Assessment of radiological evaluation of penetrating chest trauma patients at the Radiodiagnosis Department, Assiut University Hospital: an audit study

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Received 26 January 2020
Revised 22 February 2020
Accepted 06 March 2020
Published 10 August 2020

Journal of Current Medical Research and Practice
2020, 5:332–336

Introduction

Penetrating chest trauma is one of the most common forms of trauma presented to Assiut University Hospital. Each year, more than 300 cases of penetrating chest trauma are encountered in the emergency unit. Firearm shots and penetrating stabs are the most common causes, yet it may be a result of industrial accidents, falls, collisions, or blast injuries. The presentation of penetrating thoracic trauma can vary widely, from stable patients with few complaints to hemodynamically unstable patients requiring immediate life-saving interventions. Even apparently stable patients with penetrating chest injuries can deteriorate precipitously; and a focused evaluation must be rapidly performed to assess for life-threatening conditions. Penetrating chest trauma is generally less common but more deadly than blunt chest trauma. According to small retrospective reviews, chest injuries are a relatively common cause of preventable death among trauma patients.

Patients and methods

This study was conducted in patients who are presented by penetrating chest trauma to the Assiut university hospital trauma unit during the period from the 1st of October to the 31st of December 2017. After history taking and clinical examination, all patients were subjected to chest radiography in the radiology department, followed by multislice computed tomography (MSCT) chest in seven cases who needed further imaging.

Aim

The aim of the study was to determine the need for multislice computed tomography of the chest in patients with penetrating trauma to the chest after initial radiographic screening at Assiut University Hospital during a period of 3 months.

Results

This study was conducted on 47 patients presented with penetrating chest trauma to the Trauma Unit – Assiut University Hospital, from October 1 to December 31, 2017; about 85% of them did not need further assessment by multislice computed tomography of chest.

Conclusion

In the majority of penetrating chest trauma cases, a 'chest radiography' was sufficient for diagnosis and management of the patients.

Keywords:
clinical audit, Multislice computed tomography, Penetrating chest trauma

J Curr Med Res Pract 5:332–336

2357-0121

Introduction

The presentation of penetrating thoracic trauma can vary widely, from stable patients with few complaints to hemodynamically unstable patients requiring immediate life-saving interventions. Even apparently stable patients with penetrating chest injuries can deteriorate precipitously and a focused evaluation must be rapidly performed to assess for life-threatening conditions. Penetrating chest trauma is generally less common but more deadly than blunt chest trauma. According to small retrospective reviews, chest injuries are a relatively common cause of preventable death among trauma patients [1,2].

The incidence of penetrating thoracic trauma varies geographically. In the USA, 9% of all trauma-related deaths occur from injuries to the thorax, of which one-third involve a penetrating mechanism [3,4].

In Europe, the incidence of penetrating trauma is reported to be as low as 4% [5].

However, in countries or regions engaged in warfare, up to 95% of military deaths may result from a penetrating mechanism. Urban centers tend to have higher rates of interpersonal violence and a correspondingly higher percentage of injuries involve penetrating mechanisms compared with rural regions.

Most penetrating chest injuries do not require major operative intervention and many patients are managed with observation and serial evaluation using radiography or simple tube thoracostomy. Approximately 15–30% of penetrating thoracic injuries require surgery, as opposed to less than 10% of injuries from blunt chest trauma [6].

Patients and methods

This study was conducted on patients who were presented with penetrating chest trauma to Assiut University Hospital Trauma Unit during the period from October 1 to December 31, 2017. It included 42 men and five women. Their ages ranged from 4 to 82 years. After history taking and clinical examination, all patients were subjected to chest radiography in the radiology department, followed by multislice computed tomography (MSCT) chest in seven cases who needed further imaging. An informed written consent was obtained from all the patients included in the study.

The study was approved by the Medical Ethics Committee of the Faculty of Medicine, Assiut University and assigned the number IRB# 17100952.

Two of those patients performed other investigations, for example, chest ultrasonography and echocardiography during evaluation:

(1) Complete history taking included:
   (a) Mode and timing of trauma.
   (b) The main symptoms such as dyspnea, chest pain, hemoptysis, fever, and previous operations.
(2) Complete examination by cardiothoracic surgeons.
(3) Other investigations:
   (a) Chest ultrasonography
   (b) Echocardiography.

Patient instructions and preparation

(1) The patients were informed of the procedure steps and were reassured.
(2) The patients were trained to hold breath and to listen and follow the instructions.
(3) Patients who were unable to hold their breath were instructed to breathe as shallow as possible during the acquisition.

The procedure

(1) Chest radiograph:
   (a)In case of erect posteroanterior view in most patients (36 patients):
   (i) The patient faced the standing Bucky and the tube-film distance was 1.5 m as a standard.
   (ii) Exposures were performed after deep inspiration with breath holding.
   (b) In case of polytraumatized patients (11 patients) or those who were unable to stand, anteroposterior radiograph was performed in supine position.

