

# GUNSHOT SHRAPNEL WOUND OF THE THIGH WITH DAMAGE TO THE SUPERFICIAL FEMORAL ARTERY (FEATURES OF CLINICAL MANIFESTATIONS, DEVELOPMENT OF COMPLICATIONS WITH LATE MEDICAL CARE AND PRESERVATION OF THE LIMB)

DOI: 10.36740/WLek2023052010

Igor A. Lurin<sup>1,2</sup>, Vitaly V. Makarov<sup>3,4</sup>, Volodymyr V. Nehoduiko<sup>3,4</sup>, Kostiantyn M. Smolianyuk<sup>4</sup>, Stepan M. Chobey<sup>5</sup>, Oleksandr Yu. Ott<sup>6</sup>

<sup>1</sup>NATIONAL ACADEMY OF MEDICAL SCIENCES OF UKRAINE, KYIV, UKRAINE

<sup>2</sup>STATE INSTITUTION OF SCIENCE «RESEARCH AND PRACTICAL CENTER OF PREVENTIVE AND CLINICAL MEDICINE» STATE ADMINISTRATIVE DEPARTMENT, KYIV, UKRAINE

<sup>3</sup>MILITARY MEDICAL CLINICAL CENTER OF THE NORTHERN REGION, KHARKIV, UKRAINE

<sup>4</sup>KHARKIV NATIONAL MEDICAL UNIVERSITY, KHARKIV, UKRAINE

<sup>5</sup>UZHGOROD NATIONAL UNIVERSITY, UZHGOROD, UKRAINE

<sup>6</sup>MILITARY MEDICAL CLINICAL CENTER OF THE CENTRAL REGION, VINNYTSIA, UKRAINE

## ABSTRACT

**The aim:** To demonstrate the features of clinical manifestations and complications that occur with delayed medical treatment in cases of gunshot shrapnel through a wound of the thigh with damage to the superficial femoral artery.

**Materials and methods:** The wounded individual, S., was 52 years old and had sustained a gunshot wound through a shrapnel wound of the left thigh with damage to the superficial femoral artery and soft tissue defect. Medical assistance was provided during the stages of medical evacuation.

**Results:** The soldier sustained a gunshot wound through the upper third of the left thigh, resulting in damage to the vascular-nerve bundle and a soft tissue defect. First aid was provided at the scene, and surgical procedures were performed during the stages of medical evacuation, including primary surgical treatment of wounds in the upper third of the left thigh.

On the second day following the injury, the wounded man was transferred to the Vinnytsia Military Medical Clinical Center and admitted to the vascular surgery department. After an ultrasound examination and repeated surgical treatment of the wound on the left thigh, damage to the superficial femoral artery was identified.

**Conclusions:** The presence of features of blood circulation in gunshot wounds of the main vessels of the lower limbs can favorably affect the possibility of saving the limb, as evidenced by the case presented.

**KEY WORDS:** gunshot wound, superficial femoral artery, thrombosis, limb preservation

Wiad Lek. 2023;76(5 p.2):1199-1204

## INTRODUCTION

The frequency of wounds and injuries of blood vessels in modern military conflicts has increased significantly (7.5–12.0%). At the same time, despite the increase in the number of injuries to the large vessels of the chest and abdomen, the main vessels of the neck - 90% of combat vascular injuries are injuries to the arteries and veins of the extremities [1-3].

In more than 90% of cases of vessel damage, they are severe, and 8% are extremely severe. The most frequent injuries and injuries of the vessels of the femoral-popli-

teal segment (up to 40–50%), and vessels of the lower leg and shoulder (20–30% each) [1, 4].

In the case of gunshot wounds of arteries, there is often simultaneous damage to veins (40–50% of cases), nerve trunks (30–70%), and bone fractures (40–60%) [3, 5].

Vascular injury is associated with a high risk of critical ischemia, limb amputation, and high mortality [6-8]. The ongoing war is associated with the frequent use of rocket launchers and other high-energy weapons, causing significant damage to soft tissues and internal



**Fig. 1.** Wounded S, 52 years old. The second day after a gunshot wound to the left hip with damage to the superficial femoral artery. The appearance of the postoperative wound with the existing label before the repeated surgical treatment of the wound.



