CASE REPORT – OPEN ACCESS

International Journal of Surgery Case Reports 82 (2021) 105864

Contents lists available at ScienceDirect

International Journal of Surgery Case Reports

journal homepage: www.casereports.com

Successful Treatment of GSW to the Intrapericardial Inferior Vena Cava wall: Case Report

Amin Rezazadeh, Ali Samady Khanghah*

Department of Surgery, Fatemi Hospital, Ardabil University of Medical Sciences, Ardabil, Iran

ARTICLE INFO

Article history:
Received 21 February 2021
Received in revised form 31 March 2021
Accepted 1 April 2021
Available online 6 April 2021

Keywords:
Bullet
Inferior vena cava
Penetrating injury
Cardiopulmonary pump

ABSTRACT

INTRODUCTION: Penetrating traumas to the thorax could be potentially serious. Vena caval wounds are highly lethal, so that half of the patients die before reaching the hospital, and another 50% may die perioperatively. Although rare, most of them are the result of gunshot wounds.

PRESENTATION OF CASE: We report a 13-year-old boy shot by an air gun through his right hemithorax. During surgery, an air gun bullet appeared right within the wall of the intrapericardial inferior vena cava (IVC).

DISCUSSION: Traumas to the thoracic contents as vena cava are inevitable, presenting mostly with haemo or pneumothorax. If the victim reaches the operating room alive, the approach to his or her vena cava rupture remains a challenge in the hands of surgeons.

In this case, the surgeon, following the bullet removal, repaired the penetration immediately by direct suturing because clamping the inferior vena for its thin wall can expand the rupture, also blocking systemic venous return.

CONCLUSION: The surgeon in a general trauma center that is almost lacking cardiopulmonary pump can repair the vital injuries to the IVC with the technique of direct suturing.

1. Introduction

Thoracic injury, regardless of a small proportion of traumatic patients, has a noticeable mortality rate [1]. However, up to a quarter of prehospital mortalities are for damages to the thoracic cavity [2]. Mediastinal injuries for the presence of vital contents are more lethal in all ages. Penetrating injuries to the vena cava are much rarer but severe. They can be associated with haemodynamic instability and often produce a substantial technical challenge to the surgeons [3]. In our patient the air gun bullet had stopped closely within the wall of IVC, which had packed the source of bleeding. The trauma surgeon in a general operating theatre was able to remove the bullet from the vessel wall then successfully repairing the aperture. This work has been reported in line with the SCARE criteria [4].

2. Presentation of case

A 13-year-old boy presented to our trauma center from a local hospital. He was a victim of an air gunshot through his right hemithorax from a distance of two meters 4 h before arrival. There was not a notable point in his past medical history. On the primary survey, the blood pressure and heart rate were detected in 100\60 mmHg and 90 beats\minutes accordingly; maintaining his airway with fluent speech and a saturation of 96% on room air besides dyspnea and painful respiration. Chest examination revealed an entry wound at the 6th intercostal space without ongoing external bleeding. In the initial chest radiography, the bullet's position seemed to be in the middle mediastinum (Fig. 1). Before any further investigations, a right chest tube was inserted. The echocardiography from the view of probable pericardial effusion was normal, and computed tomography (CT) revealed beam-hardening artifact in the middle mediastinum, degrees of right lung lower lobe collapse, mediastinal haematoma, haemopneumothorax, and the correctly positioned chest tube (Fig. 2). He was then underwent right-sided anterolateral thoracotomy surgery with the preoperative diagnosis of lower lobe laceration of the right lung and mediastinal injury. After removing about 200 cc blood (Fig. 3) and pericardiotomy, the air gun bullet appeared closely within the wall of intraperi-

* Corresponding author.
E-mail addresses: aminrezazadeh50@yahoo.com (A. Rezazadeh), alisamady89@yahoo.com (A. Samady Khanghah).

