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Comparative characteristics of computed tomography and radiography in the diagnosis of blunt chest trauma

G.Sh. Gasimzade

Azerbaijan State Advanced Training Institute for Doctors named after A. Aliyev, Baku, Azerbaijan

Abstract

Aim. To conduct a comparative analysis of the effectiveness of X-ray diagnostics and computed tomography in detecting injuries in patients with blunt chest trauma.

Methods. We examined 68 patients with chest injuries (men and women) and an average age of 34.6±7 years (between 18 and 65 years). The causes of injury were: road accidents — 37 (54.4%), falls from a height — 21 (30.8%), blunt blow to the chest — 10 (14.8%). The results of X-ray and computed tomography examination of patients were compared.

Results. X-ray examination revealed a chest bone fracture in 24 (35.3%) patients, while computed tomography revealed a bone fracture in 32 (47.1%) cases (χ^2=1.943; p=0.163). This allows us to state that the results of computed tomography scans are more accurate in the diagnosis of chest fractures. computed tomography scan revealed chest injuries — pneumothorax and hemothorax, in 56 (82.4%) cases, while X-ray examination in 37 (54.4%) cases (χ^2=12.277; p <0.001). Thus, the results of the study showed that computed tomography is a more informative method of diagnosis compared to radiography, since computed tomography revealed 11.8% more cases of chest bones fractures, and 28.0% more cases of chest cavity damage with blunt trauma.

Conclusion. Our study allows us to recommend computed tomography of the chest in blunt trauma as the initial preferred diagnostic radiology.

Keywords: blunt trauma of the chest, radiography, computed tomography.

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Background. Chest injuries are becoming a leading cause of morbidity and mortality in patients with blunt chest trauma. Injuries to the chest organs, on average, account for 10%–20% of hospitalized patients and rank third after injuries of the extremities and craniocerebral injuries [1]. The mortality rate in patients with chest injuries has also been reported as high as 25%. Simultaneously, 70% of chest injuries are blunt chest trauma, and the remaining 30% are full-thickness injuries [2, 3].

Concomitant injuries with damage to the chest are dangerous because in many cases they are accompanied by rib fractures. Rib fractures are often accompanied by damage to the chest organs, which quite often complicates the course of the injury and, in case of untimely diagnostics and failure to provide adequate assistance, leads to the death of the patient [4, 5]. Fractures of the lower ribs may arouse the suspicion of intra-abdominal visceral trauma, while fractures of rib reflect trauma to the heart and major vessels [6].

Radiological imaging is essential for the diagnosis and timely treatment of patients with chest trauma. X-ray has been the method used in diagnosing chest injuries for a long time. The development of medical technologies and widespread use of more modern methods of radiation diagnostics in practice have contributed to the fact that more accurate and effective methods are now used for a detailed assessment of trauma and severity of injuries to the chest and thoracic organs.

Computed tomography (CT) scan is one of the radiation diagnostic methods; it enables diagnosing hidden injuries in more than half of the patients with injuries in the chest and thoracic organs that were not detected during the initial X-ray diagnostics. In case of chest trauma, the use of CT scan enables the diagnosis of severe and relatively

For correspondence: dr.gasimzade@mail.ru Received 09.04.2020; accepted 30.06.2020.

minor injuries of the chest and thoracic organs in a timely and more detailed manner compared with X-ray [7–11]. In patients with blunt chest trauma, CT scan reveals more lesions than conventional radiography [12, 13].

The study conducted a comparative analysis of the efficiency of X-ray and CT scan in detecting injuries in patients with blunt chest trauma.

Materials and methods. Sixty-eight patients with chest trauma were examined. The study included men and women, with the mean age of 34.6±7 years (18–65 years).

The causes of trauma to the chest and thoracic organs were determined on admission of the patients to the hospital, while collecting anamnestic data. The clinical diagnostic examination of patients with signs of injury and suspected trauma to the chest and thoracic organs was performed in the Department of Radiation Diagnostics at the Clinical Medical Center of the Ministry of Health of the Republic of Azerbaijan. Damage and dysfunction of the vital organs of the chest were assessed using the X-ray diagnostic method and CT. The patients were examined using a Plessart Model DXB-0324CS-A (Digital Radiography System) X-ray apparatus made by Toshiba (Japan). In addition, diagnostics were performed using an Aquilion 16 Model TSX-101A computer tomograph (Toshiba, Japan).

Statistical processing of the digital material was performed using discriminant analysis and Pearson χ^2 test and Yates' correction in the MS Excel-2019 spreadsheet processor.

The study was conducted in accordance with the standards of clinical practice, and approval was obtained from the Ethics Committee of the A.A.Aliyev Azerbaijan State Institute for Advanced Medical Studies, Baku.

Results and discussion. In most patients, the injuries were caused by road traffic accidents (37 patients, 54.4%), in 21 (30.8%) patients, the chest injury was caused by a fall from a height, and in 10 (14.8%) patients, the chest injury was caused by a blunt blow to the chest.

X-ray examination revealed a fracture of the chest bones in 24 (35.3%) patients, while CT scan showed a fracture in 32 (47.1%) patients ($\chi^2 = 1.943$; $p = 0.163$). This shows that, when diagnosing fractures of the chest bones, the results of CT scans are more accurate.

