Features of the course of penetrating thoracic wounds with intrathoracic foreign bodies

I. D. Duzhyi, S. O. Holubnychyi, R. Z. Elastal, V. V. Bryanyk, O. P. Yurchenko, P. I. Proskurnia

1Sumy State University, 2Sumy Regional Clinical Hospital

According to the literature, medical and sanitary losses during hostilities are caused by mine and bullet injuries, the frequency of which reaches 25–60% [1–3]. Military personnel suffer most often in combat, with a slightly lower incidence (23.76%) among the civilian population [4]. Thoracic injuries account for up to 12% of total combat injuries [1]. Intrathoracic injuries, which are, of course, penetrating, are characterised not only by the presence of foreign bodies (bullets, ammunition fragments, parts of surrounding objects and clothing), but also by infection [5–7].

Depending on their location in the pleural cavity or lung, foreign bodies can put pressure on tissues, nerve roots and nerves that are sensitive to irritation, which are part of various plexuses, including cardiac, aortic, esophageal, small and large vessels, which can cause acute bleeding and long-term bleeding due to erosion of the vessel walls and haemostasis disorders. In view of this, it is recommended to remove foreign bodies immediately if their size is more than 10 mm [8, 9]. However, it is advisable to remove them in specialised thoracic departments, and those located in the pericardium or heart – in cardiac surgery departments [10]. The above substantiates the urgency of the problem and explains our desire to share with the medical community and thoracic surgeons our observations on the peculiarities of the course of wounds caused by the use of non-standard UN-banned bullets with a shifted centre of gravity, and penetrating wounds caused by shell fragments, which can be localised unpredictably, creating insurmountable difficulties for some victims in diagnosing foreign bodies, which can result in nerve damage and the formation of pleural empyema. The course of the latter depends on the circumstances and can become chronic, when major surgical interventions such as pleurectomy are necessary to prevent the formation of a chronic pulmonary heart [8–10].

We followed two patients who were admitted to the thoracic department 1 and 1.5 months after a penetrating chest wound. The examination of both patients was standard with the use of computed tomography (CT) and ultrasonography, but it was not possible to obtain sufficiently objective clear signs. The results of clinical examinations of both patients indicated the presence of an inflammatory process (leukocytosis and a shift in the blood formula to the left against a significant blood clotting rate), which was the basis for the use of a minimally invasive intervention – video thoracoscopy in one of them, and pleurectomy in the other. The blood coagulogram of both patients showed signs of hypercoagulation.

Taking into account the peculiarities of the wound and the unique and severe course of the wound trauma process, we consider it appropriate to provide a summary of the medical histories of both victims.

1. Patient U., born in 1984, a resident of Konotop, while fleeing in his car from the Russian occupiers, came under fire. The bullets broke the front window. He felt weakness in his right hand, which was used to shift the gear lever. At the same time, I felt general weakness and signs of dizziness. He managed to get to the hospital in 15 minutes. His general weakness increased significantly, his body felt like cotton wool, and his right arm stopped working. The doctors who examined him found his shirt and jacket soaked in blood. His systemic blood pressure was 90/60 mm Hg, and his tachycardia reached 110 in 1 minute. In the posterior part of the right hemithorax, the entry wound of a gunshot wound with a trickle of blood was found. Given the general condition of the victim, the state of haemodynamics, the absence of vocal tremor over the right hemithorax, dullness on percussion in the same place, intrapleural bleeding was noted. Indications for surgical intervention were established on the basis of vital signs.