   (i) The patient's back was toward the table Bucky and the tube-film distance was 1 m.
(2) MSCT of the chest:
   (a) The patients were examined in supine head-first position, with the arms above the head.
   (b) An initial anteroposterior and lateral scouts were taken.
   (c) The region to be examined was planned from the root of the neck to the upper abdomen.

Data processing and reconstruction in multislice computed tomography

Axial cuts were sent to the workstation for postprocessing and reconstruction.

Contiguous transverse 1.5 mm images were routinely reconstructed at mediastinal and lung window settings.

Maximum intensity projection and virtual reality reformatted images were done providing three-dimensional images that were helpful in providing more anatomical and pathological details and also in displaying complex anatomical relationships.

The computed tomography (CT) examinations were non-contrast as vascular injuries were not suspected by the physicians in any of the cases.

The following items were checked in each patient:

(1) Lung parenchyma, pleura, and pericardial lesions,
(2) Other mediastinal abnormalities,
(3) Chest wall abnormalities.

These findings were correlated with clinical findings, and other investigations to reach or confirm the diagnosis.

Patients who were hemodynamically unstable did not undergo any imaging and were operated immediately. These patients were not included in the study.

Patients who underwent only chest radiography which showed no radiological abnormalities were put under observation and were managed conservatively.

Patients who were hemodynamically stable and underwent chest radiography and did/did not undergo a CT study, which showed the hemothorax, pneumothorax or both, underwent tube thoracostomy.

Patients who underwent tube thoracostomy were observed and if hemodynamically unstable, underwent surgical exploration.

Results

This study was conducted on 47 patients presented with penetrating chest trauma to the Trauma Unit – Assiut University Hospital, from the October 1 to December 31, 2017; about 85% of them did not need further assessment by MSCT of the chest (Tables 1 and 2, Figs. 1–4).

Discussion

Penetrating chest injuries are a challenge to the thoracic or trauma surgeon. Penetrating thoracic trauma, especially that due to stab wounds and high-velocity gunshot wounds, is increasing at an alarming rate in our region. It became one of the leading causes of mortality in our hospital. Management differs according to the hemodynamic status of the patient upon arrival, imaging findings, and clinical evaluation [1].

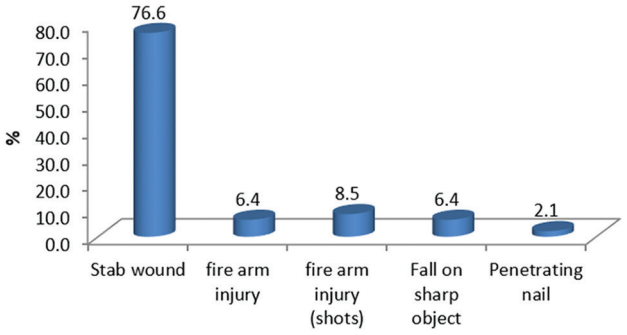
In this study, only 14.9% of patients needed a CT of the chest while in the majority of patients, radiography was the only needed imaging modality. CT findings included hemothorax, lung hematoma, contusions, and atelectasis, with only a small percentage showing no significant findings. Comparing patients who had a CT chest after x-ray showed that only three patients had further findings that were detected in CT.

Our results are consistent with Darwish *et al.* [7], who stated that although chest CT identified additional injuries (mainly minimal hemothorax or pneumothorax and lung contusions) in ~11% of their patients, it is unlikely that these injuries would have been overlooked if chest CT was not done as they would likely have been detected on follow-up chest radiographs anyway. Moreover, the clinical significance of CT findings was limited because they had no impact on patient treatment strategy in 94.4% of scanned patients, and

Table 1 Male predominance in 89% of cases and their mean age

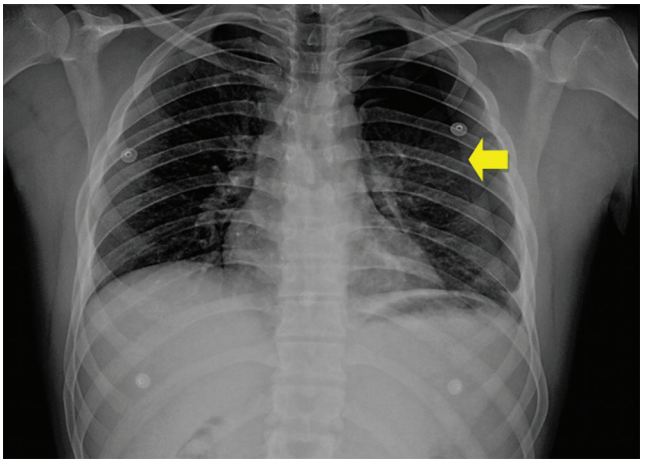
	n (%)
Sex	
Male	42 (89.4)
Female	5 (10.6)
Age	
Range	4-82
Mean±SD	27.89±14.72