https://doi.org/10.1016/j.ijscr.2021.105864

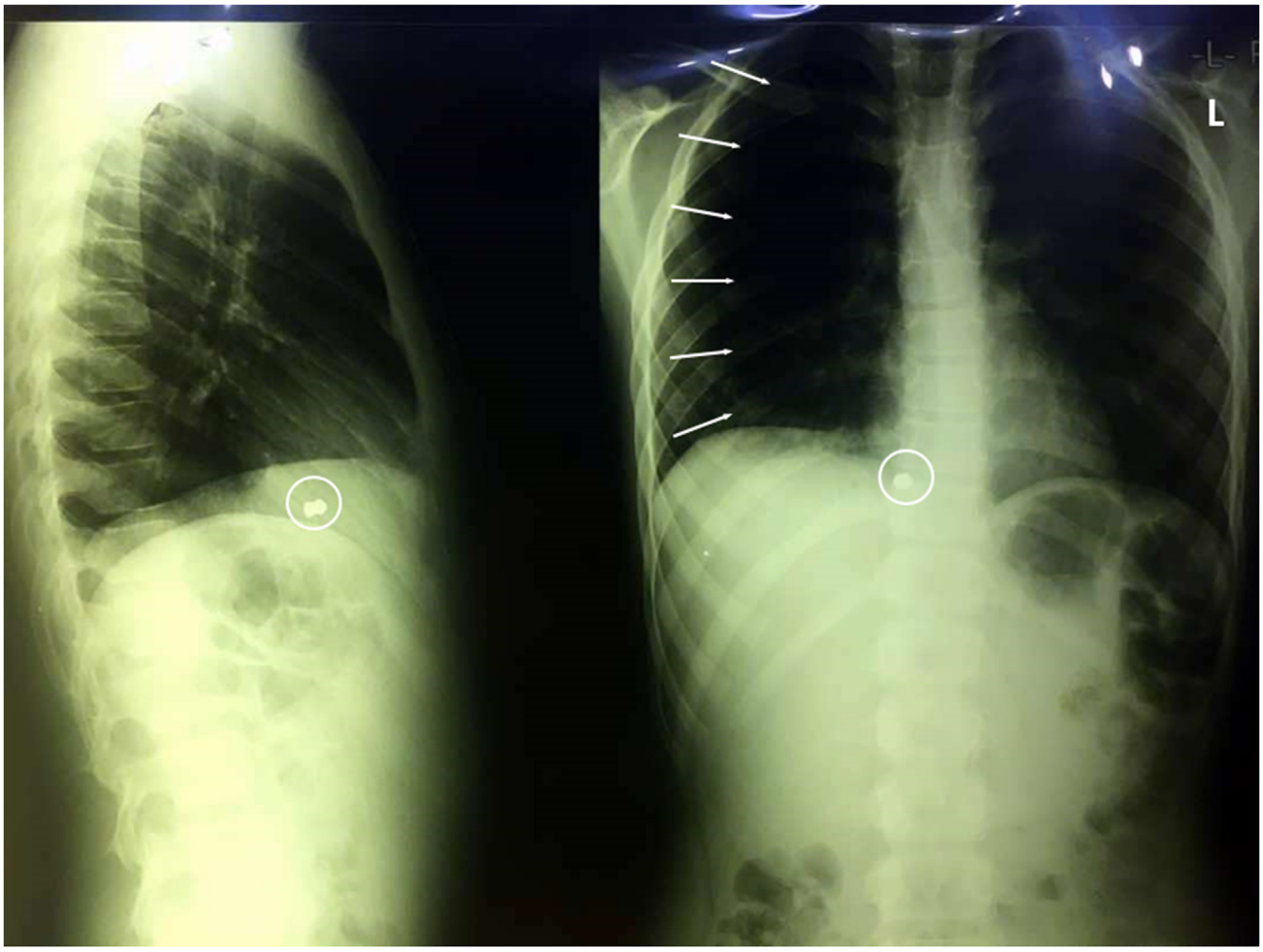

Fig. 1. The primary chest x-ray showing the visceral pleural line (arrows) because of right-side pneumothorax and the air gun bullet inside the middle mediastinum (circle).

cardial inferior vena cava that penetrated the right lung through and through on its way to IVC (Fig. 4). There was not any ongoing bleeding because of its tight package. Knowing that ligature of the IVC for the blockage of the venous return and consequently, cardiac output is not practicable, and the cardiopulmonary bypass pump was not accessible, the only way in front of the surgeon was the release of the abdominal IVC by making a 5-centimeter incision at the diaphragm then immediately repairing the defect with 4-0 polypropylene sutures. Following controlling the potentially lethal bleeding source, tractotomy, and ligature of small bronchi, the surgeon repaired the diaphragmatic cut with 3-0 Nylon running suture (Fig. 5), finally, a pericardial tube was placed. During staying at the hospital, no complications like rebleeding or air leakage occurred. The chest and pericardial tubes were removed one week and five days later accordingly. The patient successfully improved, and monthly follow-ups found him in health without notable complications.

The research registry unique code of this work is *researchregistry6704* [5].

