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DAMAGE TO THE ARTERIES OF THE LOWER LIMB DUE TO BONE FRACTURES: A CASE REPORT

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Abstract
A 38-year-old male patient, A.H., sustained multiple injuries, including a femoral fracture with damage to the superficial femoral artery (SFA) and fractures of the right 1st to 8th ribs, after falling from a height of four meters during a handstand. The patient underwent simultaneous surgical interventions, including crossectomy of the great saphenous vein, autovenous grafting of the SFA to restore vascularization, and retrograde intramedullary locked nailing of the femur. After four weeks, the patient was discharged from the hospital, bearing weight on both lower limbs with the assistance of a walker.

Keywords: Closed femoral shaft fracture, vascular injury, superficial femoral artery, thrombectomy, fasciotomy, intramedullary locking nail.

Introduction

A thorough clinical examination and appropriate diagnostic studies enable the identification of these rare vascular injuries in closed fractures. Early vascular repair helps prevent potentially limb-threatening complications. Successful outcomes rely on teamwork, the ability to recognize often subtle signs of vascular injury, a high level of vigilance, effective communication, proficient use of imaging techniques, deep knowledge of relevant surgical procedures, and proper sequencing of interventions.

The issue of providing emergency specialized care for traumatic vascular injuries remains relevant despite significant advancements. Mortality rates for injuries involving major arteries and veins range from 8% to 26.4%, while limb amputation rates vary between 10.8% and 26%, with no observed trend toward reduction [1], [2].

If a person sustains a fracture of the major long bones, it may be complicated by vascular and nerve injuries. If left untreated in the early stages, such injuries can lead to potentially devastating complications, including the need for amputation. In cases of closed fractures of major long bones, vascular injuries are rare, and a surgeon may not initially suspect their presence.

We present a report on a similar clinical case encountered in our medical practice.

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II. CASE REPORT

A 38-year-old male patient, A.H., sustained multiple injuries, including a femoral fracture and fractures of the right 1st to 8th ribs, after falling from a height of four meters during a handstand. The patient was transported by emergency medical services and arrived at the hospital within an hour.

Upon examination in the emergency department, the patient was conscious and hemodynamically stable. He complained of chest and right thigh pain, as well as difficulty breathing due to chest pain. Physical examination revealed deformity, tension, swelling, and crepitus in the mid-to-lower thigh region. Active movements were present in the toes and ankle joint.

Following adequate pain management, the patient underwent radiographic and ultrasound imaging. X-ray examination confirmed a comminuted fracture of the mid-to-lower femoral shaft along with multiple fractures of the 1st to 8th ribs. Ultrasound of the pleural and abdominal cavities did not reveal any free fluid.

On the following day, a progressive increase in thigh swelling was observed, prompting a duplex ultrasound examination of the lower limb vessels. The scan revealed signs of sural vein thrombosis and raised suspicion of a developing pseudoaneurysm at the femoral fracture site.

A decision was made to perform computed tomographic angiography (CTA) along with conventional computed tomography (CT) of the thigh and chest. The imaging confirmed a comminuted femoral fracture (Fig. 1D, E), partial puncture-type injury of the superficial femoral artery at the level of the femoral fracture (Fig. 1A, B) with the formation of a pseudoaneurysm (Fig. 1C), as well as fractures of the 1st to 8th ribs along the midaxillary line (Fig. 1F).