After a short-term infusion preparation with fibrinogen under intravenous infusion anaesthesia, an anterolateral right-sided thoracotomy was performed. A significant amount of blood was found in the pleural cavity, which was collected and reinfused with about 600 ml; two torn wounds with significant bleeding were found in the lower and upper lobes of the right lung. A hardware pneumonectomy was performed. Additional revision of the pleural cavity. No foreign bodies were found. The pleural cavity was drained with a rubber tube. On the 6th day after surgery, bronchial stump failure was detected. Conservative therapy was ineffective, but the patient remained in hospital.
After the invaders were expelled from the territory of the region, the patient was transferred to the thoracic ward. Upon admission to the thoracic ward, he complained of shortness of breath, weakness, pain in the right shoulder girdle, clavicle, weakness in the right arm, which made it impossible to control it, dry skin of the arm, and pain when touching it. Neurological examination: active movements in the right upper limb were significantly limited, muscle strength in the right upper limb was reduced to 2 points, right flexor elbow and carpal tunnel reflexes were significantly reduced, hypesthesia in the VI–XVIII nerve on the right. Active examination (CT and bronchoscopy) revealed the presence of a metal object (bullet) in the posterior–upper mediastinum on the right, and a 2 mm right main bronchial stump failure. Coagulogram: fibrinogen 6.88 g/l, plasma tolerance to heparin 9 minutes, plasma recalification time 70 seconds, international normalised ratio 1.09, activated partial thromboplastin time 34.20 seconds. Taking into account the condition after pneumonectomy, prolonged functioning of the bronchial fistula, and the coagulogram, the patient was prescribed the anticoagulant Xarelto, infusion therapy, protein and rheological drugs in addition to antibacterial drugs to prevent disseminated intravascular coagulation. After preparation, therapeutic bronchoscopy with adhesive occlusion of the right main bronchial stump was performed. VDethoracoscopy: fibrin layers in the pleural cavity vault. The same layers in the rib–diaphragmatic cavity and on the diaphragm. After removal of the layers, a foreign body was found in the posterior–upper mediastinum, which was located on the lateral surface of the lower cervical vertebrae, covering the stellate ganglion (Fig. 1). 5 ml of 0.25% novocaine solution was injected into the surrounding tissues, after which the foreign body was bluntly separated from the stellate ganglion and sympathetic trunk. Additional sanitation of the pleural cavity and its drainage were performed.

The postoperative period was uneventful. Starting from the 3rd day, the pain in the shoulder girdle and right arm decreased, and strength appeared in it. Active movements in the right arm were restored almost completely; muscle strength in the right arm was restored to 4 points, tendon and periosteal reflexes were restored slightly (D<S), satisfactory. There are no sensory disorders. The drainage was removed on the 6th day. The pleural cavity was full. The patient was discharged under the supervision of a surgeon.

2. Patient M., 26 years old, a resident of the district centre. During an artillery shelling, a shell hit his house and caused several injuries to his upper limbs and chest, two superficial, one "deep" on the lateral surface of the chest on the left in the eighth intercostal space. Since he could not get to a doctor during the war, he stayed at home. The wounds on his body seemed to have healed. Gradually, he developed pain on the left above the rib arch, which intensified with deep breathing. At the same time, there was pain in the left shoulder and in the clavicle area, the pain was aching, unpleasant, I wanted to "tear" this area. 3 weeks after the liberation of the district centre from the invaders, the victim managed to get to the district hospital and was consulted by a neurologist and a surgeon. After an X-ray, he was diagnosed with left–sided pleurisy with the presence of effusion. A pleural puncture revealed a significant density of the chest wall and parietal pleura – the puncture needle passed with considerable difficulty. It was possible to aspirate up to 30 ml of fibrinous exudate with separate bloody "threads". Aspirate examination: specific gravity 1.018, leukocytes and individual denatured red blood cells; neutrophils 70%, lymphocytes 2%, eosinophils 10%, denatured mesothelium. No malignant cells and mycobacteria were found, single bacterial specimens.

Given that there was no possibility of hospitalisation, erythromycin and doxycycline and one of the non–steroidal anti–inflammatory drugs were prescribed. However, only one of the prescribed drugs, erythromycin, could be found. A few days later, despite taking the medication, the patient's body temperature began to rise and pain in the supravacular region increased. In order to relieve the pain, he took a non–steroidal anti–inflammatory drug if the pain increased. Only after the region was completely liberated from the invaders could he return to the district hospital, from where he was referred to a thoracic surgeon at the regional clinical hospital.

On admission, the patient complained of pain in the left half of the chest and left shoulder girdle, weakness, dizziness, shortness of breath. Objectively, there was pallor, tachypnea; the left half of the chest lagged behind the right in the act of breathing; vocal tremor over the left hemithorax was significantly weakened, percussion – over the left half of the chest, dullness to the third rib in the anterior regions, with auscultation in the same place, breathing was very weakened. X–ray – left hemithorax reduced in volume, mediastinum slightly shifted to the left, opacification in the lower–lateral parts up to the third rib; right lung was increased transparent without additional shadowing. Clinical blood test:
erythrocytes $3.5 \times 10^{12} /l$, haemoglobin 102 g/l, leukocytes $8.8 \times 10^{9} /l$, 12% of rod-shaped cells, 42% of segmented cells, 7% of eosinophils, 23% of lymphocytes, 16% of monocytes, erythrocyte sedimentation rate 42 mm/h. Coagulogram: platelets 240 thousand/μL, fibrinogen 8.8 g/l, plasma tolerance to heparin 15 minutes, plasma recalcification time 70 seconds; international normalised ratio 1.9, activated partial thromboplastin time 34.20 seconds. Electrocardiography: moderate right ventricular hypertrophy, right ventricular mass close to the mass of the left ventricular myocardium. Spirography was not performed due to the patient's general serious condition. Stange test 22 s, Saabrże test 15 s.

