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Case Report

Superficial femoral artery rupture after open distal third femoral shaft fracture: A case report

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Abstract

Objective: This case report aims to demonstrate an instance of superficial femoral artery (SFA) rupture after an open femoral shaft fracture.

Case Presentation: Our patient was a 22-year-old man admitted to the emergency department after a motorbike accident with a deformity at the distal third of the thigh and an open wound on the medial side. Radiographs and computed tomography angiography revealed a left distal third femoral fracture with ipsilateral SFA injury. We performed fracture reduction external fixation following SFA reconstruction using a 5-cm saphenous vein autograft. Prophylaxis fasciotomy was not performed. At a 6-month follow-up, the wound was well-healed, the Doppler ultrasound showed good blood flow at the reconstructed artery, and a rigid callus entirely covered the fracture. At 1-year follow-up, the patient could walk with full weight-bearing. Maximum knee range of motion was restored, and the patient could return to daily activities.

Conclusion: Vascular injury after femoral shaft fracture is rare, and accurate diagnosis with timely and appropriate surgery plays a crucial role in achieving limb salvage, reducing the risk of complications, and improving the overall quality of patient life.

Keywords: Femoral shaft fracture, Superficial femoral artery, Rupture, Saphenous vein graft, Vascular reconstruction, Anticoagulation

Introduction

The most frequent cause of femoral shaft fracture is high-energy trauma. It rarely results in arterial injury, which affects only 1%–2% of patients with this fracture type (1). Arterial injuries can result in significant loss of vascularization; therefore, if this kind of injury does not receive prompt intervention, it could cause prolonged ischemia and a higher likelihood of amputation, and it may even directly threaten the patient's life (2). To illustrate the importance of appropriate intervention, we present a case of a patient who sustained an open left distal third femoral shaft fracture with an ipsilateral superficial femoral artery (SFA) injury due to a motorbike accident.

Case Presentation

Our patient was a 22-year-old man admitted to the hospital one hour after falling off while riding a motorbike at midnight. There was nothing abnormal about his personal and family history. On initial assessment, the patient was conscious and oriented but hemodynamically unstable. Clinical examination revealed deformity of the left distal thigh and a 3 cm × 3 cm wound on the medial side with bleeding and bone exposure. The absence of left dorsalis pedis and posterior tibial arteries was detected, and limb oxygen saturation could not be recorded. However, the patient could move his toe and ankle, and the distal limb was warm and in good color with no signs of ischemia. Radiographs showed a transverse distal third femoral shaft fracture (Figure 1A-B). Computed tomography angiography demonstrated vascular interruption with a 10 cm gap in the distal third of the SFA (Figure 1C). The patient was finally diagnosed with a Gustilo grade IIIC open fracture of the left distal third femur shaft with SFA injury.

The patient was put under general anesthesia, and a trauma team took part in exposing the lesion. It revealed that the femoral vein was intact, but the SFA was ruptured with two contractive and blunt ends with thrombosis (Figure 2A). These ends were then secured with Bulldog forceps. Following thorough debridement and irrigation of the wound, muscle, and fracture, fracture reduction and external fixation were performed. Subsequently, a vascular team took over the surgery. The blunt ends were trimmed to healthy tissues before repair. Thrombectomy was performed proximally and distally with a Fogarty embolectomy catheter No.2, and the vessel was flushed with a heparin 5000 IU in 500 mL saline solution. A sudden gush of fresh blood was observed from the arteriotomy site right after the procedure. Next, we clamped the proximal and distal ends and released them