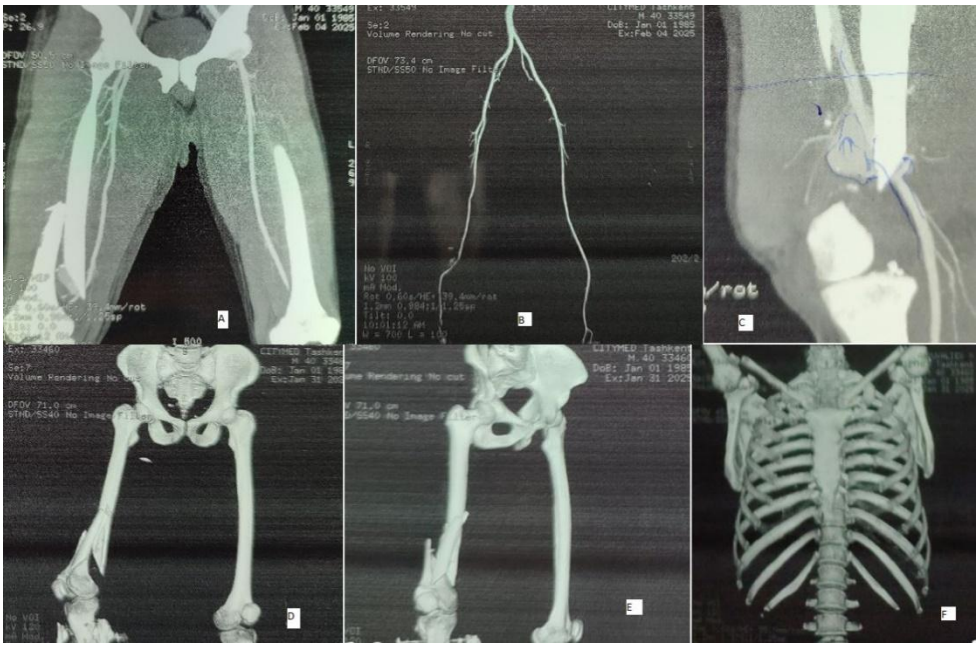

Fig. 1

The anesthesiologist, orthopedic trauma surgeon, and vascular surgeons conducted a multidisciplinary medical consultation. Given the complexity of the comminuted femoral fracture, the high risk of significant blood loss during osteosynthesis, and the need to prevent thromboembolism due to potential thrombus migration from the sural veins, a staged surgical approach was planned.

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The first step involved performing a crossectomy of the great saphenous vein of the thigh with simultaneous autologous vein graft harvesting. This was followed by a revision of the superficial femoral artery and autovenous grafting. Finally, intramedullary osteosynthesis of the femur was planned to prevent compression of the vascular graft by the metal implant.

The patient was urgently transferred to the operating room. In the first stage, a crossectomy of the great saphenous vein was performed in the inguinal region, along with the preparation of an autologous venous graft. Through the same incision, the bifurcation of the superficial and deep femoral arteries was exposed to allow for emergency hemostasis in case of intraoperative bleeding (Fig. 2A).

Next, via a medial approach at the femoral fracture level, between the adductor and extensor muscles, surgical exploration was performed, revealing the injured segment of the superficial femoral artery (Fig. 2 A, B). A stepwise resection of the damaged arterial segment was carried out (Fig. 2 C), followed by vascular reconstruction using autovenous grafting with the previously harvested vein, sutured with Prolene 7-0 (Fig. 2 D, E).

