



CASE STUDY

MULTIPLE RADIOLOGIC FINDINGS IN A SIMPLE BLUNT THORACIC TRAUMA

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ABSTRACT

Blunt thoracic trauma is one of the main contributors to trauma-related deaths, with the broad possibility of pathological chest injury. Imaging plays an important role in detecting most internal organ injuries. Here we presented a 56-year-old male with progressive chest pain following blunt chest trauma several days prior without any early intervention. Chest radiograph showed rib fractures, pneumothorax, atelectasis, and raised left hemidiaphragm. Further CT scan evaluation identified additional hemothorax and subcutaneous emphysema, confirming the fourth to tenth rib fractures, pneumothorax, and unilateral hemidiaphragm elevation. As seen in our case, a chest radiograph is crucial in the initial evaluation of chest injury, usually by identifying pathological landmarks. While a chest radiograph is limited to one projection, a CT scan provides a global evaluation of a region with high sensitivity and specificity in detecting and confirming most injuries. Thus, one must not overlook any lightly appeared blunt thoracic trauma while optimizing the use of radiography and CT scan for the evaluation of injuries

Keywords: Blunt Trauma; CT scan; Chest radiograph; Lungs; Thoracic Trauma

АБСТРАКТ

Тупая травма грудной клетки является одной из основных причин смерти, связанной с травмой, с широкой возможностью патологического повреждения грудной клетки. Визуализация играет важную роль в выявлении большинства повреждений внутренних органов. Здесь мы представили 56-летнего мужчину с прогрессирующей болью в груди после тупой травмы грудной клетки за несколько дней до этого без какого-либо раннего вмешательства. Рентгенография грудной клетки выявила переломы ребер, пневмоторакс, ателектаз и приподнятую левую гемидиафрагму. Дальнейшая компьютерная томография выявила дополнительный гемоторакс и подкожную эмфизему, подтвердив переломы четвертого-десятого ребер, пневмоторакс и одностороннее поднятие гемидиафрагмы. Как видно из нашего случая, рентгенограмма грудной клетки имеет решающее значение при первичной оценке травмы грудной клетки, обычно для выявления патологических ориентиров. В то время как рентгенограмма грудной клетки ограничивается одной проекцией, компьютерная томография обеспечивает глобальную оценку области с высокой чувствительностью и специфичностью в выявлении и подтверждении большинства травм. Таким образом, при оптимизации использования рентгенографии и компьютерной томографии для оценки повреждений нельзя упускать из виду легкую тупую травму грудной клетки.

Ключевые слова: Тупая травма; компьютерная томография; рентгенография грудной клетки; легкие; торакальная травма.

INTRODUCTION

Approximately 1.3 million people die yearly because of road traffic accidents, with more than half being vulnerable road users such as pedestrians, cyclists, and motorcyclists.¹ Victims of road traffic accidents usually suffer multi-trauma, with thoracic trauma involved in 50% of the cases. Furthermore, thoracic trauma is responsible for the second cause of death in isolated trauma and the third cause of death in multi-trauma.²

Mechanisms of thoracic trauma can be divided into blunt and penetrating trauma. Penetrating trauma is rare and usually limited to the thoracic. On the other hand, blunt chest trauma accounts for around 25% of all trauma-related deaths.³ Because most blunt thoracic trauma injuries are externally inapparent, imaging plays a crucial role in detecting injuries and formulating critical management.⁴

Chest radiology is the first-line workup for rapid triage and initial evaluation, usually done with anteroposterior (AP) projection due to the patient being confined to bed and for ease of acquisition.⁵ For secondary evaluation, Computed Tomography (CT) scan is the diagnostic choice for accurately delineating injury severity and detecting additional findings that might change the management of the patient.⁶ This study reported a patient suffering blunt chest trauma without looking for early medical intervention, later found with multiple injuries.

CASE PRESENTATION

A 56-year-old male was admitted to the emergency department with progressive left chest pain. Three days ago, he had a traffic accident, fell from his motorcycle, and hit his chest. He did not look for help straight after the injury due to the absence of any apparent external wound. The intensity of the symptoms increased daily and was exacerbated if he raised his left arm. He also

felt an increasing shortness of breath since then. He felt no other significant symptoms.

His upright chest radiograph (**Figure 1**) showed radiolucent peripheral space in the left apicolateral, indicating pneumothorax. There was also homogenous consolidation in the left basal area of the lung and raised left hemidiaphragm. We also identified rib fractures from the fourth rib through the lower ribs. His right lung showed no signs of abnormality.