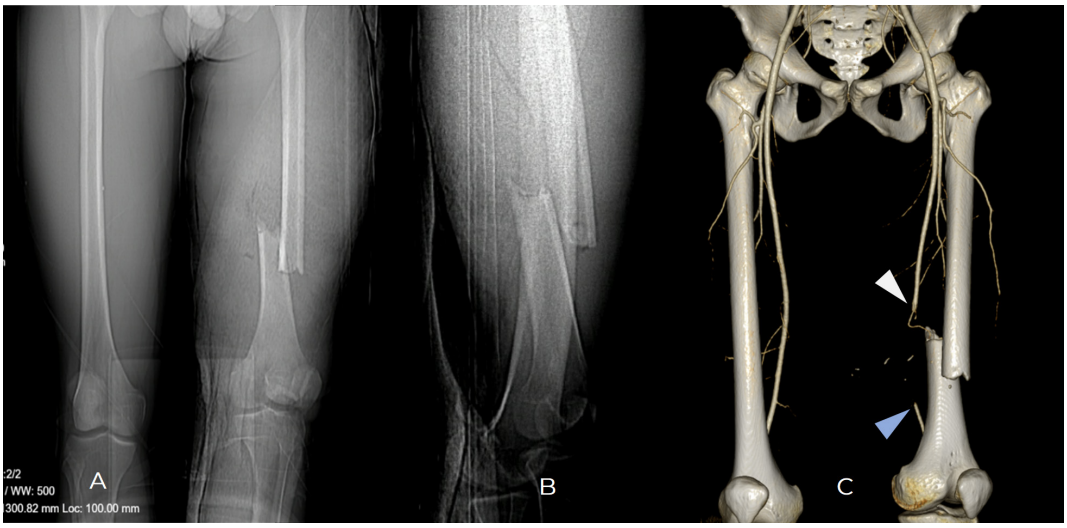

Figure 1. Imaging examinations: Anteroposterior (A) and lateral radiographs (B) showed a left distal third femoral shaft fracture. Computed tomography angiography (C) showed vascular interruption in the left distal third of the SFA (proximal end: white pointer; distal end: blue pointer)

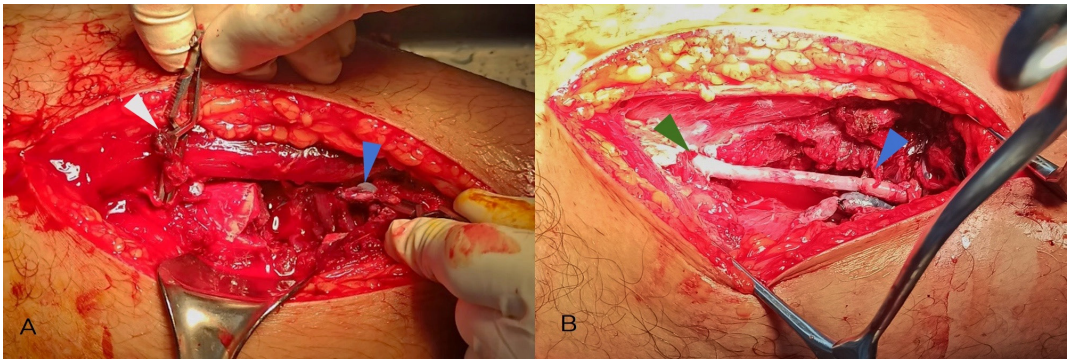

Figure 2. Surgical procedure: (A) The ruptured SFA was exposed with two ends presented bluntly with thrombosis (proximal end: white pointer; distal end: blue pointer). (B) After artery reconstruction using a 5-cm reversed saphenous vein autograft (proximal end: green pointer; distal end: blue pointer)

individually to assess the back-flow and in-flow. Due to a significant 5 cm gap between them with considerable tension, performing an end-to-end anastomosis was deemed unfeasible. Therefore, a reversed saphenous vein graft was used. A small team harvested the ipsilateral great saphenous vein and prepared the graft. A longitudinal incision exposed the saphenous vein, ligating its side branches with 3-0 cotton thread. After dissection, the vein was removed and distended with normal saline for one minute. The autograft was trimmed to the appropriate length and reversed to be ready for reconstruction. We used the anastomosis technique described in a previous study, using a non-absorbable monofilament suture size USP 7-0 under 3.5x loupe visualization (3). After the reconstruction (Figure 2B), we rechecked the back-flow and in-flow, ensuring good flow. The distal pulse was palpable, and oxygen saturation was detectable after a few minutes. A fasciotomy was not performed. In operation, one unit of packed red blood cells was transfused.

