



BLUNT TRAUMA INTERCOSTAL LUNG HERNIATION AND DELAYED EXTRA PLEURAL HEMATOMA

Tino Klancir¹, Višnja Neseek Adam^{1,2,3}, Sanja Berić^{1,3}, Martina Matolić¹,
Elvira Grizelj Stojčić¹ and Aleksandra Smiljanić¹

¹University Department of Anesthesiology, Resuscitation and Intensive Care,
University Hospital Sveti Duh, Zagreb, Croatia;

²Josip Juraj Strossmayer University of Osijek, Faculty of Medicine, Osijek, Croatia;

³Josip Juraj Strossmayer University of Osijek, Faculty of Dental Medicine and Health Care, Osijek, Croatia

SUMMARY – Blunt chest trauma is an important cause of morbidity and mortality in traumatized emergency patients. We report the case of a 74-year-old man who suffered a glenohumeral joint dislocation, trans trochanteric femur fracture, multiple rib fractures, diaphragmatic rupture with chest herniation of the spleen and stomach associated with herniation of the lung through an anterior chest wall defect after blunt trauma. Although immediate surgical repair was performed, he developed a delayed complication of multiple rib fracture in the form of large extrapleural hematoma that had to be surgically removed. Due to massive pulmonary contusion and prolonged pulmonary collapse, we used surfactant to facilitate alveolar opening after evacuation of the hematoma.

Key words: Chest trauma, lung herniation, extrapleural hematoma, diaphragmatic rupture, surfactant

Introduction

Traumatic lung herniation is an extremely rare, potentially life-threatening condition, caused by the rapid increase in intrathoracic pressures coupled with defects in the chest wall. It is defined as a protrusion of lung tissue from the thoracic cavity through an abnormal opening in the chest wall, diaphragm or mediastinum.¹ Because of its extreme rarity traumatic lung herniation has been reported mainly as case reports in the literature and its incidence and prevalence are unknown.² Although there is no consensus on the management of lung herniation, surgical repair is generally recommended. We report a patient suffering from multiple injuries including intercostal lung herniation that was surgically repaired and delayed complications in the form of large organized extrapleural hematoma.

Case report

A 74-year-old man suffered blunt chest trauma and presented to our emergency room complaining only about severe left shoulder pain. There was no history of loss of consciousness. During primary survey, the patient was in stable hemodynamic and respiratory condition. Oxygen saturation was maintained at a level of 96% on oxygen supplement. Blood pressure was 120/70 mmHg and pulse rate was 115 beats per minute. The Glasgow Coma score was 15. Examination revealed flail chest and subcutaneous emphysema with decreased breath sound on the left side. Further evaluation revealed clinical suspicion of a left femur fracture and a dislocated left shoulder. A whole-body computed tomography (CT) scan was notable for ventral intercostal left lung herniation (Figure 1.A), a rupture of the left hemi-diaphragm associated with herniation of the stomach and spleen into the chest (Figure 1B.), left-side fractures of the 1st to 3rd and 4th to 11th rib that were significantly displaced (Figure 2.), right-side fracture of the 3rd to 6th rib, left-side hemothorax and

Corresponding author: Prof. dr. sc. Višnja Neseek Adam, prim. dr. med.,
University Hospital Sveti Duh, Sveti Duh 64, Zagreb, Croatia
E-mail: visnja.neseek@hotmail.com

