CASE REPORT

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TREE BRANCH PENETRATING CHEST TRAUMA: CLINICAL CASE REPORT AND RETROSPECTIVE STUDY

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Abstract. *Thoracic trauma, both blunt and penetrating, is a common and potentially life-threatening condition, which often requires multidisciplinary approach. Almost half of all polytrauma cases are associated with the presence of chest injuries, which could potentially become the main cause of death. According to the conducted retrospective analysis for a 1-year period to our clinic were admitted 71 patients with chest trauma, 94,4% of which – blunt trauma. The most common mechanism of trauma was falling, followed by traffic accidents. Pneumothorax or hemopneumothorax was diagnosed in more than half of all cases, and thoracic drainage placement as a primary surgical intervention was performed in 56,34% of cases. Despite these facts, there is still no generally accepted algorithm for the management of such patients. We present a clinical case of penetrating thoracic trauma, caused by tree branch falling on a moving car, managed by performing an urgent thoracotomy. The patient was extubated on the first and discharged on the 13th postoperative day without any complications, and the lung parenchyma expanded.*

Key words: *thoracic trauma, chest trauma, thoracocentesis, drainage*

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INTRODUCTION

Thoracic trauma is a common cause of death in many polytraumatized patients. Ribs fractures and contusion changes can potentially lead to severe pain syndrome or chest instability and further complications such as pneumonia. Traumatic pneumothorax compromises breathing, continuous active bleeding could cause hemorrhagic shock or lead to retained hemothorax with further fibrothorax or pleural empyema development, sternum fracture could be related to heart contusion, accumulation of pericardial effusion and potential hemodynamic threatening. Adequate management of such cases and individual treatment plan corresponding to recognized guidelines are crucial aspects in prevention of possible complications.

CASE REPORT

An 18-year-old male patient was admitted to the emergency department after a car accident with signs of traumatic shock. According to paramedics a tree branch fell on the moving car, penetrated the windshield and subsequently the patient's chest. Physical examination revealed the presence of

the hemithorax puncture wound caused by a foreign body, entering chest cavity through the supraclavicular fossa above middle third of the clavicle, with a caudal course ending subcutaneously along the left paravertebral line; breath sounds on the left side were absent (Fig. 1A). Blood pressure immediate after admission – 105/79 Hg mm; pulse – 110 beats/min; AI = 1.05.

Performed laboratory tests revealed HGB / hemoglobin – 154 g/l; HCT / hematocrit – 0.49; APTT (sec.) – 27.0; APTT (ratio) – 0.79; fibrinogen – 1.92 g/l; Prothrombin time (sec.) – 12.5; Prothrombin time (%) – 89.48; Prothrombin time (INR) – 1.12; pH – 7.30; pO_2 – 276.37; pCO_2 – 37.75; HCO_3 – 18.0; SBC – 18.5; BEb – 7.6; BEecf – 8.4; tCO_2 – 18.9; O_2Sat – 99.6%.

Due to the presence of a total traumatic pneumothorax on the left, a thoracocentesis was urgently performed and a chest drain was placed, after which a full body CT was performed (Fig. 1B).

CT scan revealed the presence of a foreign body (tree branch) entering the left hemithorax supraclavicularly, continuing in the thoracic cavity to the 8th intercostal space along the scapular line ending subcutaneously at the level of L3 paravertebrally; fracture of the 3rd rib along two lines, with an 8 cm free fragment displaced intrathoracically; fracture of the 10th rib on the left along the scapular line and the 11th rib paravertebrally; subcutaneous emphysema of the left cervical region, left hemithorax and left lateral region of the abdominal wall; lacerations and contusion changes in the dorsal segments of the left upper and lower lung lobes along the course of the foreign body. No lesions of the main vessels were detected. The foreign body was imaged in contact with the left diaphragmatic dome dorsally, without CT signs of diaphragm disruption or penetration into the abdominal cavity (Fig. 2).

