

CASE STUDY

Pulmonary artery thromboembolism and its recurrence in penetrating injuries of the lower extremities (analysis of clinical cases)

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ABSTRACT

Two clinical cases of the onset and recurrence of pulmonary embolism (PE) in military personnel with penetrating wounds of the lower extremities are presented. Both patients were taking a prophylactic dose of anticoagulants.

In the first case, high-risk PE developed with recurrent hypertension and few symptoms, which contributed to late diagnosis and sudden death. In the second case, PE recurred in a patient receiving a full dose of anticoagulants for no apparent reason.

Therefore, attention should be paid to this category of patients with penetrating injuries of the lower extremities, their risk of VTE should be stratified in more detail, and the possibility of PE recurrence should be considered, even against the background of anticoagulant therapy. It is promising that risk scales should be reviewed and new criteria for the diagnosis and possibility of recurrence of PE should be developed for this category of patients, which will take into account a greater number of risk factors, develop algorithms for the diagnosis of PE with the possibility of more frequent detailed examinations, and adjust the prophylactic doses of anticoagulants, taking into account the inability to wear elastic stockings due to wounds on the lower extremities.

KEY WORDS: pulmonary embolism, penetrating injury of the lower extremities, clinical cases

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INTRODUCTION

Since the start of the war in Ukraine, there's been a big jump in the number of patients with injuries, including penetrating injuries to the lower limbs, which is dangerous because of damage to blood vessels, nerves, and muscles, and the development of infectious complications that are resistant to antibiotic treatment. However, such injuries have another complication that often goes unrecognised in time and can lead to death, as there is often a mildly symptomatic clinical condition that ends in sudden death [1]. This complication is pulmonary embolism (PE), which is recognised by the WHO as one of the most common cardiovascular diseases and is the third leading cause of sudden death after ischaemic heart disease and acute cerebrovascular accident, even in peacetime [2]. The incidence of PE in peacetime mechanical injuries ranges from 1% to 3%, and in mine-blast injuries and gunshot wounds, it is 3–5% of cases, with predominant development on the 2nd–4th day, but most often observed within 5–7 days after the injury, with a high risk of recurrence in the following 4–6

weeks [3]. Patients with multiple and combined chest injuries, accounting for up to 15% of medical losses, are most alert to the occurrence of PE, which has led to significant adjustments in the understanding of the etiology, pathogenesis, clinical course and treatment, including in the cohort of patients with multiple injuries [2]. However, patients with penetrating wounds of the lower extremities require no less attention in terms of vigilance for the occurrence of PE, as they may have an atypical clinical picture of PE and, due to limited mobility, may not notice pathognomonic symptoms. An equally important factor that significantly increases the risk of VTE is the development of traumatic shock in combat trauma, including penetrating wounds of the lower extremities, which is diagnosed in 8–10% of individuals [2]. During traumatic shock, haemodynamic disorders occur in the pulmonary circulation, contributing to the development of microthrombi and surfactant microatelectasis. As a result of fractures of long and tubular bones, the dispersibility of neutral blood plasma fat is disrupted, which provokes the development of fat

embolism, including in the vessels of the small circle, against the background of microthrombi. An additional component that significantly increases the risk of thrombosis is massive blood loss and the development of microcirculation disorders [2]. Another important factor is the type of vessel that was damaged during the injury. The Pennsylvania Trauma Outcome Study registry showed that the incidence of VTE fluctuates around 13.2% in penetrating injuries of the femoral and popliteal arteries, while in isolated arterial injuries it is only 3.1%. Open surgical interventions significantly increase the risk of deep vein thrombosis, which in turn increases the risk of PE [4].

An important component of the treatment of penetrating injuries of the lower extremities is the prophylactic use of anticoagulants. Pharmacological prevention of VTE is a critically important component of optimal trauma care, significantly reducing the risk of VTE [5]. The D-dimer Age Sex Hormones (DASH) scale has been proposed to assess the likelihood of recurrence after a first episode of VTE [6]. The basis is the level of D-dimer concentration 30 days after the end of anticoagulant prophylaxis. The incidence of VTE is the same in patients with blunt or penetrating trauma, but independent risk factors for VTE differ depending on the mechanism of injury, the severity of the patient's condition, and the need for oxygen support, which is crucial when considering a thromboprophylaxis strategy. Factors that increase the risk of VTE in patients with blunt trauma include blood transfusion, deterioration of neurological status, and pelvic fracture. Factors that increase the risk in patients with penetrating trauma include vascular injury, severe abdominal trauma, and age between 40 and 59 years. Taking these characteristics into account, it is possible to predict the risk of VTE, which depends on the mechanism of injury. There are studies whose authors argue that by examining APACHE II scores in surgical patients, it is possible to detect VTE even in patients with a low risk of VTE, which will allow preventive measures to be taken in a timely manner. However, this approach is most appropriate for patients with severe trauma who are in the intensive care unit undergoing various types of oxygenation and blood gas correction [7]. Elevated D-dimer levels detected after discontinuation of anticoagulant therapy have high negative predictive value for VTE recurrence. Even when D-dimer levels are within reference ranges, other factors such as age, gender, and other factors that may contribute to VTE are important [8]. For example, VTE is more common in men than in women. The risk of VTE also increases with age, especially in the presence of additional risk factors [8].