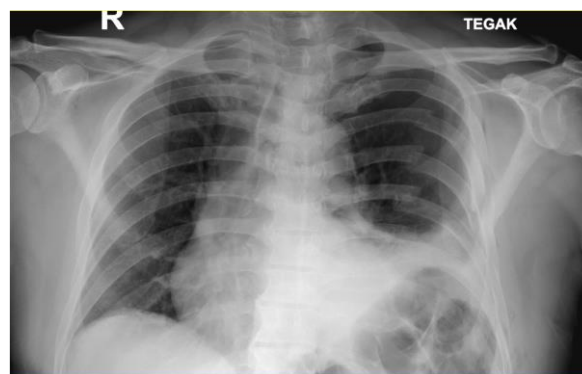


Figure 1. The posteroanterior chest radiograph showed left apicolateral pneumothorax.

Further thoracoabdominal CT scan examination with iodine contrast was conducted, confirming the presence of left pneumothorax, left hemothorax with a Hounsfield Unit (HU) value of 33, left basal atelectasis, subcutaneous emphysema in the left lateral soft tissue, and multiple fractures of ribs from the fourth to tenth ribs. The tenth rib fracture was so close to the left hemidiaphragm, suggesting an injury to the left phrenic nerve and raising the left hemidiaphragm. The patient received emergency treatments, and a chest tube was placed in the left pleural space. There was breathing difficulty at the time of admission. However, greatly improved after receiving oxygen management and subsequent clinical treatments. The pneumothorax and subcutaneous emphysema resolved spontaneously after several days. The patient received in-hospital management for several days and was scheduled for further orthopedic management for the rib fractures

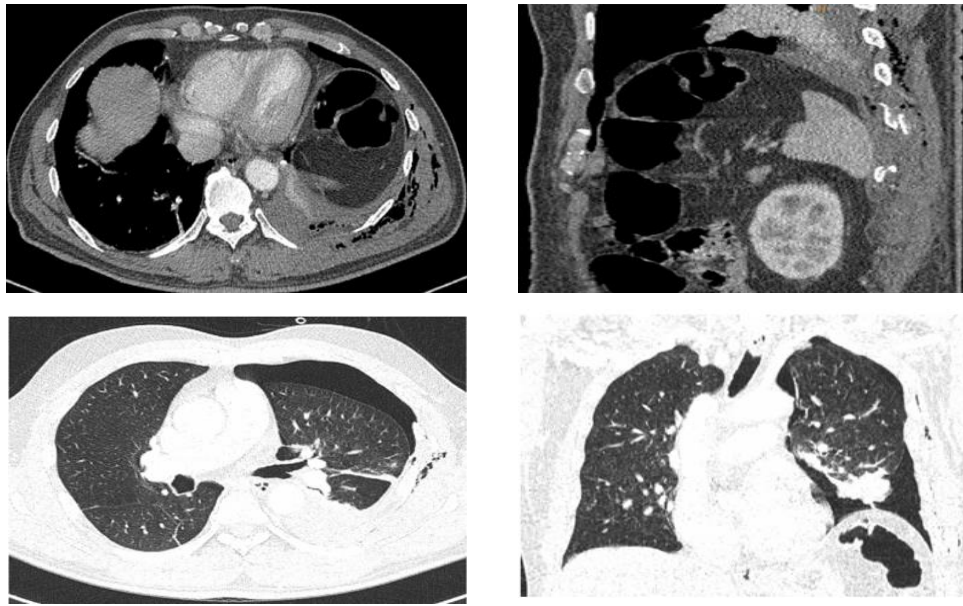


Figure 2. The thoracoabdominal CT scan with iodine contrast showed left pneumothorax, left hemothorax, left basal atelectasis, subcutaneous emphysema in the left lateral soft tissue, and multiple fractures of costae.

DISCUSSION

This case report showed some of the vast pathological manifestations potentially occurring in blunt thoracic trauma, mainly when the patient had not been evaluated and managed immediately. To our knowledge, there is no study regarding the time until initial hospital admission with the prognosis, but any blunt thoracic trauma without any treatment will significantly increase the patient's morbidity and mortality.⁷ Compared to penetrating injury, blunt injury to the chest also showed a higher rate of post-traumatic complications with pneumonia and retained hemothorax as the main late complication.⁸

Outside the lung, subcutaneous emphysema is a common finding in thoracic trauma, defined as air trapping in the extrathoracic soft tissue. SE might be easily identified through physical examination and imaging. On the chest radiograph, SE appears as radiolucent striations in the pattern following muscle fibers, as seen in our case. When the air covers every fiber of the pectoralis muscle, it may appear as a 'ginkgo leaf sign'.⁹ CT scan can also easily detect SE, occurring as hypodense (dark) air pockets in the soft tissue, as seen in our patient.¹⁰

Soft tissue injury may also present as chest wall hematoma on the blunt injury site.¹¹ SE and hematoma are usually not life-threatening and will resolve by themselves.^{10,11} Inward displacement of extrapleural fat either by intrathoracic or extrathoracic hemorrhagic fluid collection, defined as extrapleural hematoma, might also happen in up to 81% of patients with a rib fracture. Chest wall hematoma, extrapleural hematoma, or parenchymal hematoma is undifferentiable through a chest radiograph (Fig. 5) but easily identified through a CT scan.¹²