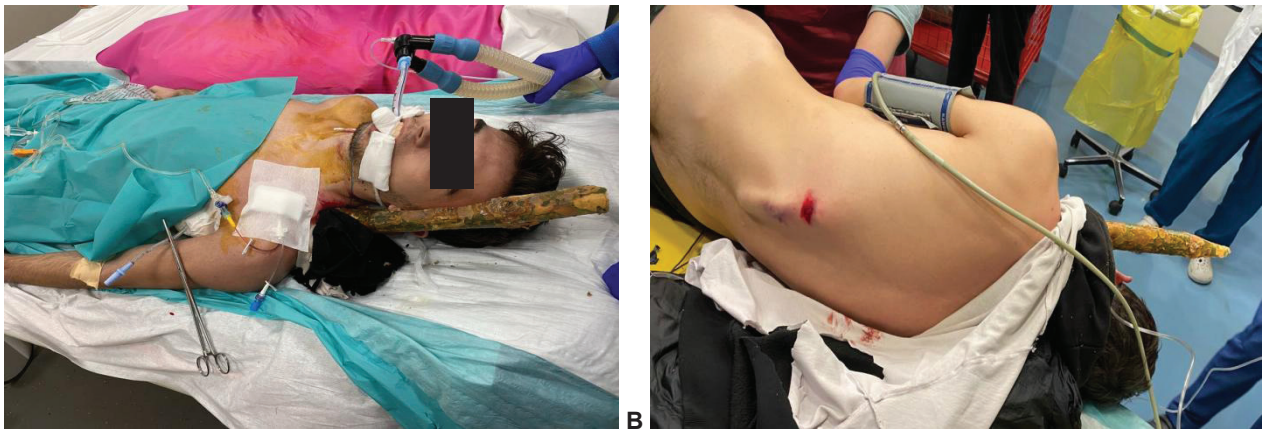

Fig. 1A – patient after admission to the emergency department, **B** – patient after intubation and chest drainage placement

