» **Case Report** «

Open Surgical Bypass for Superficial Femoral Artery Occlusion Caused by Blunt Trauma

Akihiko Ikeda, MD,¹ Yohei Kudo, MD,¹ Michihiro Maeda, MD,² Aito Tochiki, MD,²
Haruto Ichimura, MD,³ Masafumi Uesugi, MD,³ and Tomoaki Jikuya, MD¹

Blunt vascular trauma of the lower extremities brings about a high amputation rate, because other organ injuries disturb revascularization. We experienced a case of a superficial femoral artery occlusion caused by blunt trauma. The patient also had a femoral bone fracture and a large skin defect with deep muscular injuries of the thigh. We performed a femoropopliteal (FP) bypass using a saphenous vein which was routed through the contaminated wound. Postoperative vacuum-assisted closure therapy was used to prevent graft infection. Surgical bypasses using saphenous veins are approved treatments for arterial occlusions from blunt trauma if the grafts go through contaminated wounds.

Keywords: vascular trauma, surgical bypass, emergency surgery

Introduction

Blunt vascular trauma of the lower extremities brings about a high rate of limb loss. Although revascularization is essential for limb salvage, it can be affected by other organ injuries. When contaminated wounds are located near the damaged vessels, vascular surgeons are reluctant to perform open surgical bypasses because of the risk of graft infection. Here we report a case of a superficial femoral artery (SFA) occlusion caused by blunt trauma. The patient also suffered from a femoral bone fracture and a large crushing wound of the thigh, including a skin defect and deep muscular injuries. We performed a femoropopliteal (FP) bypass using

a saphenous vein graft (SVG) which was routed through the contaminated wound.

Case Report

A 30-year-old man, who injured his right leg at work with a heavy industrial machine, was transferred to our emergency department. Physical examination revealed that he was alert and conscious with a Glasgow Coma Scale score of 15. His vital signs were as follows: blood pressure, 132/80 mmHg; heart rate, 91 beats/min; and respiratory rate, 25 breaths/min. His right thigh had a crushing wound comprising a large skin defect and deep muscular injuries (Fig. 1A). Distal arterial pulses in the right leg could not be detected using a Doppler flowmeter. The patient could move his right leg, but he had lost sensation in his right leg. The result of focused assessment with sonography for trauma was negative. Computed tomography (CT) revealed a comminuted fracture of the trochanteric section of the right femoral bone, which was accompanied by injuries of the thigh muscles and subcutaneous tissue (Fig. 1B). In addition, the right SFA was occluded at the proximal portion. The peripheral arteries which were distal to the popliteal artery were visualized by collateral flow. Because the occluded site of the SFA corresponded to the crushing wound of the thigh, we considered that the arterial occlusion resulted from the intimal injury caused by the blunt trauma and not a thrombus. When the CT scan was completed, 3 h had passed since he injured his right leg. From these findings, we rated the injury severity score as 9, the probability of survival as 99.4%, and the mangled extremity severity score (MESS) as 5.^{1–3)} He immediately underwent an emergency surgery to salvage his limb after the imaging examination.

While the patient was under general anesthesia, wound cleansing and external femoral bone fixation were performed. The right femoral artery was then exposed in the groin, and the popliteal artery was exposed above the knee via a medial approach. The great saphenous vein was harvested from the contralateral leg. After intravenous administration of heparin (5000 U), the proximal and distal

¹Department of Cardiovascular Surgery, Tsukuba Medical Center Hospital, Tsukuba, Ibaraki, Japan

²Department of Emergency Medicine, Tsukuba Medical Center Hospital, Tsukuba, Ibaraki, Japan

³Department of Orthopedic Surgery, Tsukuba Medical Center Hospital, Tsukuba, Ibaraki, Japan

Received: April 5, 2015; Accepted: June 30, 2015
Corresponding author: Akihiko Ikeda, MD. Department of Cardiovascular Surgery, Tsukuba Medical Center Hospital, 1-3-1 Amakubo, Tsukuba, Ibaraki 305-8558, Japan
Tel: +81-29-851-3511, Fax: +81-29-851-3511
E-mail: ai-cvs@sd6.so-net.ne.jp

Fig. 1 Patient's preoperative condition. (A) A crushing wound in the right thigh, including a large skin defect and deep muscular injuries. (B) Preoperative CT showing a comminuted fracture of the trochanteric section of the right femoral bone (asterisk) and an occlusion of the right superficial femoral artery (arrow). CT: computed tomography

parts of the femoral artery were clamped. The reversed SVG was anastomosed to the femoral artery using a 6-0 polypropylene suture in a side-to-end manner. The SVG was routed under the sartorius muscle, and distal anastomosis was performed in the same manner as the proximal anastomosis. After establishing the FP bypass, the thigh wound was cleansed again, and debridement was performed. Simultaneously, we also confirmed that the SVG was placed under the sartorius muscle (Fig. 2A). Finally, a vacuum-assisted closure (VAC) device was mounted on the thigh wound (Fig. 2B).

After the surgery, continuous administration of heparin (12000 U/day) was started. However, the anticoagulation therapy was stopped 1 h later because of massive bleeding of the injured muscles, and a blood transfusion, including red blood cells and fresh frozen plasma, was

Fig. 2 Treatment progress of the right thigh wound. (A) A saphenous vein graft (arrow) can be observed under the sartorius muscle (asterisk) through the right thigh wound. (B) A vacuum-assisted closure device is mounted on the right thigh wound.

performed. After the bleeding decreased, administration of heparin was started again on the second postoperative day. Cefazolin (3 g/day) was administered until the third postoperative day. We continued the VAC therapy for 1 month while regularly exchanging the device every 3–4 days. On the seventh postoperative day, intramedullary nailing for the femoral bone fracture was performed. After 1.5 postoperative months, the patient was transferred to another hospital for rehabilitation. After 6 postoperative months, he returned to our follow-up visit. The right thigh wound had completely healed (Fig. 3A) and he could walk without a cane. We confirmed a widely patent FP bypass with CT (Fig. 3B) and only low-dose aspirin treatment was continued.