Consultative conclusion: multiple shrapnel wounds, chronic left–sided pleurisy of the second degree [8], initial signs of pulmonary heart formation, arthroneuropathy of the left upper limb, restrictive type of respiratory disorder (vital capacity of the lungs less than 80% of the proper values, forced expiratory volume more than 70% of the proper values; Tiffno index more than 70%, hypertension of the first degree in the pulmonary artery (29 mm Hg), respiratory failure of the second degree.

Given the presence of a chronic inflammatory process in the left pleural cavity with signs of pulmonary heart formation, complicated by arthroneuropathy of the left upper extremity, the patient was given indications for surgical intervention – pleurectomy.

After a short infusion preparation under intubation anaesthesia with the use of muscle relaxants, a left–sided posterolateral pleurectomy was performed according to our modification [8], during which, after removal of the pleural sac, the main part of which was located in the basal parts on the diaphragm, reaching the vault of the pleural cavity and fused with the pericardium, an additional revision of the diaphragm was performed, since the most intimate fusion of the pleural sac was with this fibromuscular formation, which is the main (up to 75%) respiratory muscle of humans. During its revision, a 30 × 30 mm fibrous mass was found in the lateral part of the diaphragm. A blunt and partially sharp excision of the latter in its centre revealed the presence of an irregularly shaped metal body that had "sunk" into the thickness of the muscular part of the diaphragm. The blunt and sharp metal body was removed, and it turned out to be a shell fragment (Fig. 2). The diaphragm wound was sutured with two silk ligatures. The chest cavity was drained with two drains.

When examining the macro specimen, namely the section of the visceral leaflet of the pleural sac, in addition to 25–30 ml of fibrinous exudate, a red blood cell–fibrin clot was found as a result of contractile changes in the fibrin–soaked haematoma. This finding confirms that the victim had a haemothorax after penetrating trauma, which underwent a number of changes characteristic of haematomas and was complicated by pleurisy, which quickly evolved into a chronic process. By the way, the rapid transformation of acute pleurisy (haemothorax) is characteristic of an untreated pleural cavity haematoma [8, 11, 12].

The postoperative period was unremarkable: the lung filled the chest cavity, drains were removed on days 2 and 3, sutures were removed on day 9, and healing was primary tension. The patient was discharged on day 19.

Conclusions.

Thoracic foreign bodies are typical of penetrating thoracic injuries, they can be conventional bullets or bullets with a displaced centre of gravity, etc., and they can infect the pleural cavity, requiring intensive antibiotic therapy and drainage. In addition, the trauma can be accompanied by multiple injuries not only to the chest wall and pleura, but also to the lung, which causes, in addition to bleeding and air intake; the formation of pleural empyema, possibly with the formation of a pulmonary fistula. If the operation to remove the haematoma is delayed, chronic pleurisy may develop, whether catarrhal or purulent.

In some patients (including those described in this article), foreign bodies put pressure on sensitive nerve endings and on nerves or even nerve ganglia, which is accompanied by corresponding signs, the causes of which are difficult or impossible to establish immediately if the history is not properly taken and a thorough examination with appropriate pathophysiological analysis is not performed.

Therefore, patients with foreign bodies in the pleural cavity or suspected of having them as a result of injury should be taken to the thoracic department as soon as possible.

Funding. The work was funded by the state budget.

Authors' contribution. Duzhyi ID – concept, study design, editing the article; Golubnychyi SO, Elastal RZ – collection of material; Bryanyak VV, Yurchenko OP, Proskurnia PI – analysis of data, writing and editing the text. The authors are solely responsible for all aspects of the work and for resolving issues related to the accuracy and integrity of the information provided.

Conflict of interest. The authors declare that they have no conflicts of interest.

Consent for publication. All authors approved the paper to be published.
References

Received 05.01.2024