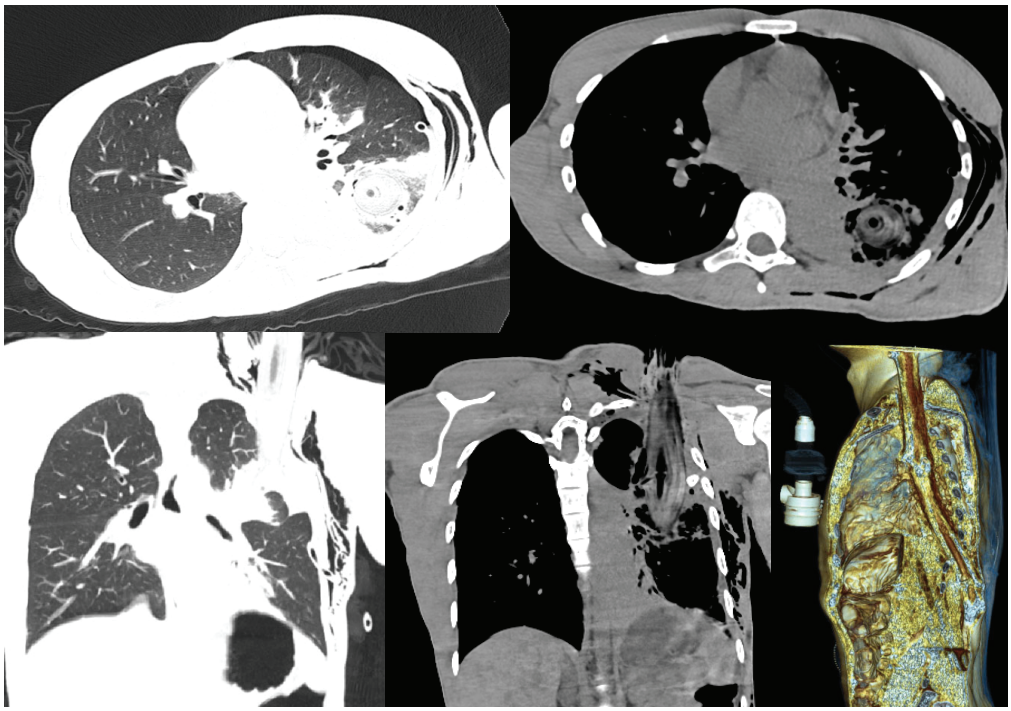

Fig. 2. Emergency CT scan performed after admission

After a brief discussion, emergency operative treatment was performed. Under general anesthesia left anterolateral thoracotomy was performed in the 5th intercostal space. Foreign body was found penetrating laterally to the neck, passing through thoracic cavity mainly dorsally, damaging posterior segments of the left lung, leaving pleural cavity through the 8th intercostal space, ending in the soft tissues in the left thoracodorsal region. Approximately 30 cm of the tree branch were located intrathoracically. Partial resection of the 3rd rib was performed due to polyfragment fracture. The foreign body was extracted in a cranial direction. A wound channel was found passing through the 3rd, 6th and 9th segments with a transparenchymal course. Devitalized tissues were removed and atypical resection of the damaged segments was performed. After the lavage of the pleural cavity with antiseptic solutions, mechanical and chemical pleurodesis were performed. Definitive hemostasis was achieved using electrocoagulation and local hemostatic sponges. Two thoracic drainages were placed ventrally and dorsally to the lung parenchyma.

The entrance lacero-contusion wound was located in the medial part of the left supraclavicular region, had a linear shape and the length of approximately 5 cm. The wound channel had an oblique course, tearing the muscles and apical parietal pleura. The wound was revised, devitalized soft tissues were removed, lavage with antiseptics was performed. A tube drain was placed and fixated to the skin.

A skin incision about 5 cm long was made in the left thoracolumbar region above the site of the protruding distal end of the foreign body. The wound canal was also treated with antiseptic solutions and drained with a tube drain. The wounds were covered with dry sterile dressings.

Postoperatively, the patient was admitted to the intensive care unit, where he was extubated on the first postoperative day. On the 8th postoperative day, the patient was transferred to the surgical department, from where he was discharged afebrile, with primary healing surgical wounds and expanded lung parenchyma on the 13th postoperative day (Fig. 3).

DISCUSSION

According to the data of the World Health Organization injuries related to road accidences are the 8th leading cause of death across all age groups and especially among young people aged 30-49. In 2016 the mortality rate of 1,35 million was registered globally due to traffic accidences (Fig. 4) [1].

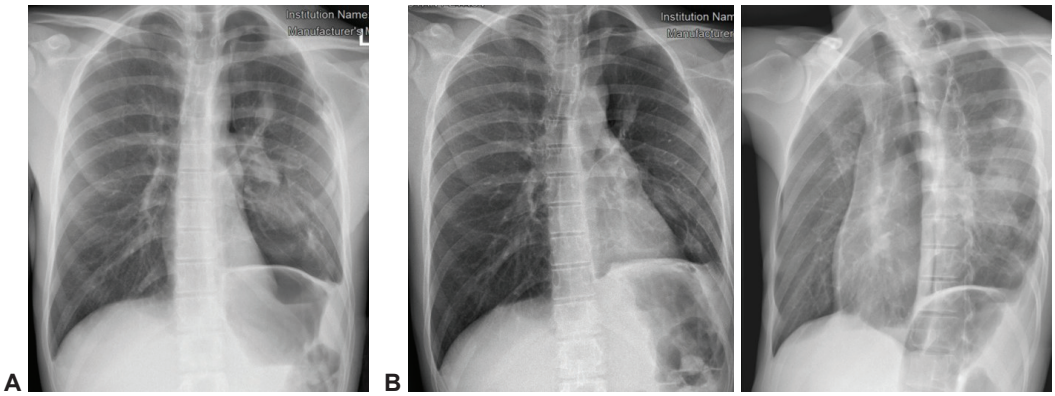

Fig. 3. Chest X-ray: **A** – on the 13th postoperative day, **B** – on the 26th postoperative day