Discussion

Several previous reports on vascular trauma of the lower extremities have been published (Table 1).⁴⁻⁷⁾ Most of the patients were young males, and the SFA is a vulnerable artery, comprising approximately 30% of all of the cases. Blunt vascular trauma of the lower extremities is associated with a high rate of limb loss. Revascularization, including open surgical bypass and endovascular repair, is essential to prevent leg amputation. However, revascularization can be affected by other organ injuries. Trauma patients generally suffer from multiple injuries, and other severe organ

Fig. 3 Patient's postoperative condition. (A) The right thigh wound is completely healed. (B) Postoperative CT showing a widely patent femoropopliteal bypass (arrow). An intramedullary nail is implanted in the right femoral bone (asterisk). CT: Computed tomography

injuries, such as brain damage, aortic injury, abdominal organ injuries, and pelvic fracture, can be life-threatening.⁸⁾ In such cases, lifesaving is given priority to limb salvage. Even if the trauma is limited in the lower extremities, an isolated vascular injury is rare. Vascular trauma of the lower extremities is often complicated by bone fractures and deep muscular injuries, which are predictive factors for a poor outcome of limb salvage.⁶⁻⁸⁾ The MESS system, including the degree of skeletal and soft tissue injury, limb ischemia, shock, the patient's age, and the time elapsed since the injury, has been used to make the decision on amputation.³⁾ Amputation is recommended in patients with a MESS greater than seven.

The major concern regarding revascularization for traumatic vascular injuries is bleeding caused by anticoagulation therapy. As observed in our patient, anticoagulation therapy can result in significant bleeding from a fractured bone and injured deep muscles. In particular, endovascular repair requires not only balloon angioplasty but also stent graft insertion. Therefore, anticoagulation therapy, including aspirin and heparin, is essential after endovascular repair.⁹⁾ However, open surgical bypasses may not always require anticoagulation therapy.⁵⁾ In clinical settings, open surgical bypasses are often performed for ischemia in the lower extremities in patients with arteriosclerosis obliterans, which partly affects anastomotic sites and distal runoff. Meanwhile, patients with vascular trauma of the lower extremities are typically young and healthy, which suggests that the vascular system is normal except for the injured area. Furthermore, autologous SVGs are more effective for preventing thrombosis than artificial grafts.¹⁰⁾

When open surgical bypasses are used to treat vascular trauma of the lower extremities, the risk of graft infection should be considered. As mentioned above, vascular trauma of the lower extremities is generally accompanied by complicated wounds in the limbs. Trauma wounds with large skin defects are diagnosed as contaminated wounds.¹¹⁾ Although vascular surgeons are reluctant to perform open surgical bypasses when contaminated wounds are present on the bypass route, these procedures can be established in such situations. Adequate lavage and debridement of the contaminated and necrotic tissue in the perigraft area are mandatory. Among the three different types of graft materials, including antibiotic-bonded grafts, arterial allografts, and autologous SVGs, autologous SVGs have the lowest infection and highest long-term patency rates.¹²⁾ Furthermore, VAC therapy is considered effective for the prevention of graft infection after open surgical bypasses which are performed through contaminated wounds. VAC therapy facilitates the rapid conversion of a large contaminated cavity into a manageable lesion. Verma et al. reported that VAC therapy resulted in 84% graft preservation rates in cases with graft infection in the groin.¹³⁾

In the present case, the external fixation of the femoral bone fracture was performed before the FP bypass. Early fracture fixation markedly reduces the incidences of acute respiratory distress syndrome, fat embolism syndrome, pulmonary thromboembolism, and pneumonia in patients with multiple traumas, including femoral bone fractures.¹⁴⁾ If the patients are unstable, external fixation which is performed for damage control orthopedics is preferred to definitive surgery. Furthermore, we believe that performing the external fixation before the FP bypass is important for determining the length of the graft.

Table 1 References related to vascular trauma of the lower extremities⁴⁻⁷⁾

Author (year)	No. of patients	Median age	Male/Female	SFA injury (%)	Blunt injury (%)	Mortality (%)	Amputation in all cases (%)/in blunt injury cases (%)
Faris IB (1997)	119	29	107/12	24 (19.7%)	119 (100%)	7 (5.9%)	63 (51.6%)/ same as all cases
Hafez HM (2001)	550	24 (Male) 35 (Female)	480/70	240 (37.2%)	122 (22.2%)	9 (1.6%)	89 (16.2%)/ 30 (24.6%)
Topal AE (2010)	140	26	133/7	53 (31.2%)	19 (13.6%)	4 (2.9%)	13 (9.3%)/ 4 (21.1%)
Kauvar DS (2011)	651	27	556/95	181 (27.8%)	220 (33.8%)	18 (2.8%)	42 (6.5%)/ 20 (9.1%)

SFA: superficial femoral artery

Conclusion

We successfully performed an open surgical bypass for a SFA occlusion caused by blunt trauma. Because multiple injuries are common in trauma patients, bleeding caused by anticoagulation therapy after revascularization should be carefully monitored. Open surgical bypasses using autologous SVGs do not always require postoperative anticoagulation therapy. In addition, the SVGs can be tolerant of infection, and this advantage is reinforced by the combined VAC therapy. If contaminated wounds are present in injured limbs, open surgical bypasses using SVGs can be accomplished in cases with vascular trauma.

Disclosure Statement

The authors have no conflicts of interest.

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