

Erosive Bleeding After Battlefield Vascular Reconstruction: A Case Report and Practical Lessons

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Vascular injuries in modern warfare are frequently complex and contaminated and are associated with a high risk of secondary complications. Erosive bleeding after vascular reconstruction represents a limb- and life-threatening condition. We report a case of combined gunshot and shrapnel injury to both upper extremities in a soldier, initially treated with temporary vascular shunting and subsequent autovenous reconstruction. The postoperative course was complicated by erosive bleeding at the graft site, requiring urgent reoperation and staged wound management. Limb perfusion was successfully preserved. This case illustrates the importance of shunting, repeated surgical assessment, aggressive infection control and staged reconstruction strategies in contaminated combat-related vascular injuries.

Keywords: *Vascular Injury; Autovenous Bypass; Erosive Bleeding; Combat Trauma; Limb Salvage; Negative Pressure Wound Therapy*

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INTRODUCTION

Vascular injuries and hemorrhage remain among the most critical challenges in trauma care and are the leading preventable cause of death in combat casualties. In modern warfare, these injuries are increasingly complex owing to high-energy weapons, body armor, and blast mechanisms, resulting in combined and contaminated wounds. Experience from previous wars has shaped modern diagnostic and treatment strategies [1,2]. Compared with earlier conflicts, contemporary battlefields are characterized by a higher incidence of combined and complex injuries, driven by changes in weapon systems and combat tactics. These factors have significantly altered both the anatomical distribution and clinical presentation of vascular trauma. Extremity vascular injuries are particularly demanding because

they are often associated with extensive soft-tissue damage, fractures, ischemia, and contamination. Early diagnosis, rapid hemorrhage control, temporary or definitive revascularization, and strict infection control remain key determinants of outcome [3–6].

Despite technically successful vascular reconstruction, secondary complications such as infection, graft thrombosis, and erosive bleeding might occur and threaten both limb and patient survival. We present a case of a complex upper-extremity vascular injury complicated by erosive bleeding after autovenous reconstruction, successfully managed with repeated surgery and staged wound treatment.

This case series has been prepared in accordance with the CARE (CAse REport) guidelines.

CASE PRESENTATION

This is the case of a 20-year-old male patient wounded during enemy shelling on 24 January 2024. On admission to the National Military Medical Clinical Center, he was diagnosed with blind gunshot shrapnel wounds to both upper extremities, including a gunshot shrapnel wound of the right forearm complicated by injury to the vascular bundle. On the day of injury, the patient received first aid on the battlefield with application of a tourniquet. At the first evacuation stage, primary wound debridement was performed along with fasciotomy of the right forearm and placement of a temporary vascular shunt in the brachial/forearm arterial segment.

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The day after, the temporary shunt thrombosed. It was removed, a brachial artery thrombectomy was performed, and arterial reconstruction was carried out using an autologous venous graft. Four days later the patient was evacuated and admitted to our center for specialized vascular care. Five days post-injury, sudden erosive bleeding occurred from the graft area (Figure 1). Urgent surgical exploration revealed tissue necrosis and graft erosion. Hemostasis was achieved and repeat reconstruction of the brachial artery was performed (Figure 2).

During subsequent care, multiple wound revisions and debridements were performed. The graft was covered with a muscle flap and managed with negative pressure wound therapy (Figure 3).

The patient received broad-spectrum antibiotics, anticoagulation, analgesics, and anti-inflammatory agents. Additional therapy included probiotics, prokinetics, antisecretory medications, and supportive care. At discharge, both upper extremities were warm with satisfactory perfusion. Distal pulses were palpable, with good flow in the reconstructed brachial artery. Persistent motor and sensory deficits remained in the

right forearm. All wounds were closed or appropriately covered, with satisfactory healing.

Ethical Approval and Informed Consent

Ethical approval to report these cases was given by the Local Ethics Committee of the National Military Medical Clinical Center. Written informed consent was obtained from the patients.

DISCUSSION

Vascular trauma remains a major contributor to morbidity and mortality in modern warfare. The incidence of vascular injury in contemporary conflicts is significantly higher than in earlier wars and reflects changes in weapon systems, protective equipment, and combat patterns [7]. Extremity injuries account for the majority of battlefield trauma and generate a substantial surgical workload. Early revascularization, temporary shunting, and damage-control vascular surgery are now well-established strategies [8]. However, contaminated wounds, delayed definitive care, and massive soft-tissue



Figure 1 Episode of erosive bleeding from the graft site.

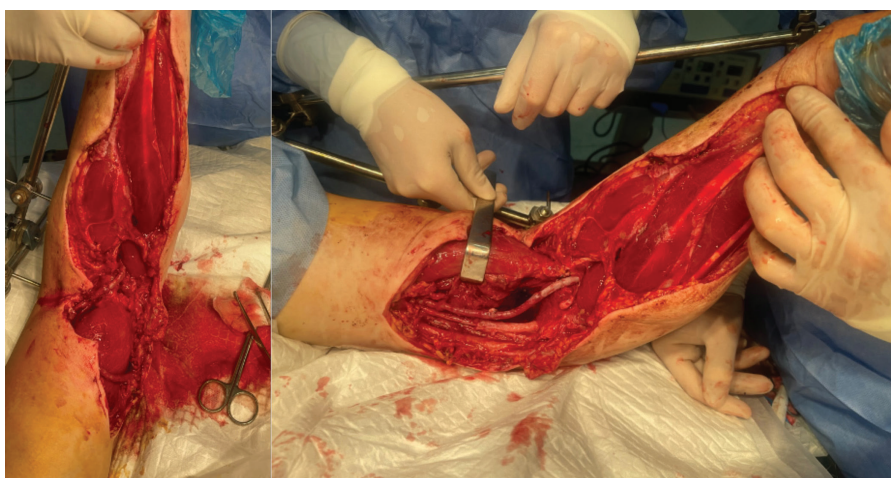


Figure 2 Repeat autovenous brachial artery reconstruction.