3. Discussion

Injury to the thoracic cavity containing the lungs, heart, and great vessels increses mortality rates. Gunshot and stab wounds are the most causes of penetrating, whereas vehicle accidents are the most common cause of blunt trauma to the thorax [6]. Accordingly, bullets, fragments, and stabbings are responsible for more than 90% of thoracic great vessel injuries [7].

The leading cause of death in such cases is direct combined effects on respiratory and haemodynamic functions [8]. Furthermore, such patients may also have injuries in the other organs.

Haemodynamically unstable patients with transmediastinal gunshot wounds must undergo tube thoracostomy rapidly and transport to the operating room.

Simply, when a penetrating injury reaches the mediastinum, it indeed imposes severe damages to the lungs' parenchyma and the tracheobronchial system as ruptures and haemopneumothorax. Damage to each of the mediastinal components can cause terrible and, in some cases, uncontrollable bleeding so that the majority of patients die before reaching a therapeutic center [9]. Commonly, chest radiography stands in the first-line imaging modality during initial evaluation, especially in multiply traumatized patients [10]. If haemodynamic status allows, CT and echocardiography can provide valuable information in the upcoming chest trauma management [11].

Compared to abnormal chest radiographs taken initially, CT of the chest will illustrate 20% more detailed pathology [12].

Using CT, motion and beam-hardening artifact are limiting factors in evaluating cardiac injury or retained fragments within the mediastinum and myocardium as in our case.