**Fig. 2.** Wounded S, 52 years old. The second day after a gunshot wound to the left hip with damage to the superficial femoral artery. Damage to the superficial femoral artery was detected during repeated surgical treatment of the wound.



**Fig. 3.** Wounded S, 52 years old. The second day after a gunshot wound to the left thigh with damage to the superficial femoral artery. Removed blood clots.

organs, limb amputations, longer treatment and rehabilitation times, or fatal outcomes [9, 10].

A frequent violation of the international law for humanitarian treatment during the war by the Russian army is

associated with problems of the safe evacuation of injured people to appropriate Levels of medical care and interrupted supply of medical equipment, due to frequent artillery strikes on medical facilities. There is a clinical challenge for the management of gunshot wounds under the above-mentioned conditions as well as the application of damage control surgery in case of severe vascular injury [6].

## THE AIM

The aim was to demonstrate the clinical features and complications that arise when medical assistance is provided late in the case of a gunshot wound with shrapnel through the thigh, resulting in damage to the superficial femoral artery.

## MATERIALS AND METHODS

Wounded S., 52 years old, sustained a gunshot through a shrapnel wound of the left thigh with damage to the superficial femoral artery and soft tissue defect. Medical assistance was provided during the stages of medical evacuation.

Damage to the left superficial artery was detected on the 2nd day after the injury when the injured person arrived at the III level of medical care at the Military Medical Clinical Center of the Central Region.

The wounded man was examined. General tests of blood, urine, biochemical blood analysis, blood coagulogram, and ultrasound examination of the vessels of the lower extremities were performed using an ultrasonic diagnostic HM70 EVO Samsung Medison scanner (Korea, 2021).

## RESULTS

According to the patient S.'s account and accompanying medical documentation, the wound was a gunshot wound that occurred during the performance of official duties on February 5, 2023, around 02:00 near one of the settlements in the Donetsk region. The wound was located in the upper third of the left thigh and resulted in damage to the vascular-nerve bundle and a soft tissue defect. First aid was provided on site, and initial surgical treatment of the wound in the upper third of the left thigh was performed during medical evacuation on February 5, 2023. The patient was then transferred to the Vinnytsia Military Medical Clinical Center for further treatment on February 7, 2023, where he was admitted to the vascular surgery department. Ultrasound examination of the arteries of the left lower limb revealed collateral blood flow in the popliteal fossa and periphery. Examination of the wound revealed a mark indicating that the bleeding was stopped by stitching it with blue polypropylene, as seen in Fig.1.



**Fig. 4.** Wounded S, 52 years old. The second day after a gunshot wound to the left thigh with damage to the superficial femoral artery. A – Superficial femoral artery with end-to-end anastomosis. B – installed VAC system.



**Fig. 5.** Wounded S, 52 years old, after a gunshot wound to the left hip with damage to the superficial femoral artery. A – alloprosthesis of the superficial femoral artery. B – the appearance of the limb after alloprosthesis of the superficial femoral artery.

On the day of receipt, 07.02.23 performed: Repeated surgical treatment of the wounds of the left thigh, necrectomy, revision of the vascular-nerve bundle, and damage to the superficial femoral artery was detected (Fig. 2).

Thrombectomy was performed from the proximal and distal ends of the superficial femoral artery with a Fogarti catheter No. 5, 6 (Fig. 3)

The left superficial femoral artery was restored with end-to-end anastomosis, and installation of the VAC system (Fig. 4).



**Fig. 6.** Wounded S, 52 years old. The 40th day after a gunshot wound to the left hip with damage to the superficial femoral artery and surgical treatment. Echogram of the vessels of the lower extremities, there are no circulatory disorders.

During the initial stages of evacuation, the patient did not notice any progression of ischemia of the left lower extremity. Upon examination upon admission, 2 days after the injury in Vinnytsia, the left lower limb was somewhat cooler compared to the right, sensitivity and movements in the toes and ankle joint were preserved, and pulsations on a. poplitea et a. dorsalis pedis were not felt. During ultrasound diagnosis of the arteries of the left lower limb, collateral blood flow was diagnosed distal to the injury site and an anastomosis between the deep femoral artery and the superficial femoral artery on the left in the lower third of the thigh was revealed.

