

Case Report of a Combat Casualty in Ukraine With Foreign Body (Bullet) Migration to the Heart

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ABSTRACT The article provides a detailed description of a case of combat injury in Ukraine due to a bullet wound to the neck involving intravascular migration of the bullet through major veins into the right atrium. Surgical care was provided at a role 3 hospital in eastern Ukraine. The authors emphasize the differences in the clinical picture and surgical treatment of a patient with migration of a foreign body to the heart compared to traumatic cardiac injury. The key to success in performing surgical interventions in such cases is the integration of examinations, conditions, and experience of specialists providing treatment.

INTRODUCTION

Trauma of the heart is always a challenge in emergency surgery. In combat, survival to surgical intervention is relatively rare, particularly in cases where transport to a surgical hospital is delayed, and cardiac injury is not commonly seen in combat hospitals.

Migration of foreign bodies in the human body is most often, according to the literature, associated with entry into the gastrointestinal tract,¹ respiratory tract, or soft tissues. Sometimes such an event leads to the simulation of various diseases.^{2,3} Clinical algorithms for the diagnosis⁴ and treatment⁵ of these conditions have been developed and implemented. Given the prevalence and development of flexible endoscopy, the use of fiber optic devices is the most common intervention. A large number of invasive medical procedures may also lead to the iatrogenic entry of foreign bodies into various parts of the body, necessitating their removal.⁶

The combat theater involves the traumatic impact of a wide variety of foreign bodies into the human body in the form of bullets, fragments, secondary shells, etc. The presence of soft tissue wounds with foreign bodies is a common reason for surgical interventions, although migration into the lumen of hollow organs, body cavities, and vascular lumen is less common.⁷ Foreign bodies may penetrate directly into the heart chambers, myocardium, or pericardial cavity and are often

fatal. Migration of a foreign body to the heart chambers is possible through the main vessels during injury and after medical manipulations.⁸

Since the beginning of hostilities in Ukraine, the number of cases of heart injuries has increased significantly. The presence of a foreign body on imaging of the heart chambers does not always indicate damage to the organ and treatment may be complex. This case describes a rare situation of fragment migration to the heart from combat injury with a description of the medical care and surgical technique used in Ukraine.

REPORT OF CASE

The patient is a 38-year-old Ukrainian serviceman who was injured in a gunfight. Initial medical assistance was provided near the point of injury, including application of pressure dressings to the wounds, pain relief, tranexamic acid, antibiotics, and tetanus prophylaxis. No blood transfusions were performed. During the prolonged evacuation from the battlefield (approximately 48 hours), the patient's stable condition and the absence of bleeding from the neck wound did not necessitate any further intervention.

Upon arrival at Role 3 two days after the injury, his condition was stable and he was able to move independently. A thorough inspection of the neck wound was conducted: After the removal of the dressings, no signs of inflammation or bleeding were observed, and the wound tract was tightly closed by muscle tissue without signs of a tense hematoma. There were also penetrating wounds to the left forearm, left knee joint, and lower third of the right shin. During an X-ray of the forearm for a gunshot fracture, a foreign body was incidentally noticed in the projection of the heart shadow (Figure 1).

Computed tomography of the chest cavity confirmed the location of the metallic density of the mobile foreign body in the right heart, the exact location was difficult to determine due to the presence of significant imaging artifacts (Figure 2).

Concomitant injuries included gunshot wounds of the neck, a tangential wound to the left knee joint and soft tissues of the lower third of the right tibia, and a forearm wound with a large defect in the middle third of the radius, treated

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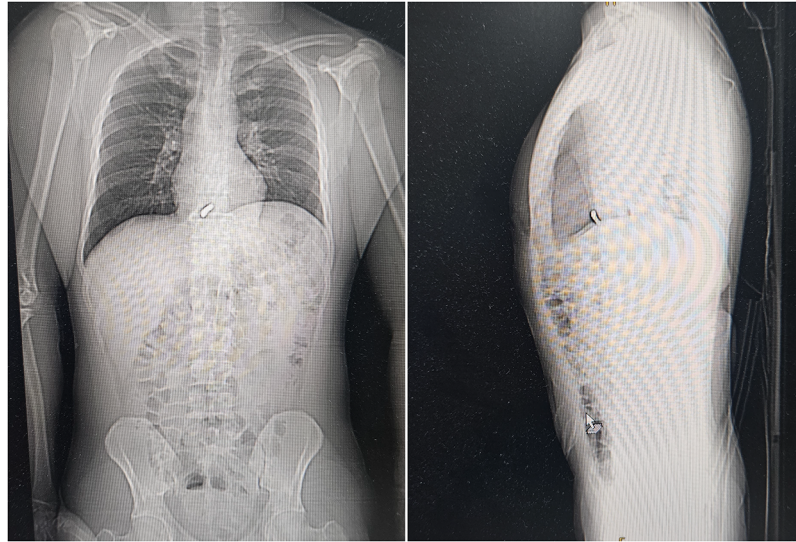


Figure 1. Radiography of the chest in direct and right lateral projection.