CASE REPORT

Two clinical cases of the onset and recurrence of PE in military personnel with penetrating wounds of the lower extremities are presented. The patients were over 40 years of age. Both patients were taking a prophylactic dose of anticoagulants. Both patients had no history of traumatic shock, major blood loss, injury to the femoral and popliteal arteries, pelvic fractures, or severe injuries to the chest and abdominal organs. Prior to the episode, the patients were somatically stable and did not require resuscitation measures.

CLINICAL CASE 1

A 44-year-old soldier, V., was admitted to the surgical department with a penetrating wound to his right lower limb. He underwent surgery the next day. Due to severe pain, he was practically bedridden for 5 days. On the evening of the fifth day after the operation, he went to the hospital restroom on his own, where he briefly lost consciousness. When he came to, he returned to his ward. He complained only of slight dizziness. His blood pressure was measured at 85/45 mm Hg, but an hour later it was 110/70 mm Hg, and the dizziness had disappeared. He noted slight general weakness. The patient refused further examination on that day, arguing that he had recovered satisfactorily and was feeling better. The next day, on Monday, the risk of PE in this patient was stratified using the Caprini scale. The patient scored 12 points, indicating an extremely high risk of VTE. Accordingly, compression ultrasonography of the lower extremities was performed, revealing an enlarged inferior vena cava that did not collapse on inspiration and thrombotic masses in the deep veins. The results obtained indirectly indicate right ventricular dysfunction, which is probably caused by the development of acute pulmonary heart disease. An ECG was performed, which showed no rightward shift of the electrical axis, partial blockage of the right bundle branch, minor repolarisation abnormalities in the form of flattened T waves and slight inversion in the right chest leads. PE was suspected, although the patient did not complain of shortness of breath. However, an objective examination revealed a decrease in saturation to 92%. A transthoracic echocardiogram was performed, which revealed significant enlargement of the left ventricle with signs of hypokinesis, tricuspid regurgitation of the II degree, prolapse of the mitral valve into the left ventricle, enlarged pulmonary artery valve that does not close during inspiration, grade II pulmonary hypertension, and a floating thrombus in the right atrium. The patient was diagnosed with PE, which causes haemodynamic disturbances and right ventricular dysfunction.

Auscultation of the lungs revealed weakened vesicular breathing on the right above the upper lobe, indicating the development of infarct pneumonia. A contrast-enhanced computed tomography (CT) scan of the chest was performed: thrombotic masses in the pulmonary artery trunk with 90% occlusion, increased diameter of the pulmonary artery, symptom of 'amputation' of the branches of the right upper lobar artery. Infiltrative changes in the right upper lobe of the lung. Given the presence of persistent hypotension and right ventricular dysfunction, the patient was diagnosed with high-risk PE and the following diagnosis was made: Penetrating injury of the right lower extremity, condition after surgery. High-risk PE, grade II cardiopulmonary shock. Right upper lobe infarction-pneumonia. Grade I respiratory failure (*Sa O₂* 92%).

When analysing this clinical case, it should be noted that the patient did not have typical clinical symptoms of PE, which would manifest as sudden shortness of breath, coughing, and chest pain. The presence of persistent hypotension, which was recorded, indicated the development of a catastrophic situation, but the patient's general condition did not correspond to the severity of the developing pathology. Even his heart rate was within the range of 85-92 beats per minute. Only the next day (Tuesday) did the patient begin to notice slight difficulty breathing and palpitations. The patient was examined only with regard to the risk factors for PE, rather than the presence of a typical clinical situation, although there was thrombosis of 90% of the pulmonary artery trunk, which may indicate a subacute course of PE. The laboratory test results corresponded to the severity of the injury: moderate leukocytosis, haemoglobin 120 g/l, transaminases elevated 1.2 times, so they were not interpreted as changes in PE. Another important point was that the patient received a prophylactic dose of anticoagulants (enoxaparin 0.4 ml twice daily), but there was no complete prevention of thrombus formation. Complete mechanical prevention with elastic bandages was impossible due to surgery on the lower leg. The patient was consulted by vascular surgeons and a decision was made to perform surgery – thromboectomy. However, the patient died during the operation.

