

Open Chest Wounds and Missed Injuries - A Really Opened Pandora's Box

LUCIANA TEODORA ROTARU¹, RENATA MARIA VĂRUȚ²

¹Department of Emergency Medicine, University of Medicine and Pharmacy of Craiova, Emergency Department & Pre hospital Care, Emergency County Hospital Craiova

²Faculty of Pharmacy, University of Medicine and Pharmacy Craiova

ABSTRACT: The purpose of the study is to highlight the importance of systematic approach and investigation for identification of potential life threatening lesions to a serious injured patients with the presence of obvious other lesions. Material and method: A clinical case patient, with penetrating transfixing chest trauma, severe shock and respiratory distress. Results: HEMS emergency evacuation under aggressive resuscitation, to a regional trauma center. Further clinical examination, imagistic and complex biomarkers revealed cardiac, lung, spleen and spinal cord contusions. Emergency intervention practiced foreign body extraction, extensive exploration, regulate and surgical treatment of the wound trajectory. Two weeks later, the patient has been discharged from hospital without complications. Conclusions: 1. Patient with opened, penetrating chest trauma should be considered and managed as a life threatening situation but the assessment plan and the investigation strategy required should be extensive in order to identify all visceral both thoracic and abdominal tissues injuries, not only the life-threatening one, as cardiac contusion and spinal cord injuries. 2. Cardiac contusion is not a rare event, but a rare confirmed diagnosis, in association with other sources of shock or hypoxia, the result of traumatic complex of lesions, which include cardiac contusion, could thus impact on survival chances. 3. Air evacuation is, the first intention to assist such a patient in the trauma center.

KEYWORDS: missed injury, cardiac contusion, chest trauma, penetrating trauma, FAST, cardiac biomarkers

Background

Opened chest trauma is recognized as a potentially life-threatening situation, especially if trauma is transfixing, high speed penetration, the foreign body may be a large fragment or can fragment itself, is heavily contaminated, the lesion is located in the middle chest floor and trauma is anterior-posterior direction and median [1,2].

Sometimes, although these conditions are fulfilled, the intra thoracic damage initially looks to be minor and evolution of the case benign. Frequently, short time after the event and especially when patients are excessive mobilized, the respiratory and hemodynamic condition worsening, the patient collapses as a consequence of potentially fatal lesion association, frequent hypoxemic, compressive and hemorrhagic [3].

The purpose of the study

It is well know that „the mirage of the first lesion” are a leading cause of missed lesions in severe trauma, as well that there are not really „occult” lesions but only missed lesions. The study aimed to highlight the importance of systematic approach and investigation for identification of potential life-threatening lesions to a serious injured patients with obvious other lesions. Two of the most frequent missed traumatic lesions in thoracic trauma are consider to be spinal cord injury and cardiac contusion.

Case presentation

We are presenting the case of a 48 years old male patient, who, working at home, has fell down from 5 m height, with lateral impact in a fence fragment. After the impact he was alert, with minimal shortness of breath and thoracic pain, but a piece of wood penetrated transfixing his lateral left side thoracic wall, passed though all the thorax and exit from the upper lateral right side thoracic wall. He was brought by his family, with the wood pillar into his thorax to meet on route, HEMS Craiova team, as primary air rescue mission. A written agreement was obtained from the family members after the resolution of the case for acceptance this case presentation.

As the medical resuscitation team arrival on scene, they found a confused and agitated patient, with a Glasgow Coma Scale (GCS) of 13, respiratory rate (RR) of 36/min, high respiratory effort, hemodynamic unstable, blood pressure (BP) of 127/87mmHg, oxygen saturation (SaO₂) of 78%, atrio-ventricular rate (AV) response of 156/min. Clinical examination identified thoracic lateral and anterior subcutaneous emphysema and the absence of breathing noises in the left side chest and diminishing to the opposite side, cardiac noises diminishing, paradoxical pulse.

After stabilization, full immobilization and general anesthesia induced, and vasoactive support established, the patient was air evacuated

into the Emergency County Hospital Craiova - the regional trauma center (Fig. 1a,b)



Fig. 1. a-chest penetrating foreign body, b-chest penetrating foreign body

Left chest drainage was practiced, showing hemo pneumothorax in the amount of approximately 150ml. blood. FAST examination

revealed small blade of fluid only in spleen renal space, a small area of spleen contusion, and none visible pericardial fluid (Figure 2 a,b,c)



Fig. 2. Sonogram images a-fluid blade between spleen and kidney, b-spleen contusion, c-pericardial space

Clinical investigations: normal ECG, borderline normal echocardiography, but abnormal dynamic of myocardial enzymes with increasing values of Creatine kinase Mb from repeated measurements over a period of 5 hours (from 2,9ng/ml to 13,6ng/ml), and Troponin I-0,42ng.ml. Blood laboratory tests showed acute

blood loss corresponding to a level II (compensated) hemorrhagic shock.