After surgery, we continuously evaluated the distal circulation of the limb through oxygen saturation measurement at the toes. Adequate oxygen and fluid were provided, and our patient was closely monitored for potential complications, such as reperfusion syndrome, compartment syndrome, or infection. Antibiotics, pain relief, anticoagulants, and an additional unit of packed red blood cells were prescribed during postoperative care. For anticoagulation, on the first day after surgery, the patient received a slow intravenous infusion of heparin 5000 IU diluted in 50 mL 0.9% sodium chloride and changed to subcutaneous enoxaparin 0.4 mL from the second day for five days. The patient did not suffer any complications, was discharged six days after surgery, and was prescribed oral anticoagulants for three months.

At the first follow-up two weeks after surgery, the wound had healed well, and arterial Doppler ultrasound showed a triphasic flow in the SFA. In addition, radiographs revealed a stable and aligned femoral fracture and the external fixator (Figure 3A-B). At the 3-month follow-up, the radiographs (Figure 3C) showed fracture stabilization and osseous bridge formation within the gap. Therefore, we transferred from the external fixator to an above-knee cast (Figure 4) for 4–6 weeks, encouraging the patient to have partial weight-bearing. At the 6-month follow-up, the fracture was entirely covered with a rigid callus, and the cast was removed. A rehabilitation program was

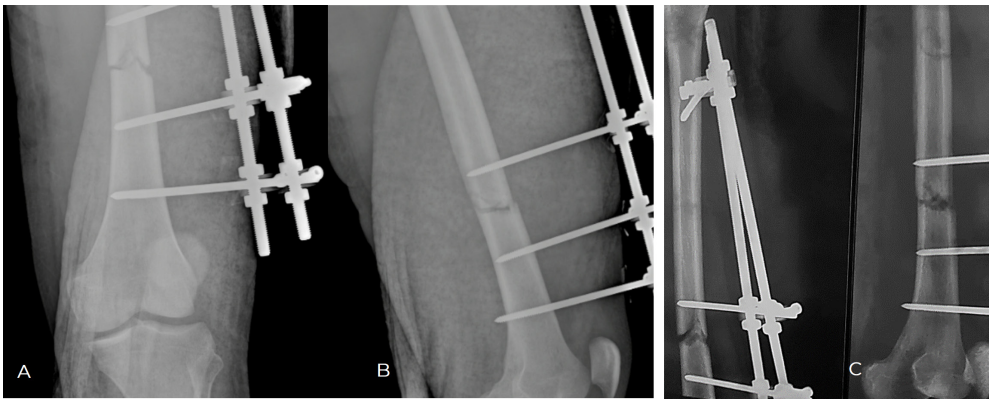

Figure 3. Femoral radiographs 2 weeks (A-B) and 3 months after surgery (C)

Figure 4. Femoral radiographs after removing external fixation and applying above-knee cast

applied to help the patient improve knee motion. At the 1-year follow-up, our patient had obtained full weight-bearing, restored maximum knee range of motion, and returned to daily life activities.

Discussion

Femoral shaft fractures are common. However, vascular injury associated with these fractures is rare, accounting for under 1%, and mostly related to penetrating trauma (2). The SFA is crucial for supplying blood not only to the thigh but also to the lower leg. Therefore, its injury can have the most severe consequences.

It was easy to jump to the diagnosis in this case because the patient presented with a deformity of the thigh and a wound on the medial side at the fracture level, which suggested that the SFA must be examined. However, in other closed fractures, it was found that the SFA injury could be misdiagnosed when the peripheral pulsations were still detected through the arterial network around the knee (4). The delay in diagnosis and intervention, or misdiagnosis, can cause extremity loss or even death (5). In this case, it took about three and a half hours for the patient to go from the injury to surgery and about 2 hours more to re-vascularize, within the golden time of 6 hours for limb salvage (2,6).