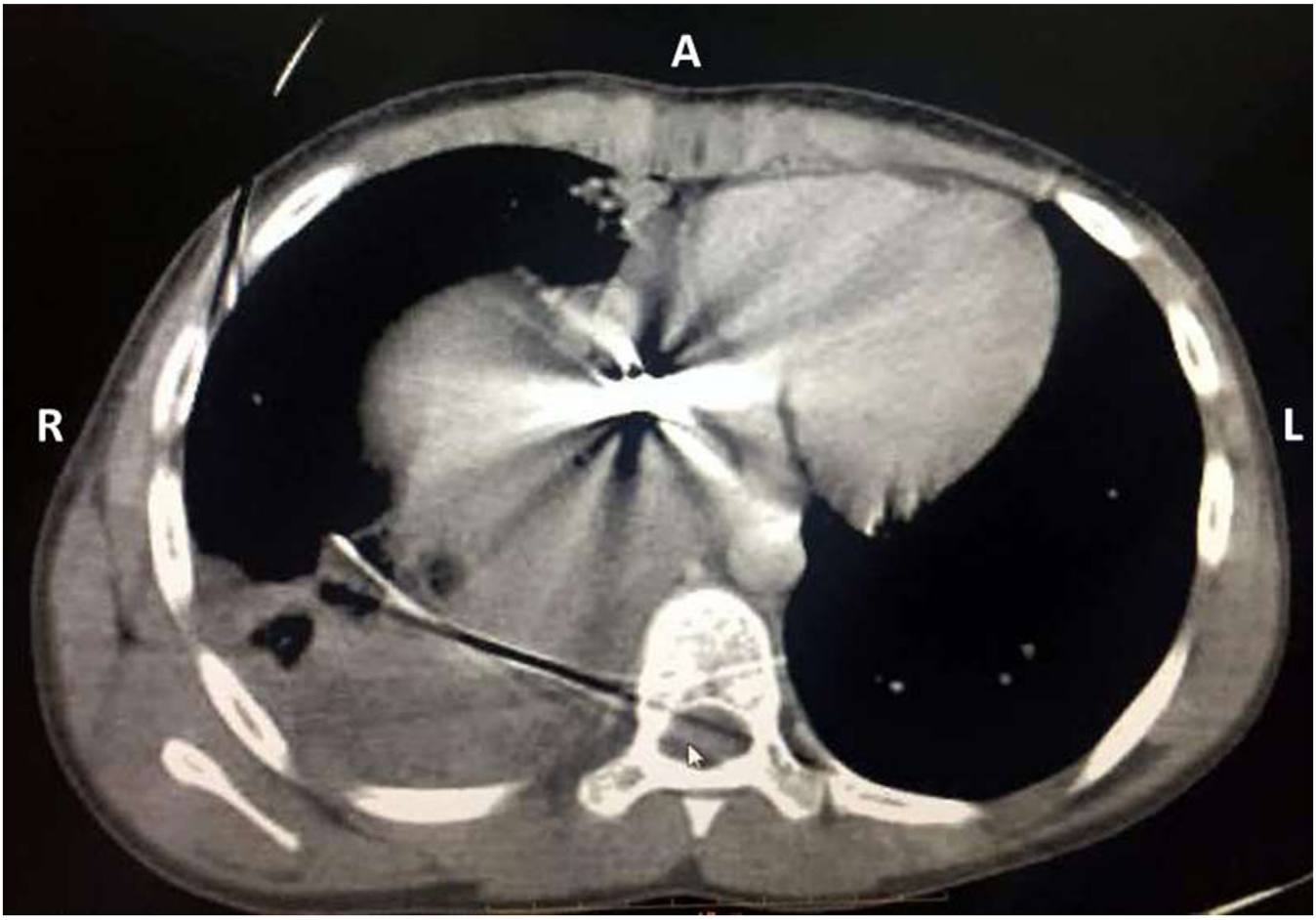

Fig. 2. Chest CT demonstrating the more accurate position of the bullet with its high-density foreign material artifact, haemothorax, the atelectasis of the inferior lobe of the right lung, and an accurately positioned chest tube.

It is also necessary to detect the wound tract, which the presence of hemorrhage, air, bone, and metal fragments can give clues to the surgeon [13].

Projectiles reaching to the mediastinum, in addition to the risk of great vessels' penetration and emboli, can produce a shearing injury on the vessel wall, which is called secondary injury [14]. The bullet in this case, was tightly placed within the wall of the intrapericardial portion of the IVC, obstructing the perforation made by itself.

Median sternotomy is the approach of choice among cardiothoracic surgeons for better exposure while in a hypotensive traumatized patient without a distinct diagnosis, the left anterolateral thoracotomy is preferred [15]. The other surgical incisions could be selected depending on the mechanism and place of injury. Injuries to the intrathoracic portion of IVC may result in haemopericardium and cardiac tamponade. Exposure to this part is tremendously difficult unless entrusting the patient to the total cardiopulmonary bypass with the inferior cannula inserted via the groin into the abdominal inferior vena cava. Repair necessitates intracaval balloon occlusion through a right atriotomy to prevent air from entering the cannula and massive blood return to the heart except via the hepatic veins [16]. For a 4-h delay, the patient reaching our centre and the critical position of the foreign body; it was potentially life-threatening to transfer him to the other hospital equipped with the cardiac operating room. Without none of the facilities mentioned above the surgeon began the operation with the right anterolateral thoracotomy; having done pericardiotomy, removed the bullet, and repaired the perforation.

4. Conclusion

Considering that, a general surgeon at a trauma center may encounter a mediastinal penetrating trauma, he or she must know the basics of handling the vital surgeries of mediastinal great vessels in the absence of a cardiopulmonary pump. The IVC injuries, despite the potential of massive hemorrhage, can be repaired by direct suturing if the surgeon acts quickly.

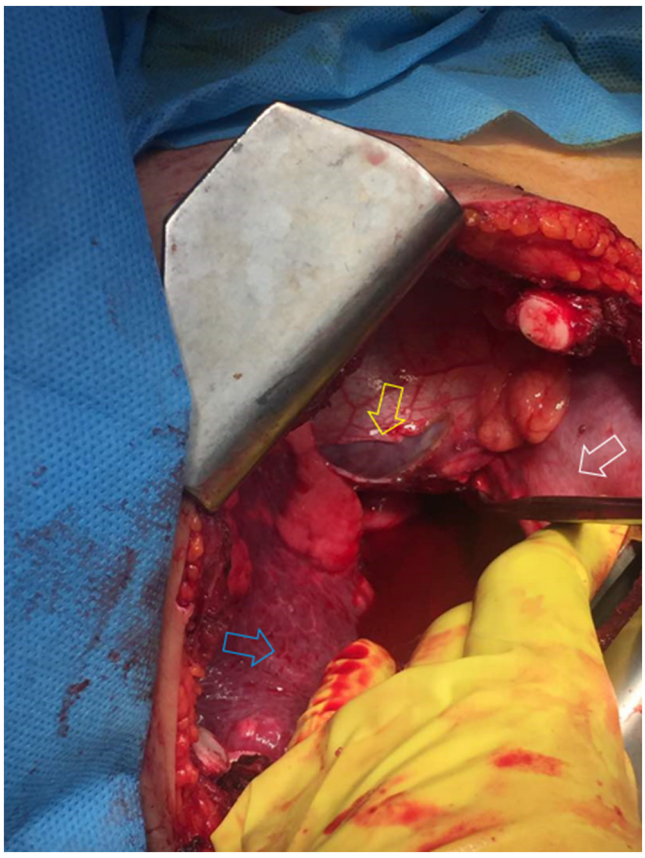

Fig. 3. After right-side thoracotomy, a volume of blood appeared. The white arrow points to the intact diaphragm, the blue arrow indicates to the collapsed inferior lobe of the right lung, and the yellow one points to the ruptured pericardium.