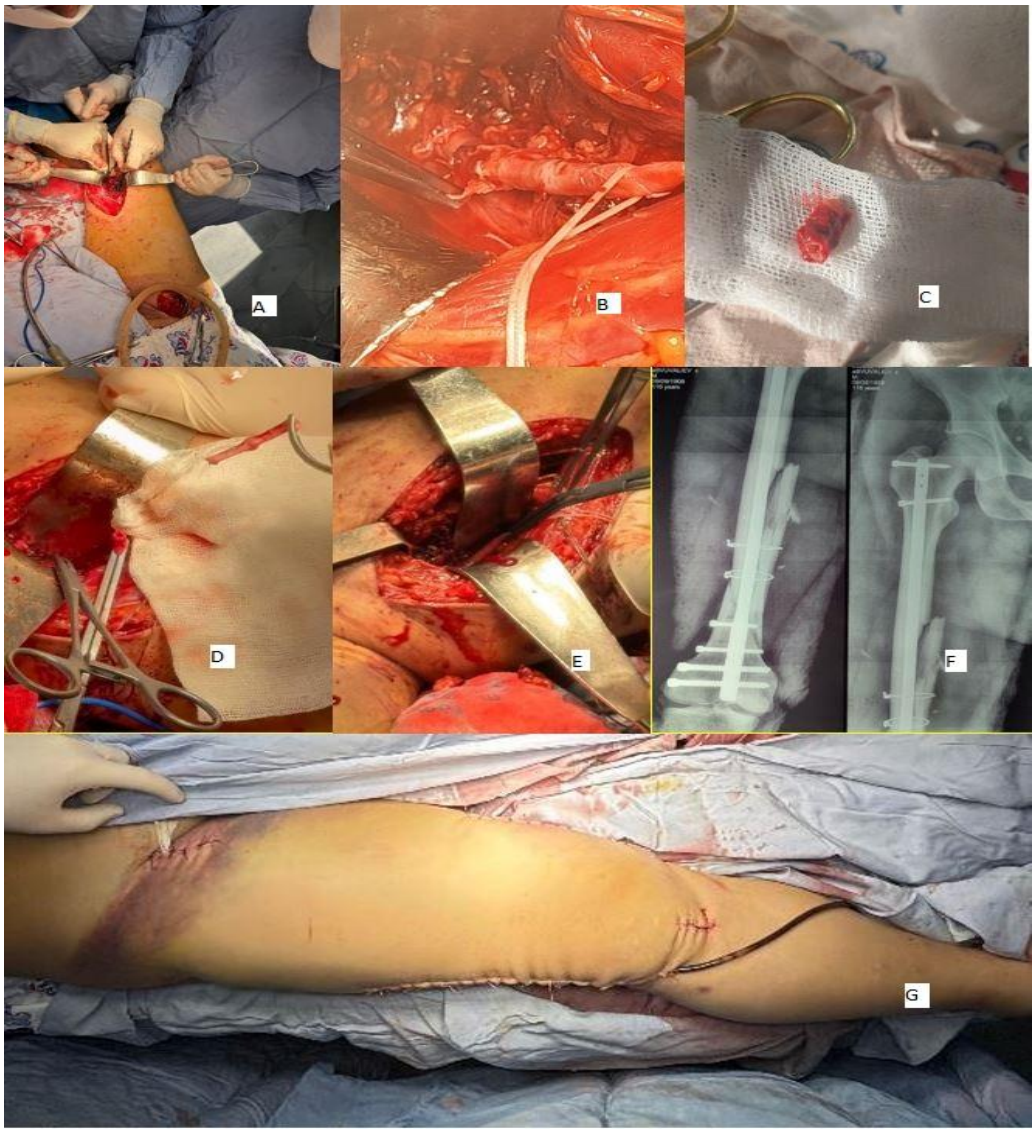

Fig. 2

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During the surgical intervention, the patient received a bolus injection of heparin at a dose of 5000 IU and a combined antibiotic therapy with cefoperazone 1.0 g + sulbactam 1.0 g. Within minutes, adequate blood perfusion of the posterior tibial and dorsalis pedis arteries was observed, with satisfactory palpation of the distal pulse and a gradual restoration of oxygen saturation levels.

Due to difficulties in repositioning the bone fragments, an open reduction was performed via a lateral approach. Cerclage wire fixation was applied to enhance osteosynthesis stability. This was followed by retrograde intramedullary locked nailing using a ChM nail (Fig. 2F).

Postoperatively, thromboprophylaxis was initiated with nadroparin (Fraxiparine) 40 mg subcutaneously twice daily for five days, followed by oral administration of apixaban (Eliquis) 2.5 mg twice daily. Antibiotic therapy was continued for seven days.