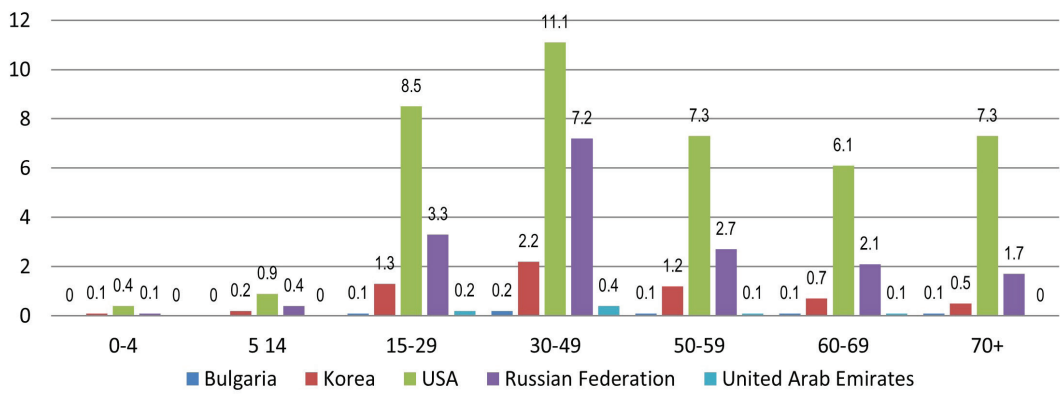

Fig. 4. Estimated deaths (,000) related to road injuries in 2019 by countries and age groups

In about 50% of polytraumatized patients serious chest injuries are reported as a main cause of death [2].

According to the conducted retrospective analysis, performed using hospital database "Gama Consult", during the period between 1.01.2024 and 2.01.2025 in the Second Surgical Clinic, Department of Thoracic Surgery UMHAT "N. I. Pirogov" 71 patients with thoracic trauma were treated: 71,8% (n = 51) males and 28,2% (n = 20) females. Overall, 56,34% of cases were caused by falling, 19,72% were due to traffic accidents, 7,0% as the result of a fight, 4,23% were related to homicide attempts and 12,67% caused by other reasons. Most of the chest traumas were blunt – 94,4% (n = 67), and 5,6% (n = 4) were penetrating. Thoracic trauma, associated with pneumothorax was diagnosed in 29,58% (n = 21) of cases, with hemopneumothorax in 26,76% (n = 19), with hemothorax in 9,86% (n = 7); chest contusion without signs of hemopneumothorax was diagnosed in 25,35% (n = 18) and sternum fractures were detected in 8,45% (n = 6) of cases.

Thoracocentesis and thoracic drainage placement as primary procedure was performed in 56,34% (n = 40) of cases, and the most commonly used drainage sizes were 20-24 Fr. Further surgical interventions in this group were required in 12,5% (n = 5): in 1 case for achieving definitive hemostasis due to continues bleeding, in 1 case for retained hemothorax, and in 3 cases due to posttraumatic pleural empyema development. Primary surgical treatment was performed in 4,2% (n = 3) of cases: in 1 case of active bleeding and hemorrhagic shock, and in 2 cases after blunt chest trauma complicated with empyema development due to delayed hospitalization.

Total mortality rate was 11,3% (n = 8). 14% (n = 10) of all patients required treatment in the ICU department mostly due to complicated polytraumas with lethality of 30% (n = 3) in this group and median hospital stay length of 34,67±8,03 days (and 1 case of 217 days of hospitalization due to tracheoesophageal fistula development). For patients, treated in surgical clinic, both conservatively and surgically, mean length of hospital stay was 4,57±2,68 days. There was 1 case of readmission and rethoracocentesis due to pneumothorax recurrence with general duration of hospitalization of 8 days. The most commonly used antibiotics for the prevention of infectious complications were ciprofloxacin and levofloxacin.