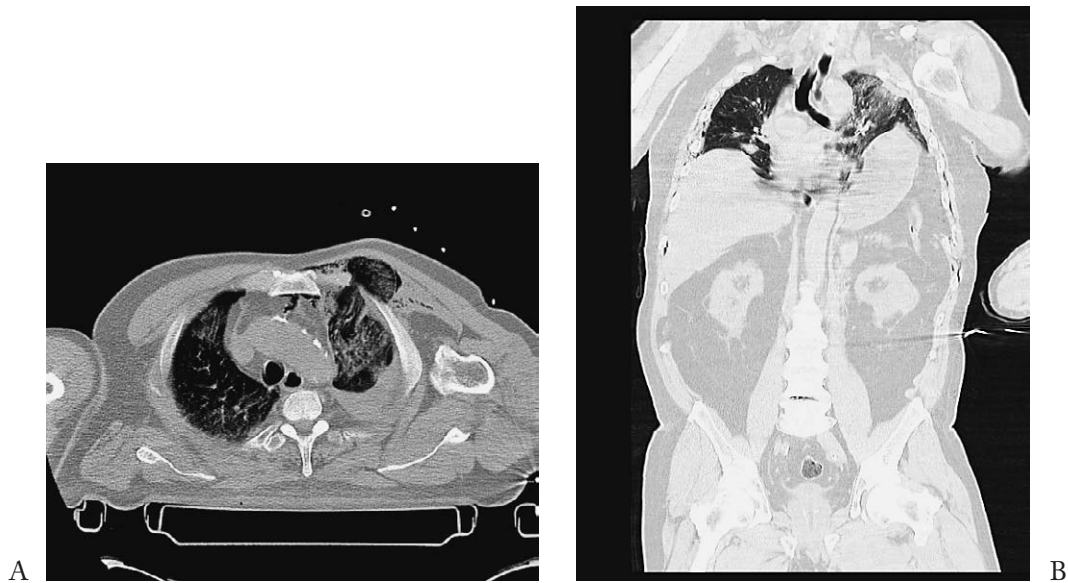


Figure 1 A. Ventral intercostal left lung herniation and Figure 1 B. Herniation of the stomach and spleen into the chest

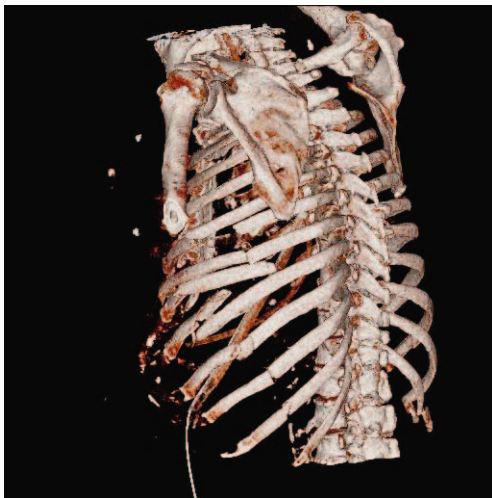


Figure 2. 3D reconstruction of left-side rib fractures that are significantly displaced

pneumothorax, insignificant right - side pneumothorax, dislocation of left glenohumeral joint, and trans trochanteric fracture of the left femur. The decision was made for an emergency thoracotomy to repair the lung herniation. A left thoracotomy in right decubitus position was performed. The abdominal organs were reduced to their normal anatomic position and a diaphragmatic defect was repaired. Further hemostats sutures to the thoracic wall and lung sutures due to left lung laceration were done. The left lung was reposi-



Figure 3. Complete left lung collapse due to extrapleural hematoma

tioned, and its full re-expansion was achieved. After surgery, the patient was admitted to ICU, sedated and mechanically ventilated due to unstable left chest wall with thoracic drainage on the left side.

The patient was ventilated on the bilevel positive airway pressure modalities. Therapeutic bronchoalveolar lavage with flexible fiberoptic bronchoscopy (FOB) was done routinely or when clinically indicated. After subcutaneous emphysema was resolved, transesophageal echocardiogram was performed and showed no cardiac injury. On day 10 a surgical tracheostomy was performed under general anesthesia to facilitate respi-

ratory wean with simultaneous osteosynthesis of left femur. On day 16 the patient was successfully weaned from mechanical ventilation.

After a short period of clinical and functional improvement, the patient's respiratory condition worsened. Because of a complete left lung collapse observed on the CT scan (Figure 3,) re-thoracotomy was performed on the day 23. Intra-operatively, the patient was found to have a large extrapleural hematoma. Surgery included dissection of the pleural adhesions, evacuation of the large hematoma and decortication with the aim of obtaining the largest possible pulmonary expansion. Shortly after re-admission to ICU, a bronchoalveolar lavage (BAL) was performed by FOB and 240 mg of surfactant (Curosurf, Chiesi Pharmaceuticals) diluted with 20 mL of 0.9% NaCl was inserted into the distal layers of the left lung. The patient was successfully weaned from the ventilator on post-operative day 1. Intense respiratory therapy was performed and showed remarkable improvement in respiratory condition. On the day 29, the tracheostomy tube was removed. A pulmonary function test revealed moderately restrictive and obstructive pulmonary ventilation impairment and further radiographic examination revealed almost complete re-expansion with only a very small atelectatic area remaining in the lung.

Discussion

Progressive worsening of left lung on the chest X-ray after the first surgical intervention was noticed, but initially it had no negative respiratory contribution. We thought it was atelectasis, but since it did not resolve on repeated bronchoscopy procedures, we suspected that the cause was of extra pleural origin. The CT revealed a large extrapleural hematoma. The presence of extra pleural fat sign on the CT scans is a typical radiological finding of extrapleural hematoma.³ In blunt trauma, rib fractures can result in small vascular tears of intercostal vessels with slow blood accumulation in extrapleural space forming extrapleural hematoma. The incidence of this finding is 7.1%.⁴ It is often misdiagnosed as hemothorax.⁵ If the chest drain is in the correct position and not occluded, the blood would be evacuated, but in this case the drain was occluded by massive adhesions. As the parietal pleura was sutured, the patient did not develop pleural hemothorax, but extra pleural hematoma.