There remained a dilemma about which procedure to perform first: bone fixation or vascular repair. Some authors suggested that vascular reconstruction should be done first to shorten ischemia time. On the other hand, fracture stabilization should be done first to reduce the risk of vascular repair disruption while manipulating the area during reduction and fixation (2). A meta-analysis study reported no significant difference in amputation rate between the two courses of action: fracture repair first or vascular repair first (7). Therefore, deciding for the patient depends on how stable the fracture is and the limb ischemia time.

In patients with closed fractures or clean wounds, internal fixation with intramedullary nails or plates could be applied if the hospital is well-equipped (2,4). On the other hand, external fixation is recommended for patients with open infectious fractures, especially in cases of vascular injury, because of its short application time with ease. However, after using the external fixator for 2–3 weeks with good soft tissue condition, some studies suggest changing to either an intramedullary nail or plate (4,8). In our case, the fracture remained stable and aligned, and callus formation was present after external fixation. Then, we decided to remove the fixation and apply an above-knee cast to avoid further surgery for the patient.

Many vascular repair or reconstruction options include thrombectomy, lateral repair, patch angioplasty, primary end-to-end anastomosis, interposition graft, or bypass graft. A vein graft is often chosen in case of a large gap between two ends, making direct anastomosis impossible. Previous papers have frequently reported using reversed saphenous vein autograft because it is applicable for almost all patients and has demonstrated good postoperative outcomes (2,6). Like some similar cases we have encountered before, in this case, we chose to use a reversed saphenous vein and successfully saved the limb.

Compartment syndrome is considered one of the significant complications following vascular injuries due to reperfusion injury. In some cases of crushed extremity or more-than-six-hour limb ischemia,

fasciotomy can be performed after vascular repair or reconstruction for prophylaxis (9). However, deciding on a fasciotomy depends on the ischemia time, how rapid the vascularization is, and associated factors like soft tissue injury and crush injury (2). Sometimes, performing fasciotomy is still more acceptable than doing nothing if we do not have enough conditions to monitor patients. Our patient presented soon in our hospital, and clinical examination showed no signs of limb ischemia; with the ability to follow the patient up postoperatively, we decided not to perform a fasciotomy.

A meta-analysis reported that a systematic anticoagulant significantly improves prognosis and reduces the risk of amputation, reoperation, or occurrence of embolism. For anticoagulation, heparin is preferred; in contrast, the use of anti-platelet is restricted due to the risk of bleeding and is not beneficial in the scene of traumatic vascular surgery (10). Therefore, local heparinization with a bolus dose of 5,000 IU through the proximal and distal site of the ruptured artery is recommended, followed by a slow heparin infusion every hour postoperatively. In addition, low molecular weight heparin can be used for the short term in patients with vascular surgery with a prophylactic dose injected subcutaneously every 24 hours (11). Finally, a new oral anticoagulant (dabigatran) is prescribed daily for up to 3 months due to its effectiveness in preventing embolism and improving the limb salvage rate (2).

Conclusion

Vascular injury is a rare complication following a femoral shaft fracture, which can leave severe complications. Accurate diagnosis with timely and appropriate surgery plays a crucial role in achieving limb salvage, reducing the risk of complications, and improving the overall quality of patient life.

Authors' Contribution

Conceptualization: Em T. Huynh, Bao T.T. Nguyen.
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Project administration: Em T. Huynh, Bao T.T. Nguyen.
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Software: Tung T. Thac, Duoc M. Le.
Supervision: Em T. Huyn, Khai Duong.
Visualization: Tung T. Thac, Duoc M. Le.
Writing–original draft: Duy K. Lam, Tung T. Thac, Duoc M. Le.
Writing–review & editing: Em T. Huynh, Khai Duong, Bao Tu Thai Nguyen.

Competing Interests

None.

Ethical Approval

Ethical approval is waived at our hospital. The patient provided written informed consent for the publication of the clinical report and the accompanying visual representation.

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