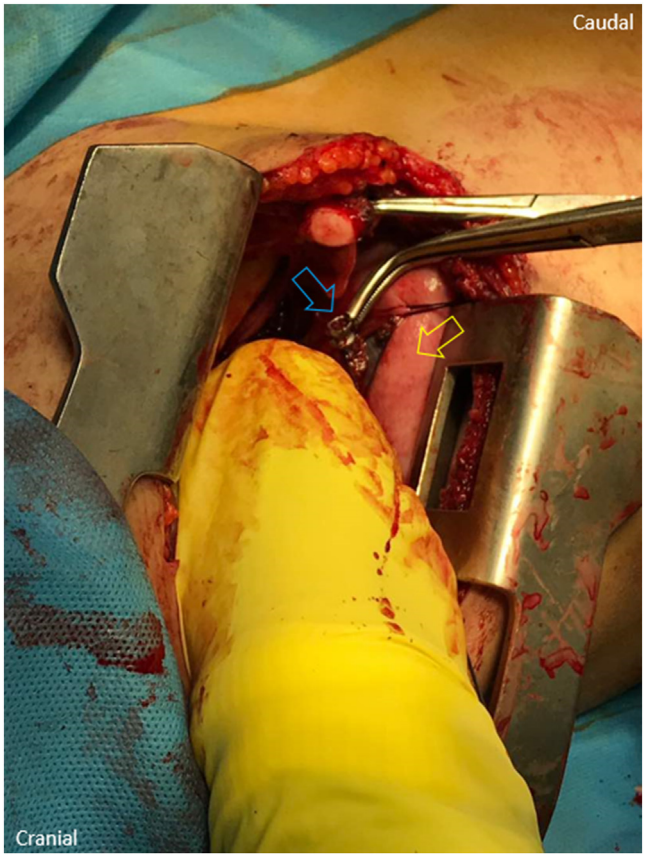

Fig. 4. The yellow arrow points the pulled over right lung middle lobe and the blue arrow pointing the bullet which is removed.

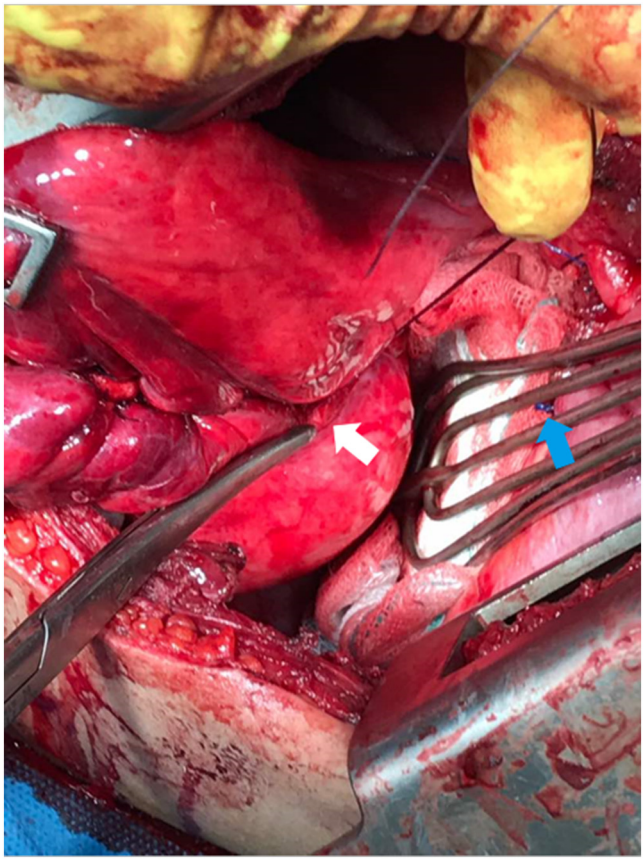

Fig. 5. The blue arrow points to the sutured diaphragmatic incision, and white arrow refers to the tractotomy procedure.

Declaration of Competing Interest

The authors declare that there are no conflicts of interest preparing this manuscript and accept any responsibilities.

Sources of funding

We authenticate not receive any financial support.