Direct and indirect lung injuries can also result in the dysfunction of lung surfactant and atelectasis may impede the function of surfactant.⁶ Such decreased function results in reduced alveolar stability and causes alveolar collapse. Due to large contusion of the left lung and prolonged atelectasis, we decided to use the surfactant after surgical evacuation of extrapleural hematoma because of surfactants stabilizing effect on the alveoli, which may improve the recruitment of non-ventilated alveoli or prevent end-expiratory collapse. Furthermore, due to the direct mechanical trauma to the lung parenchyma from herniation, a state of alveolar leakage of proteins may have led to some degree of surfactant dysfunction that exacerbated the lung injury and alveolar collapse.⁷ It is described that BAL facilitates removal of breakdown products and blood components, the recruitment of contused lung regions and the maintenance of surfactant pool size.⁸ BAL and surfactant probably blocked the inflammatory cascade (biotrauma). In conclusion, further studies about surfactant administration as treatment option for pulmonary contusion are warranted.

Acknowledgement

This paper was not financially supported by third parties. It was completely done by the authors listed.

The authors have no conflict of interest.

References

1. Mirvis SE. Imaging of acute thoracic injury: the advent of MDCT screening. *Semin Ultrasound CT MR.* 2005;26(5): 305-31. 10.1053/j.sult.2005.08.001
2. Chiang TY, Yin MF, Yang SM, Chen KC. Thoracoscopic management of incarcerated lung herniation after blunt chest trauma: a case report and literature review. *J Thorac Dis.* 2017; 9(3):E253-E257. 10.21037/jtd.2017.03.41
3. Choi YS, Kim SJ, Ryu SW, Kang SK. Traumatic Extrapleural Hematoma Mimicking Hemothorax. *J Trauma and Inj.* 2017; 30(4):202-205. 10.20408/jti.2017.30.4.202
4. Rashid MA. Value of video-assisted thoracic surgery in traumatic extrapleural hematoma. *Thoracic Cardiovascular Surg.* 1999;47(4):255-7. 10.1055/s-2007-1013155
5. Chung JH, Carr RB, and Stern EJ. Extrapleural hematomas: imaging appearance, classification, and clinical significance. *J Thorac Imaging.* 2011; 26, 218-23. 10.1097/RTI.0b013e3181eabeaba
6. Blanco O, Pérez-Gil J. Biochemical and pharmacological differences between preparations of exogenous natural surfactant used to treat respiratory distress syndrome: role of the different

- components in an efficient pulmonary surfactant. *Eur. J. Pharmacol.* 2007;568(1-3):1–15. 10.1016/j.ejphar.2007.04.035
7. Kaliyadan A, Kebede A, Ali T, Karchevsky M, Vasseur B, Patel N. Spontaneous Transient Lateral Thoracic Lung Herniation Resulting in Systemic Inflammatory Response Syndrome (SIRS) and Subsequent Contralateral Lung Injury. *Clin Med Insights Case Rep.* 2011; 4:39–42. 10.4137/CCRep.S7002
8. Strohmaier W, Trupka A, Pfeiler C, Thurnher M, Khakpour Z, Gippner-Steppert C, et al. Bilateral lavage with diluted surfactant improves lung function after unilateral lung contusion in pigs. *Crit Care Med.* 2005; 33(10):2286–93. 10.1097/01.ccm.0000182819.11807.16

Sažetak

INTERKOSTALNA HERNACIJA PLUĆA NAKON TUPE TRAUME I ODGOĐENI IZVAN PLEURALNI HEMATOM

T. Klancir, V. Neseck Adam, S. Berić, M. Matolić, E. Grizelj Stojčić i A. Smiljanić

Trauma prsnog koša uzrokovana udarcem tupim predmetom značajan je uzrok mortaliteta i morbiditeta bolesnika u hitnoj medicinskoj službi. Prikazujemo slučaj sedamdesetčetverogodišnjeg bolesnika koji je kao posljedicu udarca teškim predmetom doživio dislokaciju ramenog zgloba, transtrohanternu frakturu bedrene kosti, obostranu serijsku frakturu rebara, rupturu dijafragme s hernijacijom slezene i želuca u prsište uz pridruženu interkostalnu ventralnu hernijaciju pluća kroz ozlijeđeno prsište. Unatoč hitnom kirurškom zbrinjavanju, kao kasna posljedica serijskog prijeloma rebara razvio se veliki izvan pleuralni hematoma koji je bilo potrebno kirurški evakuirati. Zbog velike kontuzije pluća i dugotrajnog kolapsa alveola, nakon odstranjenja hematoma primijenili smo surfaktant kako bi potpomogli otvaranje i održavanje alveola otvorenima.

Ključne riječi: *trauma prsnog koša, plućna hernijacija, hematoma prsnog koša, ruptura dijafragme, surfaktant*