CT scan examination (both thoracic and abdominal segments) with contrast substance, both orally and intravenously administered, revealed both the right and left lung contusions and hemo pneumothorax fluid blade, cardiac contusion and a small blade of pericardial fluid,

upper pole spleen contusion, and spinal cord contusion limited at D7-D8 level. Late MRI sustained lung and cardiac contusion diagnosis.

Emergency surgery practiced for foreign body extraction, thorough regularization, and wound dressing and surgical treatment of the penetration trajectory. Postoperative evolution was without complications, the patient being discharged 2 weeks later.

Discussion

Taking into account the location of the injury, and the position and dimensions of the foreign body, time, distance and general circumstances of the evacuation, the medical advanced team has imposed itself a series of imperatives to respond in terms of medical assessment, immediately management and prepare for evacuation and follow-up.

Stabilization of the foreign body [1] was carried out with wide adhesive tape strips and was maintained until the admission in the operating room.

Thoracic spine damages suspicion has been one of the constraints of work felt throughout the evaluation and management of respiratory distress induced by hemo pneumothorax and the mobilization of the patient (for evacuation preparedness, exploration procedures and surgical intervention). Taking under account the mechanism of injury and serious collateral damages, [1,3] we decided a complete immobilization and CT scan certification of suspected and possible missed thoracic lesions [1,4], with the patient under general anesthesia for complete movement control.

Visceral injuries (intrathoracic) suspicion (great vessels and heart [5], esophagus [1,3,4], trachea, bronchi, lungs or pleura) and possibly abdominal border lesions (diaphragm, kidney, spleen, liver) [1,3,4]. All these structures were placed in the penetration area of the foreign body, or nearby, and could suffer injuries at the moment of impact, when the accidentally deployment of a foreign body, at the time of its extraction or transportation [6]. At the same time, the exclusion of all these conditions called for widening the investigation, by the administration of both intravenous and oral contrast substance (certification of the integrity of the esophagus), evaluation of dynamic ECG, FAST, cardiac ultrasound, and cardiac enzymes (presumed myocardial contusion) and abdominal CT scan [7]. Last but not least, thoracic drainage has exposed at increasing bleeding volume, initially buffered by the air pressure of the pleura, if the

source would be an important vessel. The presence of hemo pneumothorax also discouraged the initial decision to establish positive-pressure ventilation and possibly PEEP in their attempt to „manage" pulmonary contusion area, for spontaneous ventilation maintaining and assumed permissive hipercapnia [1,3,4,7].

Miocardial contusion was from the start a working hypothesis, especially if the worsening clinical shock degree was difficult to explain only trough hemorrhagic shock, even from multiple sources. Despite normal ECG and echocardiography, cardiac biomarkers dynamic strongly suggest cardiac contusion [8], sustained by further CT scan and MRI. Under these conditions, with myocardial function disturbed by myocardial contusion, by secondary failure induced by both the neurogenic shock and hypoxemia and also maintained by the hemorrhage, the attempt to recover the shock had encountered difficulties in rapid refill [1,3,7], requiring blood administration (2 units) and association of a strong and sustained positive vasoactive support.

Pulmonary contusion-bilateral expanded, even partial compensated by setting general anesthesia and ventilatory support [9] and chest drainage, was a cause of a supplementary right ventricular failure after load augmentation which affected the effectiveness of volume loading in attempt to compensate the shock. Also, the need for establishing PEEP in order to optimize the oxygenation of contusion areas was limited on one hand because of the poor venous return, and on the other hand, by the levels of shock; thus, it has been used discontinuous, low levels of PEEP (4-6), as the shock was controlled [1,3,6,7].

Air evacuation issue as a mean to satisfy golden hour standards, [10] required active monitoring of respiration efficiency and quantity of exhaust air and blood on the chest drain, taking into account the decision to assist ventilation, the adaptation of management behavior needs in case of installation of the shock, all of which are sensitive items. This adds to the vulnerability of the patient in accordance with the changes in atmospheric pressure at takeoff and landing moments, and during the flight with an unpressurized air evacuation means (helicopter) even for short time expected transfer. General anesthesia inducing decision through the sequence of crush induction [9,11] was largely conditional upon the air evacuation imperative and endotracheal intubation [11] and has been delayed as the ventilation with positive pressure, given the

presence of pneumothorax, until chest drainage [1,2,3].

Investigation and strategy of surgical management on arrival to the trauma center.