A follow-up duplex ultrasound scan performed after two weeks demonstrated satisfactory triphasic blood flow in the femoral artery and complete recanalization of the sural veins. The total hospital stay lasted four weeks due to delayed healing of postoperative wounds. Axial weight-bearing was initiated in the fourth postoperative week.

III. DISCUSSION

In rare cases, vascular injuries occur as a complication of bone fractures when arterial damage is caused by bone fragments or sharp fracture edges.

Femoral artery injuries account for 70% of all vascular traumas, with penetrating wounds being the cause in 90% of cases [3]. The superficial femoral artery (SFA) is involved in 33–37% of these injuries [4-6].

Vascular injuries associated with fractures of long bones in otherwise healthy young trauma patients are relatively uncommon. Given that the reported incidence of SFA injury in femoral fractures is less than 1–2%, arterial damage in closed femoral fractures often goes undetected [7].

This, in turn, reduces physicians' vigilance regarding this type of injury. The clinical presentation of vascular damage may not be immediately apparent. Physical examination can be misleading or initially fail to reveal significant abnormalities [8], as normal distal pulses are present in 5–15% of patients with vascular injuries [9].

When the intima or intima/media layers of an artery are damaged, a traumatic true aneurysm may form, characterized by an arterial expansion without extravasation of blood beyond the vessel lumen. In contrast, a full-thickness arterial wall defect leads to acute pulsatile hematoma in the immediate post-traumatic period, which later develops into a traumatic pseudoaneurysm when the surrounding tissues encapsulate the extravasated blood [10]. Several reports describe cases of femoral artery aneurysms associated with femoral shaft fractures [11-12].

In pseudoaneurysms, the presence of normal distal pulses may be misleading, and if vascular injury is suspected, additional imaging is recommended [11-13]. Duplex ultrasonography scanning is a valuable diagnostic tool, but in cases of uncertainty, arteriography (arterial angiography) should be performed. Arteriography can precisely determine the location and extent of arterial injury or identify external causes of pulse absence; however, it is a time-consuming procedure [14].

Vascular repair in arterial trauma has been shown to reduce the risk of amputation from 49.6% to 10.8% [15-16]. The safe window for surgical intervention is generally considered to be within 6 to 8 hours [16], although adequate collateral circulation may extend this timeframe [15].

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In our case, due to weakened pulses in both distal arteries of the lower limb and soft tissue perfusion maintained by collateral circulation, an accurate diagnosis took longer to establish. As a result, the time to surgical intervention exceeded 16 hours.

However, delayed vascular repair can result in poor functional outcomes, such as contracture or atrophy. In our case, these complications were avoided due to adequate blood supply [17].

Literature suggests that isolated vascular injuries with good collateral circulation can sometimes be managed conservatively without surgical intervention. However, our case differed, as the patient developed severe ischemic pain in the lower leg and toes, necessitating urgent treatment.

Various techniques exist for arterial reconstruction. In our case, autovenous grafting was chosen due to significant damage to the superficial femoral artery. Moreover, the results of venous graft interposition were favorable [18]. Synthetic grafts, on the other hand, carry a higher risk of pseudoaneurysm formation [19].

A limb with severe injury or ischemia leading to complete loss of function may require primary amputation. Delayed diagnosis of vascular injury and extensive soft tissue damage are major risk factors for limb loss. Although closed fractures are generally not associated with vascular injuries, they can still occur. Early diagnosis using computed tomography (CT) and timely surgical intervention to restore blood flow can significantly improve limb preservation. Strict immobilization of the affected limb for at least four weeks is recommended to prevent additional arterial injury at the fracture site.

FUNDING STATEMENT

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CONFLICT OF INTEREST

No conflicts of interest declared.

INFORMED CONSENT STATEMENT

The patient was informed that this case would be presented for publication and provided consent during the last follow-up.

NOTE

The study was conducted at the Department of Traumatology, Orthopedics, and Emergency Surgery No. 1 of the Tashkent State Medical University , Republic of Uzbekistan, Tashkent, Farobi Street, House 2.

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