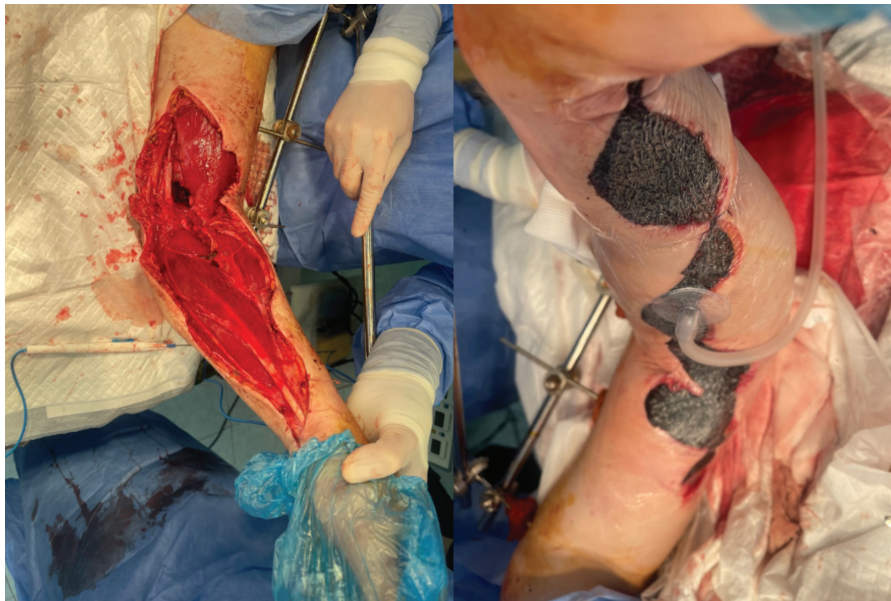


Figure 3 Muscle coverage of the vascular reconstruction and application of negative pressure wound therapy.

destruction continue to expose vascular reconstructions to a high risk of infection-related complications.

This case illustrates that a technically successful vascular reconstruction does not mark the end of treatment. In contaminated combat wounds, repeated wound inspection and staged surgical management should be considered mandatory. Erosive bleeding is not a random event but usually a sign of underlying infection, tissue necrosis, or insufficient soft-tissue coverage of the graft. Once it occurs, immediate surgical exploration is required, as delay might result in catastrophic hemorrhage or loss of the limb. Adequate soft-tissue coverage, preferably with muscle, is a critical component of vascular reconstruction in open extremity injuries. In this context, negative pressure wound therapy has become a valuable adjunct for temporary wound management, allowing control of contamination and protection of the vascular repair until definitive closure is possible [9].

Experience from the ongoing war in Ukraine, with a large number of complex vascular injuries, confirms that limb salvage in such cases is rarely achieved by a single definitive operation. Instead, a staged strategy with repeated debridement, reassessment of the reconstruction, and gradual wound closure should be regarded as standard practice in heavily contaminated battlefield injuries.

PRACTICAL RECOMMENDATIONS

Immediate hemorrhage control on the battlefield is essential, with timely and correct use of tourniquets and local hemostatic agents. Temporary vascular shunting can be used as a damage control measure when

evacuation or definitive repair is delayed, with close monitoring of shunt patency and readiness for prompt revision if thrombosis or worsening perfusion occurs. Key time intervals should be documented, including time of injury, time to tourniquet application, time to shunt placement, and time to definitive repair, to support clinical decision making and outcome analysis. In contaminated wounds, serial debridement is necessary, along with adequate soft tissue coverage—preferably using muscle—over vascular grafts during reconstruction. Negative pressure wound therapy can be used as a temporary adjunct to prepare wounds for definitive coverage and help control contamination, but it should not replace timely surgical revision when infection is suspected. Erosive bleeding must be treated as an indication for urgent surgical exploration, requiring rapid operative revision, debridement of necrotic or infected tissue, and restoration or replacement of the vascular repair as needed.

Antimicrobial therapy should be initiated early and adjusted according to culture results, with empiric regimens reflecting the high contamination risk of combat wounds. Anticoagulation should be individualized based on the balance between bleeding risk and the need to maintain graft patency, with clear documentation of timing and rationale.

Management should follow a locally adapted algorithm for vascular injury, taking into account available resources and evacuation pathways, and involving a multidisciplinary team. Finally, limitations of single case reports should be acknowledged, with a need for larger case series or registry data to support and validate these practices [10].

CONCLUSION

Combat-related vascular injuries are complex and prone to secondary complications. Erosive bleeding after reconstruction is a limb- and life-threatening event that requires immediate reoperation. This case demonstrates that limb salvage is possible through aggressive staged surgery, strict infection control, and appropriate soft-tissue management.

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None.

Ethics Statement

- (1) All the authors mentioned in the manuscript have agreed to authorship, read and approved the manuscript, and given consent for submission and subsequent publication of the manuscript.
- (2) The authors declare that they have read and abided by the JEVTM statement of ethical standards including rules of informed consent and ethical committee approval as stated in the article.

Conflicts of Interest

The author declares that they have no conflicts of interest.

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Author Contributions

The author confirms sole responsibility for the following: study conception and design, data collection, surgical treatment, analysis and interpretation of results, and manuscript preparation.

Data Availability

The data supporting the findings of this study are not publicly available due to privacy or ethical restrictions.

Declaration of the Use of Generative AI in the Writing Process

The authors declare that no AI or AI-assisted technologies were used in the preparation of this work, including the writing process, data analysis, or generation of images.

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