02/13/23, 02/20/23: Repeated surgical treatment of the wound of the left thigh, and repair of the VAC system.

21.02.23 Erosive bleeding occurred and the following procedures were performed: revision of the postoperative wound of the left thigh, thrombectomy from the left superficial femoral artery, taking a vein from the right leg in the lower third, autovenous grafting of the superficial femoral artery.

27.02.23 noted a deterioration in the patient's general state of health, including an increase in body temperature to 39°C. The patient was examined by an infectious disease doctor and an express test for Covid-19 Ag was

performed, which came back positive. The patient was then transferred to a specialized hospital.

03.03.23 Erosive bleeding occurred and the following procedures were performed: revision of the postoperative wound of the left thigh, thrombectomy of the left superficial femoral artery, and alloprosthesis of the superficial femoral artery (Fig. 5).

During the ultrasound examination of the main vessels of the lower extremities in the postoperative period without blood circulation disorders (Fig. 6)

In the postoperative period, he received 1000 units of heparin/hour/day for 5 days, after which 0.4 enoxaparin 2 times a day for 2 weeks, then rivaroxaban 10 mg, 1 tablet a day.

Recovery occurred on the 45th day.

## DISCUSSION

The main cause of death of victims of gunshot wounds is acute blood loss, which is about 85% when the main vessels are injured. The second most important problem in the conditions of modern military field surgery is the detection, treatment, and prevention of acute limb ischemia, which occurs in patients with severe hemorrhagic and traumatic shock.

Timely diagnosis and rationality of actions at the stages of medical evacuation are important to ensure optimal care in case of injury to main vessels [10].

Specialized assistance in multidisciplinary hospitals and vascular centers for injuries of blood vessels consists of the fastest possible diagnosis of vascular pathology and its complications and the full range of reconstructive interventions [8].

In this clinical case, despite the untimely diagnosis and late detection of damage to the superficial femoral artery, the peculiarities of the existing blood circulation due to the presence of collateral blood flow played an important role in preserving the limb.

Features of blood circulation also caused difficulties in the diagnosis of this injury. At the initial stages of evacuation, the clinical picture of acute limb ischemia was not clear. On the 2nd day after the injury, when the injured person was admitted to Vinnytsia, the left lower extremity was somewhat cool compared to the right, sensitivity and movements in the toes and ankle joint were preserved, pulsations on a. poplitea et a. dorsalis pedis was not felt.

Arteriography is the gold standard for confirming the violation of the integrity of the arterial bed, but this method was not used in this case due to technical difficulties, as the angiograph was temporarily not working.

As a screening method, ultrasound dopplerography continues to play an important role in the diagnosis of

vascular injuries. The advantages of ultrasound in comparison with other imaging methods are: non-invasive technique, ease of execution and interpretation of data; the absence of ionizing radiation, the possibility of conducting multiple studies in the conditions of plaster immobilization, splinting, osteometallosynthesis, foreign metal bodies, the presence and prevalence in medical institutions [5].

In the above case, ultrasound was also of great importance in making the diagnosis. Ultrasound diagnosis of the arteries of the left lower limb revealed collateral blood flow distal to the injury site and revealed an anastomosis between the deep femoral artery and the superficial femoral artery on the left in the lower third of the thigh.

Limited medical resources were and remained a common problem for medical care in Ukraine due to various causes, including insufficient planning [6]. However, military and civilian surgeons are able to diagnose and manage such severe vascular injuries even in unstable combat conditions while considering the available resources.

## CONCLUSIONS

The presence of features of blood circulation in gunshot wounds of the main vessels of the lower limbs can favorably affect the possibility of saving the limb, as evidenced by the case presented.

