Case Report

Successful covered stent-graft treatment of superficial femoral arterial injury due to blunt trauma

Takatoshi Koroki,1 Takuya Kuroki,1 Tomohiro Abe,1 Eiji Furukoji,2 and Hidenobu Ochiai1

1Department of Emergency and Critical Care Medicine, and 2Department of Radiology, University of Miyazaki Hospital, Miyazaki, Japan

Background: Endovascular treatment is used for traumatic arterial injuries in the torso. However, the effectiveness of endovascular covered stent-graft treatment for peripheral artery injury is unclear. We present a case of superficial femoral artery (SFA) injury successfully treated with a covered stent-graft.

Case Report: A 68-year-old man presented with traumatic lower limb injury and shock. Computed tomography angiography revealed left subtrochanteric fracture and hematoma with extravasation. Digital subtraction angiography revealed extravasation from a left SFA branch, and a pseudoaneurysm at the SFA trunk. We coil embolized the SFA branch, and treated the pseudoaneurysm with a covered stent-graft. Computed tomography carried out 22 days later showed complete pseudoaneurysm exclusion and sufficient stent patency.

Conclusion: We successfully used a covered stent-graft to treat SFA injury due to blunt trauma. A covered stent-graft could be effective for peripheral artery injury.

Key words: Blunt injury, endovascular treatment, femoral artery, stent, trauma

INTRODUCTION

Arterial injuries in the extremities account for 50% of all arterial trauma cases, with 64–82% resulting from penetrating injury.1 Traumatic lower extremity arterial injuries cause significant morbidity and mortality,1,2 with amputation rates of 0.95–26.1%.1

Arterial injuries are increasingly being treated endovascularly,3 with covered stent-grafts generally used for traumatic or iatrogenic aortic injuries. In peripheral arteries, covered stent-grafts are used to treat stenosis or occlusion, but are rarely used for traumatic injury.

We used a covered stent-graft to achieve hemostasis after traumatic superficial femoral artery (SFA) injury.

CASE REPORT

A 68-year-old man sustained head and lower limb injuries in a 4-m fall. He was taking medications for hypertension and diabetes mellitus. He was in shock (blood pressure 55/40 mmHg, heart rate 83 b.p.m.) at the accident scene. He received i.v. crystalloid fluids during transportation to hospital.

At arrival, his blood pressure was 106/68 mmHg, heart rate was 81 b.p.m., respiratory rate was 16 breaths/min, oxygen saturation was 100% (on O2 10 L/min), and Glasgow Coma Scale was E4V5M6; the limbs were cold and wet, indicating shock.

Physical examination revealed a 5-cm-long occipital wound, left femoral swelling, and right ankle pain. Focused assessment with sonography for trauma was negative. Blood gas analysis showed acidemia (pH 7.28) and elevated lactate (3.7 mmol/L). Hemoglobin was 9.9 g/dL, and coagulation examination revealed elevated D-dimer (77.08 µg/mL) and decreased fibrinogen (146 mg/dL).

Radiography revealed fractures in the subtrochanteric region of the left femur and the right distal tibia and fibula. Enhanced computed tomography (CT) showed hematoma...
with extravasation around the femoral fracture (Figs. 1 and 2). We diagnosed hemorrhagic shock due to left SFA injury (injury severity score 10).

We carried out right femoral artery puncture and used a 6-Fr sheath and 0.018 inch × 200 cm guidewire for antegrade angiography of the left SFA. A delivery catheter was not used because of the emergency situation. Digital subtraction angiography showed extravasation from the proximal muscle branch of the left SFA and a pseudoaneurysm in the main SFA trunk. We carried out balloon occlusion of the proximal SFA branch for 30 min (using a 5.2-Fr, 9-mm balloon) and external fixation of the fractures. Extravasation remained after balloon occlusion, and was embolized with two microcoils (Microcoilspiral [2 cm, 2 mm]; Cook Medical Japan, Tokyo, Japan). We used a covered stent-graft (Viabahn [6 mm × 2.5 cm]; Gore, Newark, DE, USA) to repair the SFA trunk (Fig. 3). Disappearance of the extravasation was confirmed. During angiography, we transfused 2 units of red blood cells and 10 units of fresh frozen plasma. On returning to the emergency room, the patient’s hemoglobin was 6.7 g/dL and lactate was 0.9 mmol/L.