CLINICAL CASE 2

A 46-year-old soldier, S., was brought to the hospital by an ambulance team after suddenly experiencing shortness of breath at rest. He also complained of pain in his left lower leg, which disappeared after taking painkillers. The medical history shows that he had an explosive-fragment blind wound of the soft tissues

of the right lower leg and lower third of the left lower leg, with an open comminuted fracture of the tibia and fibula. A week after the injury, surgery was performed to install an external fixation device, and another week later, autodermoplasty of the left lower leg wound was performed. One and a half months after the last operation, PE of the right lobar branches and segmental branches of both pulmonary arteries was diagnosed. The patient was treated and received rivaroxaban 20 mg/day to prevent recurrence. Recent contrast-enhanced CT scans showed no fresh thromboembolic masses, only a small number of thrombi with complete recanalisation. On objective examination, the general condition is moderate, blood pressure is 140/100 mm Hg, pulse is 75 beats per minute, breathing is vesicular, weakened in the lower sections, respiratory rate is 17 per minute, stage I obesity (body mass index 33.95 kg/m²), edema of the lower legs, more pronounced on the left side. The patient was assessed using the Caprini scale (verification of the risk of VTE in surgical patients), on which he scored more than 5 points, indicating an extremely high risk of VTE. Based on clinical data, a recurrence of PE is suspected, as the patient has been ruled out for heart disease and other comorbidities that would cause such a clinical picture. Given the stability of haemodynamics, the patient immediately underwent a CT scan of the chest, which revealed thromboembolism of the right lobe and branches of both pulmonary arteries, chronic bronchitis, pulmonary pneumofibrosis in D5 as a result of resolution of infarction pneumonia, signs of pulmonary hypertension, recanalisation of thrombotic masses in segmental branches. Congestive phenomena of the small circle of blood circulation. Analysing the clinical course in the first case, a distinctive feature was that, despite prophylactic doses of anticoagulants, a combination of risk factors, such as major surgery, prolonged immobilisation and, possibly, the use of painkillers, significantly influenced the development of VTE, although there were no significant risk factors such as traumatic shock, severe blood loss, or injury to large arteries. An important feature was that, in the case of high-risk PE, there was no corresponding pathognomonic shortness of breath, palpitations, or heart pain, despite the presence of recurrent hypotension, which indicated a subacute course of PE development. However, this contributed to a later diagnosis of the disease and subsequent fatal outcome.

In the second case, the patient had a recurrence of PE with pathognomonic symptoms while taking a sufficient dose of anticoagulants. It was too early to stratify such a patient according to the DASH risk probability scale, which primarily includes D-dimer indicators. His first episode of PE occurred 1.5 months

after the injury and the last surgery, and the second episode of PE occurred 1.5 months after the first episode. No apparent reasons for the recurrence of TEA were identified.

A distinctive feature of the first case is the asymptomatic course of PE, which can be explained by the patient's significantly reduced physical activity after surgery and the presence of pain symptoms, which masked shortness of breath and palpitations. There is insufficient literature on this topic, but there are studies explaining the asymptomatic course of PE in cancer patients, although there is insufficient information about wounded patients, especially those with specific wound locations.

Recurrence of PE has a marked tendency to occur after the first episode of PE, which occurs in 4% of patients after VTE, even with adequate anticoagulant therapy [9]. The occurrence of PE contributes to the development of pulmonary hypertension, which in turn increases the formation of microthrombi and contributes to the recurrence of PE. At the same time, the frequency of recurrence increases significantly in patients who discontinue anticoagulant therapy. The highest risk of recurrence occurs in the first 6-12 months, but never decreases to zero, which is why some scientists believe that VTE is a chronic disease with episodic recurrences

[9]. The risk of recurrence is significantly lower in distal vessels than in proximal vessels, which makes the presented clinical case noteworthy. Both relapses and the initial onset of PE can be caused by thrombophilia, which is not determined in the general population and was not determined in the patients presented, although in the second case, the patient was recommended to determine his genetic predisposition to thrombophilia.

CONCLUSIONS

Therefore, attention should be paid to this category of patients with penetrating injuries of the lower extremities, their risk of VTE should be stratified in more detail, and the possibility of PE recurrence should be considered, even against the background of anticoagulant therapy. It is promising that risk scales should be reviewed and new criteria for the diagnosis and possibility of recurrence of PE should be developed for this category of patients, which will take into account a greater number of risk factors, develop algorithms for the diagnosis of PE with the possibility of more frequent detailed examinations, and adjust the prophylactic doses of anticoagulants, taking into account the inability to wear elastic stockings due to wounds on the lower extremities.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

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