In 56 (82.4%) patients, CT scan showed injuries to the thoracic organs in the form of pneumothorax and hemothorax, while X-ray examination revealed pneumothorax and hemothorax in only 37 (54.4%) patients ($\chi^2 = 12.277$; $p < 0.001$). Figure 1 shows a left-sided hemothorax diagnosed by X-ray and CT scan.

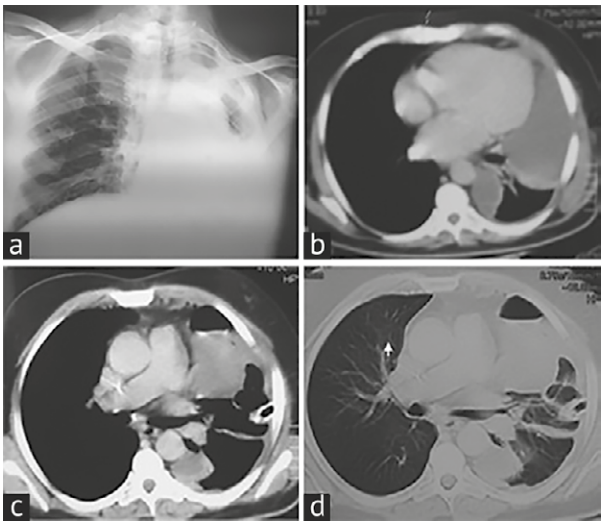

Fig. 1. Left-sided hemothorax: (a) X-ray; (b–d) computed tomography scan.

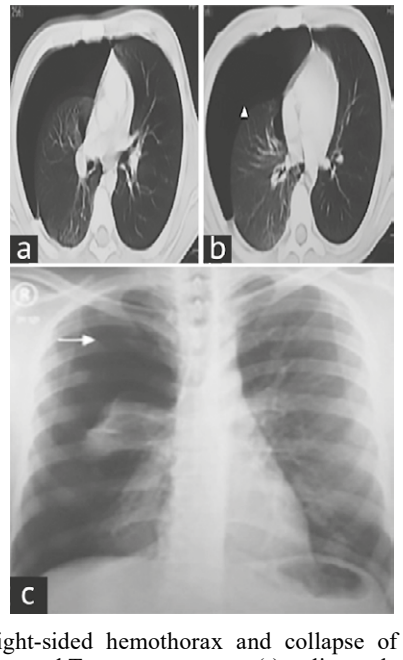

Fig. 2. Right-sided hemothorax and collapse of the lung: (a, b) Computed Tomograms scans; (c) radiograph.

Figure 2 presents a right-sided hemothorax with lung collapse, revealed by X-ray, and CT scan.

In our study, in chest trauma, pneumothorax was diagnosed in 13 (19.1%) patients using CT: it was unilateral in 10 (76.9%) patients and bilateral in three (23.1%) patients. Hemothorax was detected in 43 (63.2%) patients (unilateral in 38 (88.4%) patients, and bilateral in 5 (11.6%) patients). Hemopneumothorax was registered in 26 (38.2%) patients.

X-ray examination revealed lung damage in the form of pneumothorax in 10 (14.7%) patients ($\chi^2 = 0.471$; $p = 0.493$): it was unilateral in eight (80.0%) patients and bilateral in two (20.0%) patients. Hemothorax was registered in 27 (39.7%)

patients ($\chi^2 = 7.536$; $p = 0.006$): it was unilateral in 22 (81.4%) patients and bilateral in five (18.5%) patients. Hemopneumothorax was diagnosed in six (8.8%) patients ($\chi^2 = 16.346$; $p < 0.001$).

In our study, in severe concomitant injuries, CT scan diagnosed damage to the pericardium in five (7.3%) patients, while the radiograph showed only enlarged heart contours. This is consistent with a study by J.V. O'Connor et al. [14].

CT examination in seven (10.2%) patients revealed vascular damage, while X-ray examination showed damage only in three (4.4%) patients ($\chi^2 = 0.971$; $p = 0.324$). In chest trauma, pain was the most common clinical symptom. Pain syndrome was noted in 46 (67.6%) patients. The second most frequent clinical symptom was dyspnea, which was registered in our study in 22 (32.4%) patients. Similar results were obtained by K. Lema et al. [15].

In our study, radiography showed lung damage in 30 (44.1%) patients, while CT scan revealed lung damage in 42 (61.7%) patients ($\chi^2 = 4.250$; $p = 0.039$), which is consistent with the data of other researchers [4].

The results obtained showed that the maximum frequency of chest injuries occurs in patients aged 20 to 45 years old, which is consistent with a study by H. Mirka et al. [16], who argue that chest trauma is the most common cause of death in the young age group (18 to 34 years). In our study, the most common cause of chest trauma was road traffic accidents, which is comparable to the literature [4, 5].

The introduction of CT scanning into the widespread clinical practice for chest injuries will enable a more accurate diagnosis of damage to not only the bones of the chest, but also the thoracic organs and identifying damage to the thoracic organs, large and medium vessels, pneumothorax, and hemothorax.

Thus, the results of our study show that CT scan is a more informative diagnostic method compared with X-ray radiography, since it reveals fractures of the chest bones more often (11.8%) and injuries of the chest cavity (28.0%) caused by blunt trauma.

Conclusion. Our research recommends a chest CT scan in patients with blunt chest trauma as the initial preferred diagnostic radiation method.

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Conflicts of Interest. The author declares no conflicts of interest.

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