Rib fractures, also one of the most common thoracic injuries, occurred in about 40% of patients with severe non-penetrating trauma. The fifth through ninth ribs is more vulnerable to fracture, compared to the upper ribs being protected by the shoulder girdle and the relatively mobile lower ribs.¹³ Typical patterns were also seen in our cases, in which fractures were found from the fourth to tenth ribs. In addition to flail chest as the common physical examination findings, a chest radiograph is usually sufficient to detect and formulate rib fracture management. A CT scan

may be appropriate in several considerations, usually to confirm suspected rib fractures.¹³

Thoracic trauma might also cause pleura-related injury, with pneumothorax as the most common life-threatening injury in blunt thoracic trauma. It may result from acceleration-deceleration in blunt force injury or direct tearing/penetrating injury of the visceral pleura, resulting in pneumothorax and potentially hemothorax.^{11,14} Subcutaneous emphysema could also be a risk factor for the development of delayed pneumothorax, as it also might contribute to our case.¹²

Another clinical manifestation of thoracic injury is hemothorax, with an overall mortality of 9.4% in blunt trauma, and almost 90% of penetrating trauma patients did not make it to the hospital. Evaluating hemothorax through chest radiographs is challenging. A blunting of costophrenic angle can be seen in an upright chest radiograph with a minimum of 300-500 ml of blood, while a supine chest radiograph might overlook up to 1000 ml of blood.¹⁵ CT scans are the primary modality to confirm suspected hemothorax while discarding pleural effusion and empyema as the usual differential diagnosis.¹⁶ Hounsfield Unit (HU) measurements were usually higher than 15-16 HU in hemothorax while lower in pleural effusion and empyema.¹⁷ In our cases, fluid accumulation in the pleural space with a high HU value (33 HU) confirmed the hemothorax.

Several causes might contribute to atelectasis formation. In blunt thoracic trauma, severe chest pain reduces tidal volume and suppresses the cough reflex, leading to small airway collapse and fibrosis. Undrained hemothorax might contribute to respiratory distress and as a direct cause of atelectasis.¹⁴ Our patient suffered without pain management for three days and was found with multiple thoracic injuries, including hemothorax, leading to left lung atelectasis.

Elevated hemidiaphragm can be defined when one hemidiaphragm sitting >2 cm higher than the other counterparts through a

chest radiograph, with 'true' elevated hemidiaphragm being homogenous, regular, and continuous border without any ipsilateral retraction.¹⁸ Further CT scan evaluation should be done to detect any possible pathologies, such as diaphragmatic rupture and herniation. Our patient was also seen with unilateral hemidiaphragm elevation, with a suspected mechanism of post-traumatic phrenic nerve injury or palsy,¹⁹ as the tenth rib fracture was so close to the phrenic nerve. High energy force from the trauma or direct lacerations from the fractured ribs might also cause diaphragm damage,¹⁷ although no diaphragm rupture was found. The traction from the atelectasis might also contribute to the pathomechanism of the elevated hemidiaphragm.²⁰

Pathological findings from the imaging studies should imply considerations for appropriate management. Subcutaneous emphysema usually will resolve in 10 days without any treatment needed. However, skin incisions might be considered in an extensive case.¹⁰ Biconvex lesions of extrapleural hematomas usually require surgical management.¹¹ Conservative therapy is recommended in simple rib fracture, while surgical management is indicated in any non-union, deformity, respiratory failure, and flail chest.¹² Any tension pneumothorax and hemothorax should be treated with chest tube placement.¹⁴ In the case of atelectasis formation, some treatments such as breathing exercises, pharmacological (e.g., acetylcysteine), and non-pharmacological (e.g., fiberoptic bronchoscopy) are available.

CONCLUSION

Our cases successfully demonstrated broad pathological manifestations found in a seemingly simple blunt thoracic trauma. Recognizing clinical and imaging features are crucial in distinguishing different pathology. Chest radiograph stands as the main initial imaging evaluation in an emergency setting, while CT scan helps detect and confirm the diagnosis. Therefore, we encourage early evaluation and suggest using a chest

radiograph and chest CT scan to evaluate blunt thoracic trauma.

ACKNOWLEDGMENT

The authors thank Stephen Kurniawan, MD, and Irfan Hasyim Tadjoedin, MD, for their assistance in writing the manuscripts.

DECLARATIONS

The first and second authors are the senior advisor for this study, therefore, maintaining the quality of the information stated in this manuscript. The third author is the doctor in charge of the case presented in this study and helps with the writing of the manuscript. The second and fourth author contributes to this manuscript's writing and submission preparation. The authors declare that they have not received any external funds for this paper. The authors declare that there is no conflict of interest. No additional information is available for this paper.

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