The fact that upon arrival at the regional trauma center the patient was hemodynamically and respiratory unstable but its condition has improved after pleural effusion evacuation, and taking into account the small amount of blood discharged by the chest drainage encouraged an immediate laboratory and imaging balance sheet realization based on initially anticipated life-threatening lesions, and possible at the patient's bed side (such as FAST examination extended for thorax and cardiac) [12] in the resuscitation room. Some postponed stages of examination realized after stabilization procedures, aiming the identification of non fatal but elective for angiographic or surgical lesions (such as various cardiac lesions could be) [4,5], or for monitoring (such as spinal cord injury) [1,2,3].

Retrospective, because of the elements of hemodynamic instability, we appreciate that the decision for the identification with higher accuracy of the injuries in order to practice more targeted interventions in relation to the first decision for surgical intervention, both quickly and extended, both for diagnosis and damage control, was the correct one.

Conclusions

Any opened or penetrating chest trauma should be considered as a life-threatening situation to extent of certain exclusion of any critical or life-threatening injuries. According to the cinematic of trauma, a number of lesions considered with lower probability (because of rare clinical appearance) have yet to be methodically and gradually investigated to certainly exclude/confirm all aspects likely to influence the patient's prognosis and evolution. In line with this concept, cardiac contusion is not a rare event, but a rare confirmed diagnosis because of a rare suspicion and adequate investigation. In association with other sources of shock or hypoxia, the result of traumatic complex of lesions which include cardiac contusion, could impact survival chance

The assessment plan and the investigation strategy required were extensive in order to identify both thoracic and abdominal tissue injuries and spinal cord injuries, together with a

prioritization to first satisfy damage control concept, thus air evacuation is, from the beginning, the first intention to optimal assist and evacuate to the trauma center such a patient.

Acknowledgements

No any actual or potential conflict of interest or financial to declared.

References

1. Tintinalli JE, Stapczynski JS, Ma OJ, Yealy DM, Meckler GD, Cline DM. Tintinalli's Emergency Medicine: A Comprehensive Study Guide. In: Tintinalli JE, Stapczynski JS, Ma OJ, Yealy DM, Meckler GD, Cline DM (Eds), 2015, 8th edition McGraw-Hill Professional, London.
2. Shahani R, Galla JD. Penetrating Chest Trauma. In: Milliken JC, Talavera F, Schwartz DS (Eds), Medscape, WebMD LLC, 2015, accessed 2017.
3. Marx J, Hockberger R, Walls R. Rosen's Emergency Medicine-Concepts and Clinical Practice: Expert Consult Premium Edition, 2016, 8th edition Elsevier, London.
4. Buduhan G, McRitchie DI. Missed Injuries in Patients with Multiple Trauma. J Trauma; 2000; 49(4):600-605
5. Hanschen M, Kanz KG, Kirchhoff C, Khalil PN, Wierer M, van Griensven M, Laugwitz KL, Biberthaler P, Lefering R, Huber-Wagner S. Blunt Cardiac Injury in the Severely Injured-A Retrospective Multicentre Study, Plos One; 2015;10(7):e0131362
6. Bulger EM, Guffey D, Guyette FX, MacDonald RD, Brasel K, Kerby JD, Minei JP, Warden C, Rizoli S, Morrison LJ, Nichol G. Impact of prehospital mode of transport after severe injury: a multicenter evaluation from the Resuscitation Outcomes Consortium, J Trauma Acute Care Surg; 2012; 72(3):567-573
7. Pryor J.P., Pryor R.J., Stafford P. Initial phase of trauma management and fluid resuscitation, Trauma Reports; 2002; 3(3): 1-12
8. Martin M, Mullenix P, Rhee P, Belzberg H, Demetriades D, Salim A. Troponin increases in the critically injured patient: mechanical trauma or physiologic stress? J Trauma; 2005; 59(5):1086-1091
9. Sikorski, R.A., Koerner, A.K., Fouche-Weber, L.Y. et al. Choice of general anesthetics for trauma patients, Curr Anesthesiol Rep; 2014; 4(3): 225-232
10. Talving P, Teixeira PG, Barmparas G, DuBose J, Inaba K, Lam L, Demetriades D. Helicopter evacuation of trauma victims in Los Angeles: does it improve survival? World J Surg; 2009; 33(11):2469-2476
11. Wang H.E., Yealy DM. Out-of-hospital rapid sequence intubation: is this really the "success" we envisioned? Ann Emerg Med; 2002; 40(2):168-171
12. Mandavia DP, Hoffner RJ, Mahaney K, Henderson SO. Bedside echocardiography by emergency physicians, Ann Emerg Med; 2001; 38(4):377-382

Corresponding Author: Luciana Rotaru, Department of Emergency Medicine, University of Medicine and Pharmacy of Craiova, Medical Director Emergency Department & Pre hospital Care, Emergency County Hospital Craiova, Tabaci St. no. 1, 200642, Dolj County, e-mail: lucianarotaru@yahoo.com Craiova