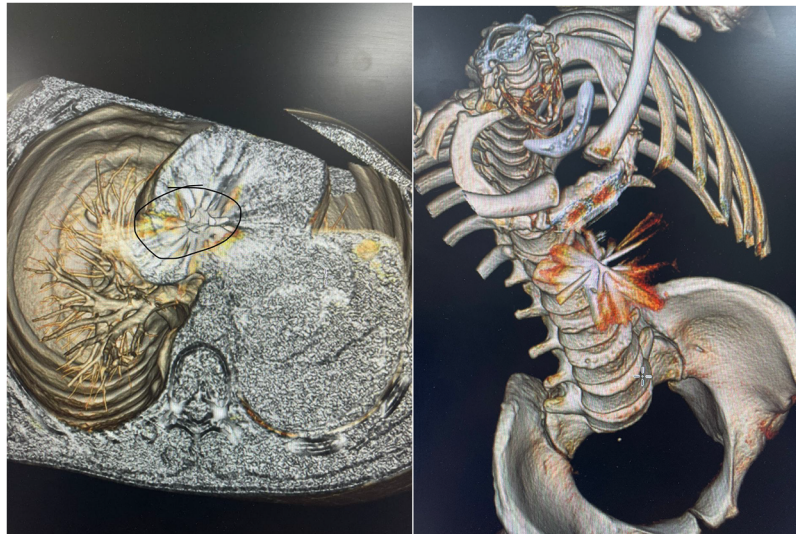


Figure 2. 3D modeling before surgery.

during the primary surgical treatment with external fixation to the left forearm.

Preoperative Diagnosis

Preoperative diagnoses included: 1) Gunshot wound of the neck penetrating the mediastinum with foreign body in the right atrium (bullet); 2) gunshot through wound of the left forearm with fracture of the left radius with bone defect, and 3) tangential gunshot wound of the left knee joint and soft tissue of the lower third of the right tibia.

Under general anesthesia with mechanical ventilation, the following procedures were performed: right thoracotomy, pericardotomy, removal of a foreign body (bullet) from the right atrium, and suturing of the right atrium. No hemopericardium was observed intraoperatively, and no foreign body

was detected within the pericardial cavity. Careful inspection of the surrounding mediastinal tissues failed to reveal any retained object. A magnet was employed to assist in localization; the foreign body was identified within the right atrium based on its response to the magnetic field, indicating ferromagnetic properties. No myocardial injury was evident. After several traction maneuvers, a 5-mm hole was created at the junction of the inferior vena cava and the right atrial myocardium. The foreign body—a bullet—was extracted through this hole. The atrial defect was closed with a single suture. The pericardial incision was left open. The estimated blood loss during the procedure was approximately 100 mL.

The postoperative period was without complications. He was extubated 15 minutes after the end of the operation, the

lungs were expanded on the postoperative X-ray after 8 hours; he was in the intensive care unit for 1 day; the chest tube was removed on the second day. During subsequent gauze dressing changes, the neck wound healed within 5 days without complications. He was transferred to the next stage of medical evacuation on the sixth day. In subsequent surgical interventions, after 1.5 months he underwent bone grafting of the radius.

DISCUSSION

Direct injury to the heart is undoubtedly an emergency condition that requires urgent surgical treatment. The survival of this category of wounded depends largely on the speed of evacuation from the battlefield. Rare cases of cardiac migration of a foreign body in the form of fragments from mines, shells, and bullets of various calibers may occur. Such migration can occur both asymptotically and complicating the clinical picture or simulating other diseases. The patient's condition can be variable. However, when the patient's condition is stable, it is possible to transfer them to a specialized hospital or a higher level of care.

Throughout the stages of medical evacuation during combat operations, limitations occur due to variable diagnostic and treatment capabilities and the number of additional casualties at each stage. Such challenges must be considered when planning advanced surgical interventions. For the diagnosis of migration of a foreign body, consider the presence or absence of tissue damage near the location of the foreign body, a wound tract in the tissues around its location, location of the potential entry wound, time elapsed since the injury, and clinical signs of an emergency (bleeding, tamponade, etc.). Such findings help determine whether the injury is a direct injury or migration.

In the described case, the bullet entered the atrium through a wound in Zone 2 of the neck, with damage to the jugular vein. An initial nonsurgical approach was deemed feasible due to his stable condition.⁹ At that time, migration of the bullet was not considered. There were no concerns regarding damage to major arterial vessels during the CT scan of the neck and chest (although the study was performed without contrast, as per the local protocol).

Considering the limited time and experience in diagnosing such conditions, there was initially no certainty that other mediastinal structures were not injured, as the possibility of migration was not considered during the surgical planning. In our opinion, delaying the surgical intervention for the removal of the bullet from the right atrial cavity increased the risk of life-threatening arrhythmias, thromboembolic, and infectious complications, as well as continued migration into the right ventricle and pulmonary trunk. The primary purpose of presenting this clinical case is to share our experience with combat-related injuries. Foreign bodies are technically difficult to find in surgery. Localization in the operating room can be facilitated by the use of a metal detector or magnet that can indicate the location of such a foreign body. It is important to

prevent further movement of the foreign body by limiting its mobility during the search. Intraoperative X-ray examination of the patient allows real-time direction of the search. More modern means (intraoperative CT, intravascular interventions, etc.) of intraoperative diagnostics are available at a considerable distance from the line of combat and patient transport to such facilities may be considered with stable patients. A thorough preoperative examination, the availability of technical support, and the experience of specialists are key to success.

CONCLUSIONS

This case report describes a combat injury characterized by injuries remote from the site of the foreign body. At the same time, the stable condition of the casualty allowed the opportunity for in-depth evaluation and determination of the plan for surgical intervention. Migration of foreign bodies (fragments, bullets, etc.) is possible not only within the gastrointestinal tract, respiratory tract, soft tissues, and cavities but also within the cardiovascular system. In such complex cases, consider the proximity of major vessels at the site of the wound (regardless of the distance) and signs of traumatic injury of surrounding organs around the location of the foreign body.

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Y.T. collected and analyzed the data and drafted the original manuscript. I.M. R.K., S.S. designed this research and reviewed and edited the manuscript. All authors read and approved the final manuscript.

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