mechanical ventilation or endotracheal tube placement without adequate imaging evaluation, then there is a high chance that the pneumothorax would be significantly increased leading to the increased morbidity, and sometimes mortality, of the patients.

Blunt trauma to the chest can present with a myriad of imaging findings. These findings can be classified as injury of the pleura, the lung parenchyma, the trachea and airways, the aorta, the heart and pericardium, the esophagus, the diaphragm, and the thoracic wall. Injuries to the pleura can present as hemothorax, pneumothorax, or hemopneumothorax. Hemothorax occurs as a result of the blood accumulating into the pleural space from variable sources such as lung parenchymal injury, injury to the great vessels, or injury to adjacent organs as the liver and spleen with associated rupture of the diaphragm. Multidetector CT is a sensitive modality in detecting even small hemothorax in the form of high attenuating fluid collection with fresh bleed showing HU of +30–+45 and clotted blood showing HU of +50–+90.[6] In our study, we found that hemothorax is the most common pleural manifestation in patients with blunt chest trauma. Pneumothorax usually occurs as a result of lung laceration by the broken ribs. Less commonly, it can also occur as a result of disruption of closed airway spaces and secondary to tracheobronchial injuries. Lung contusion is the most common parenchymal injury in chest trauma patients according to our study which is following the results published by the previous studies.[7] It refers to focal parenchymal injury and can occur as ground-glass opacity or consolidation depending on the severity of the impact. Lung laceration refers to traumatic disruption of alveolar spaces with cavity formation and is quite uncommon as compared to the contusions, according to the previous studies. However, with the use of newer imaging techniques as multidetector CT, lacerations have been found to be much more common than what was thought of. About 20.1% of patients in our study had lung lacerations. Among the thoracic chest wall injuries, ribs fracture is the most common, followed by sternal, clavicular, and scapular fracture.[8] Thoracic spine fractures in chest trauma patients usually occur as a result of hyperflexion and axial loading and sagittal and coronal CT reformats can easily detect these fractures. Diaphragmatic injury is relatively rare in blunt

chest trauma and CT can not only detect the discontinuity but can also provide information regarding the herniation of the fat and the visceral organs.[9] Tracheobronchial injuries in blunt trauma are also rare and more commonly involve the bronchi in comparison to the trachea.[3,6] They are more common on the right side. Mediastinal vascular injuries are also uncommon in blunt trauma patients and need angiographic evaluation in suspected patients. Multidetector CT has high sensitivity and specificity in diagnosing aortic trauma.[10] Meticulous evaluation in different window settings needs to be undertaken for the detection of this diversity of imaging findings associated with the blunt trauma to the chest.

CONCLUSION

Blunt trauma to the chest leads to significant mortality and morbidity worldwide. The imaging modality of choice for patients with chest trauma is multidetector CT due to its wide availability, rapid access, and use of standardized protocols. Multidetector CT is efficient in evaluating various forms of chest injuries and can guide in the proper management of the patients. As road traffic accidents are the major cause of chest trauma, careful following of the road traffic rules can significantly decrease the incidence of these injuries.

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