Ethical approval

The ethics committee of Ardabil university of medical sciences has proved and observed all aspects of this research from proposal to the final form of the manuscript. If necessary, the corresponding author can submit the certificate.

Consent

The consent in which the patient has allowed to use medical records and therapeutic information is attached to the medical document. The authors testify the patient privacy maintenance. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author's contribution

Amin Rezazadeh was the surgeon who operated on the patient, suggested publishing the method of surgery, and in the role of supervision.

Ali Samady Khanghah, a member of the research committee of the hospital prepared the manuscript and pursuits the submission process.

Registration of research studies

researchregistry6704 available at: https://www.researchregistry.com/browse-the-registry#home/registrationdetails/606166a293210c001b66b151/ (registered 9th April 2020).

Guarantor

Amin Rezazadeh accepts full responsibility for the work and approves the whole process from designing the study to publish.

Provenance and peer review

Not commissioned, externally peer-reviewed.

References

[1] D. Bliss, M. Silen, Pediatric thoracic trauma, Crit. Care Med. 30 (November (11)) (2002) S409–15.
[2] J.J. Platz, L. Fabricant, M. Norotsky, Thoracic trauma: injuries, evaluation, and treatment, Surg. Clin. 97 (August (4)) (2017) 783–799.
[3] H. Ekim, Management of penetrating superior caval vein injury, Pak. J. Med. Sci. 25 (October (5)) (2009) 869–871.
[4] R.A. Agha, M.R. Borrelli, R. Farwana, K. Koshy, A.J. Fowler, D.P. Orgill, H. Zhu, A. Alsawadi, A. Noureldin, A. Rao, A. Enam, The SCARE 2018 statement: updating consensus Surgical CAse REport (SCARE) guidelines, Int. J. Surg. 60 (December (1)) (2018) 132–136.
[5] Amin Rezazadeh, Browse the Registry, 2021, Research Registry, 29 March www.researchregistry.com/browse-theregistry#home/?view_2_search=rezazadeh&view_2_page=1.
[6] A.A. Haq, C.S. Restrepo, D. Lamus, D. Ocazionez-Trujillo, D. Vargas, Thoracic venous injuries: an imaging and management overview, Emerg. Radiol. 23 (June (3)) (2016) 291–301.
[7] K.L. Mattox, D.V. Feliciano, J. Burch, A.C. Beall Jr., G.L. Jordan Jr., M.E. De Bakey, Five thousand seven hundred sixty cardiovascular injuries in 4459 patients. Epidemiologic evolution 1958 to 1987, Ann. Surg. 209 (June (6)) (1989) 698.
[8] P.A. Hunt, I. Greaves, W.A. Owens, Emergency thoracotomy in thoracic trauma—a review, Injury 37 (January (1)) (2006) 1–9.
[9] S. Huerta, T.D. Bui, T.H. Nguyen, F.N. Banimahd, D. Porral, M.O. Dolich, Predictors of mortality and management of patients with traumatic inferior vena cava injuries, Am. Surg. 72 (April (4)) (2006) 290–296.
[10] R.N. Graham, Battlefield radiology, Br. J. Radiol. 85 (December (1020)) (2012) 1556–1565.
[11] B. Onan, R. Demirhan, K. Öz, İ.S. Onan, Cardiac and great vessel injuries after chest trauma: our 10-year experience, Turk. J. Trauma Emerg. Surg. 17 (September (5)) (2011) 423–429.
[12] A.K. Exadaktylos, G. Sclabas, S.W. Schmid, B. Schaller, H. Zimmermann, Do we really need routine computed tomographic scanning in the primary evaluation of blunt chest trauma in patients with "normal" chest radiograph? J. Trauma Acute Care Surg. 51 (December (6)) (2001) 1173–1176.
[13] K. Shanmuganathan, J. Matsumoto, Imaging of penetrating chest trauma, Radiol. Clin. North Am. 44 (2) (2006) 225–238.
[14] J.P. Lichtenberger, A.M. Kim, D. Fisher, P.S. Tatum, B. Neubauer, P.G. Peterson, B.W. Carter, Imaging of combat-related thoracic trauma–review of penetrating trauma, Mil. Med. 183 (March (3–4)) (2018) e81–8.
[15] B.I. Bodai, J.P. Smith, R.E. Ward, M.B. O'Neill, R. Auborg, Emergency thoracotomy in the management of trauma: a review, JAMA 249 (April (14)) (1983) 1891–1896.
[16] D. Feliciano, K. Mattox, E. Moore, Trauma, 7th ed., McGraw Hill, 2012, p. 507.