Even though chest traumas are commonly associated with the presence of rib fractures and lung contusion, and despite high mortality and morbidity, especially among patients older than 65, the question of primary management of this condition remains to be a topic of discussion [21, 22]. Wells B.J. et al in their retrospective analysis report 47,14% increased length of hospital stay and higher risk of empyema development after thoracic tube drainage placement without significant benefits in mortality rates compared to the group of patients, managed conservatively [3]. Due to these facts and the risks of complications, chest tube placement should be considered only in cases of severe thoracic trauma associated with flail chest, presence of hemopneumothorax, or massive hemothorax, especially with signs of hemodynamic instability or traumatic shock. When taking a decision about performing thoracocentesis, it is also essential to remember that patients with hemothorax volume under 300 ml have a probability of spontaneous resolution between 72 to 92% [3, 8, 9].

Oncel M. et al report the necessity of thoracic drainage placement as a primary procedure in 69,4% of blunt and in 30,6% of penetrating chest trauma cases, with further emergency surgical interventions required in 7,6% and 92,3% in each group [4]. The indication for urgent surgical revision according to Pohnán R. et al is active bleeding through the inserter chest drain more than 1500 ml per 24 hours or more than 200 ml per hour in 5 hours. Authors suggest performing minimally invasive procedures for all hemodynamically stable patients as the method of choice [5].

Potentially life-threatening complication of chest trauma is retained hemothorax, which occurs in about 20% of all cases and has 19,5% probability of posttraumatic pneumonia development, and such complications as fibrothorax or pleural empyema [6, 7]. VATS is the method of choice in these cases, and time remains a crucial factor for achieving satisfactory lung expansion. Abid A. et al report a complete lung expansion in 71,9% of patients who underwent a thoracoscopic procedure for retained hemothorax during the first week after chest trauma, and in 28,1% of patients who underwent the same intervention during the second week, with 84,4% shorter hospital stay in the first group [10]. Performed during the first 5 days after complicated blunt thoracic trauma, VATS helps to significantly reduce the length of hospital stay and decreases the probability of conversion from 29,4% to 8% [13]. According to Lin HL et al., out of 958 patients with blunt chest trauma and more than 3 fractured ribs, 532 patients (55,5%) developed hemopneumothorax or hemothorax, which required a drainage placement. 128 of 532 patients (24%) required further VATS due to retained hemothorax. Authors highlight that VATS combined with ribs fixation reduces the necessity of postoperative mechanical ventilation, length of air leak and overall hospital stay and decreases the usage of analgesics and complications rate [17].

Penetrating chest traumas in civil areas are most commonly caused by stab wounds or gunshots,

while in war zones, where thoracic injuries account for around 12% of all combat injuries, 48% of the cases are related to shrapnel wounds, and associated with higher risk of infection complications [18, 19, 20]. Solid amount of penetrating traumas, though, can still be managed conservatively or with adequate placement of thoracic drainages [18]. In cases, requiring surgical interventions, thoracotomy or median sternotomy remain the most common procedures for hemodynamically unstable patients, which should be performed in the first 90 minutes after hospital admission in order to reduce complication rates [11, 12].

For hemodynamically stable patients thoracoscopic procedures could be successfully used as well for the evaluation of chest trauma severity as for further surgical interventions: achieving hemo- and aerostasis, extraction of foreign bodies under visual control, treating of retained hemothorax or early stages of empyema, etc. [14, 15]. VATS, if possible, can be also successfully used to confirm and treat the diaphragm injuries, which according to different authors may occur in 15-35% of all penetrating chest trauma cases [14, 16].

CONCLUSION

Chest trauma is a common pathology both in civil areas and war zones, often associated with early and delayed serious complications and death. Adequate management of these patients, individual decision taking related to primary conservative and surgical treatment in the conditions of emergency is crucial in achieving satisfactory results, decreasing length of hospital stay, complications and mortality rates.

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