## REFERENCES

1. Het'man VH. Atlas boyovoyi khirurhichnoyi travmy (dosvid antyterorystychnoyi operatsiyi/operatsiyi ob'yednanykh syl) [Atlas of combat surgical trauma (counter-terrorist operation/joint force operation experience)]. Kharkiv: Collegium. 2021, p.385. (in Ukrainian).
2. Tsybalyuk VI. Boyova travma sertsya, hrudnoyi aorty ta mahistral'nykh sudyn kintsivok. Posibnyk [Combat injury of the heart, thoracic aorta and main vessels of the limbs. Manual]. Kyiv-Ternopil'. 2019, p.428. (in Ukrainian).
3. Boyko VV, Lisovyi VM, Makarov VV et al. Selected lectures on military field surgery. Kharkiv, «NTMT» publishing house. 2018, p.59-70. [https://repo.knmu.edu.ua/bitstream/123456789/20456/1/Макаров\\_лекции\\_web.pdf](https://repo.knmu.edu.ua/bitstream/123456789/20456/1/Макаров_лекции_web.pdf) [date access 1.02.2023] (in Ukrainian).
4. Chaplyk V, Oliynyk P, Tsehel's'kyy A. Nevidkladna viys'kova khirurhiya [Emergency military surgery]. Nash Format, Kyiv. 2022, p.511. (in Ukrainian).
5. Abdullaev RY. Ultrasonography in the Diagnosis of Gunshot Injuries of the Neurovascular Bundle of the Extremities. *EC Neurology*. 2018;10:35-37.
6. Rogovskyi VM, Koval B, Lurin IA et al. Temporary arterial shunts in combat patient with vascular injuries to extremities wounded in Russian-Ukrainian war: A case report. *International Journal of Surgery Case Reports*. 2023;102:107839. doi: 10.1016/j.ijscr.2022.107839.
7. Kazmirchuk A, Yarmoliuk Y, Lurin I et al. Ukraine's experience with management of combat casualties using NATO's Four-Tier "Changing as Needed" Healthcare System. *World journal of surgery*. 2022; 46(12):2858-2862. doi: 10.1007/s00268-022-06718-3.
8. Xu Y, Xu W, Wang A et al. Diagnosis and treatment of traumatic vascular injury of limbs in military and emergency medicine: A systematic review. *Medicine*. 2019; 98(18). doi: 10.1097/MD.00000000000015406.
9. Rogovskyi VM, Gybalo RV, Lurin IA et al. A case of surgical treatment of a gunshot wound to the left scapular region with damage to the distal axillary and proximal brachial arteries. *World Journal of Surgery*. 2022; 46(7):1625-1628. doi: 10.1007/s00268-022-06577-y.
10. Lammers D, Martin MJ. Combat vascular trauma management for the general surgeon. *Current Trauma Reports*. 2019; 5:107-118. doi: 10.1007/s40719-019-00171-9.

## ORCID and contributionship:

Igor A. Lurin: 0000-0001-6280-1725<sup>A,B,F</sup>

Vitaly V. Makarov: 0000-0002-4224-0294<sup>E,F</sup>

Volodymyr V. Nehoduiko: 0000-0003-4540-5207<sup>B,D-F</sup>

Kostiantyn M. Smolianyuk: 0000-0002-9428-7684<sup>D,E</sup>

Stepan M. Chobey: 0000-0002-1231-8169<sup>B,D,E</sup>

Oleksandr Yu. Ott: 0009-0000-4180-840X<sup>B,C,E</sup>

## Conflict of interest:

The Authors declare no conflict of interest.

---

## **CORRESPONDING AUTHOR**

**Kostiantyn M. Smolianyuk**

Kharkiv National Medical University

4 Prospect Nauki, 61000 Kharkiv, Ukraine

tel: +38067 737 40 18

e-mail: konstasmol@gmail.com

**Received:** 10.10.2022

**Accepted:** 24.04.2023

---

**A** – Work concept and design, **B** – Data collection and analysis, **C** – Responsibility for statistical analysis, **D** – Writing the article, **E** – Critical review, **F** – Final approval of the article

 Article published on-line and available in open access are published under Creative Common Attribution-Non Commercial-No Derivatives 4.0 International (CC BY-NC-ND 4.0)