Figure 1



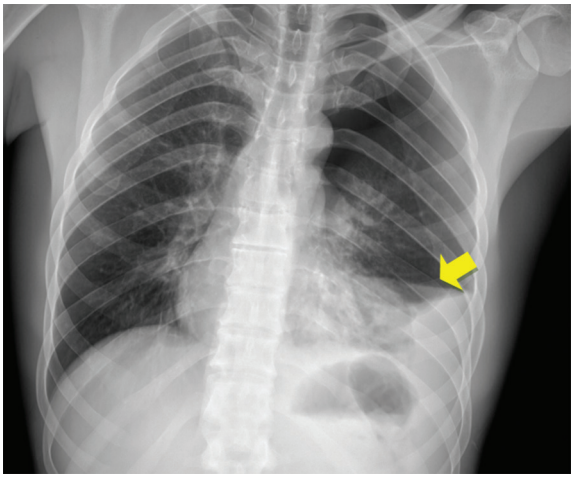
Frequency of different modes of injury in the study population

Figure 2



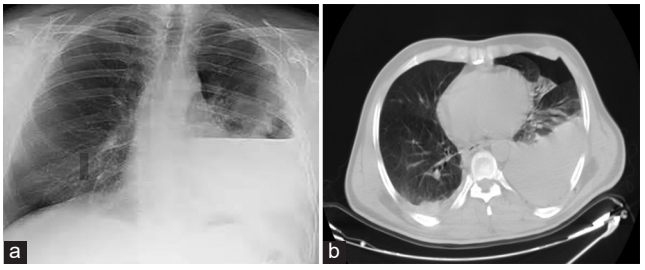
Chest radiograph of posteroanterior view showing mild left pneumothorax (arrow).

Figure 3



Left gas-fluid level representing hemopneumothorax (arrow).

Figure 4



a) Chest radiograph showing left hemopneumothorax: gas-fluid level. b) Multi-slice computed tomography (MSCT) confirming the data and also showing left lower lobe consolidation collapse.

Table 2 Relation between radiography and computed tomography findings

	CT [*n* (%)]							*P*
	No	Free	Diaphragmatic hump	Left hemopneumothorax + left lung hematoma	Right and middle lobe contusions	Right hemothorax, contusion and surgical emphysema	Right middle lobe atelectasis	
Radiographic findings								
Free	20 (50.0)	2 (100)	0	0	0	0	0	
Left hemopneumothorax	5 (12.5)	0	0	1 (100)	0	0	0	
Left pneumothorax	7 (17.5)	0	0	0	0	0	0	
Nail+no hemothorax or pneumothorax	1 (2.5)	0	0	0	0	0	0	
Raised left copula	1 (2.5)	0	1 (100)	0	0	0	0	
Right hemopneumothorax	1 (2.5)	0	0	0	0	0	1 (100)	<0.001**
Right hemothorax	1 (2.5)	0	0	0	0	1 (100)	0	
Right pneumothorax	4 (10.0)	0	0	0	0	0	0	
Shots (one under inferior cardiac surface)-right hemopneumothorax	0	0	0	0	1 (10)	0	0	

CT, computed tomography. ** highly statistically significant difference (P<0.01).

there is evidence for the conservative management of small hemothorax or pneumothorax not apparent on initial screening chest radiographs. This understanding is reinforced by recent studies which have indicated that chest CTs after abnormal chest radiographs rarely detect overlooked clinically significant injuries and that chest CT findings are associated with only limited clinical consequences.

The findings of this study were not in agreement with Mollberg *et al.* [8], who stated that among 617 (50.3%) patients who had a chest CT performed after screening chest radiography, 60.1% (371 of 617) had a negative initial chest radiograph and normal physical examination. As a result of the chest CT, 14% of those patients had 52 occult injuries identified. These injuries included 43 occult pneumothoraces or hemothoraces or both, of which 27 (62.8%) underwent tube thoracostomy.

Conclusion

Penetrating chest trauma is becoming very common in our community. Its presentation is increasing year after year. Even apparently stable patients with penetrating chest injuries can deteriorate precipitously and a focused evaluation must be rapidly performed to assess for life-threatening conditions.

Penetrating chest trauma is generally more deadly than blunt chest trauma.

Diagnosis of such trauma depends on clinical examination and radiological assessment. Chest radiography is the primary line of imaging modality. Management varies according to the hemodynamic stability of the patient and the radiological findings from conservative management to surgical exploration.

Our study included a total of 47 patients (42 men and five women). Their ages ranged from 4 to 82 years.

Comparing patients who had a CT chest after a radiograph showed that only few patients had further findings detected in CT. CT showed lesions that are somewhat difficult to diagnose by a chest radiograph such as lung hematomas, atelectasis, surgical emphysema, etc.

This study showed that, in the majority of the cases of penetrating chest trauma, a chest radiograph was sufficient for the diagnosis and management of patients. CT was only needed in a few cases in which the extent of the trauma could not be clearly assessed.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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