The patient received additional transfusions while the hemoglobin and fibrinogen were monitored. Continuous heparin infusion was given to prevent intrastent thrombosis. We carried out internal fixation of the left subtrochanteric and right distal tibial fractures on day 8, and of the right distal tibial fracture on day 14. Two surgical site infections were treated with debridement and systemic antibiotics from day 12 until hospital discharge. Computed tomography showed adequate stent patency on day 22, and we changed the heparin infusion to oral aspirin from day 38. The patient was transferred to another hospital on day 63.

**DISCUSSION**

We successfully treated traumatic SFA injury with a covered stent-graft. We carried out the procedure in a short time without vascular complications and obtained sufficient stent patency in the subacute phase.

Lower limb arterial injuries due to blunt trauma are often associated with fractures. Thus, SFA injury should be suspected in all patients with proximal femoral fracture.

Arterial injuries are increasingly being treated endovascularly rather than with open repair. Compared with open repair, endovascular interventions decrease in-hospital mortality and hospitalization duration, and result in lower transfusion requirements and mortality in patients with blunt thoracic aortic injuries.

For the peripheral arteries, injuries are generally treated by surgical approaches, whereas covered stent-grafts are
used for stenosis or occlusion. However, covered stent-graft implantation for peripheral arterial injury has been reported.\textsuperscript{3,5} Endovascular repair of peripheral arterial trauma results in fewer wound complications and shorter hospitalization than open repair.\textsuperscript{6} The hospitalization was relatively long in the present case, but this was only because the patient needed two fracture fixations and developed surgical site infections.

Compared with open repair, endovascular treatment of SFA injuries has been reported to reduce blood loss, hospital stay, iatrogenic nerve injuries, and recovery time,\textsuperscript{8} and to reduce ischemic and operative times for lower extremity injuries.\textsuperscript{9} Therefore, endovascular treatment could be beneficial for peripheral arterial injury, particularly in areas that are difficult to expose surgically.

Small pseudoaneurysms with low flow volume can be treated conservatively.\textsuperscript{10} However, we selected a covered stent for the main SFA trunk because of the close proximity of the fracture. We would have chosen endovascular treatment even if this patient only had a main SFA trunk pseudoaneurysm.

The disadvantages of the Viabahn are the lack of insurance cover for traumatic peripheral arterial injuries, contraindication in patients with heparin-induced thrombocytopenia II, and need for long-term antiplatelet therapy. The Viabahn also has the potential risk of stent thrombosis, although long-term stenosis and salvage rates remain unreported.\textsuperscript{8} Furthermore, information about postoperative anticoagulation is lacking. Our patient had a high bleeding risk because of planned surgeries for the fractures.

Thus, we initially selected heparin infusion, and switched from heparin to aspirin after the surgeries. Our patient had no stent stenosis or obstruction at 9 months postoperatively (Fig. 4). Dual antiplatelet therapy is recommended when the Viabahn is used for non-traumatic SFA stenosis or occlusion. However, the optimal antiplatelet therapy for trauma patients treated with the Viabahn remains unclarified.
Furthermore, the reported antiplatelet regimen and duration after Viabahn insertion vary.\textsuperscript{11} Although our patient was successfully managed with single antiplatelet therapy after Viabahn insertion, more cases need to be accumulated to determine the optimal antiplatelet regimen and duration for trauma patients treated with the Viabahn.

There are no reports of infection after covered stent placement, but trauma patients are at higher risk of infection and must be carefully monitored.

In the present case, endovascular treatment only took 1 h and was minimally invasive. Enhanced CT undertaken on day 22 and 9 months postoperatively revealed no stent stenosis and/or obstruction, and we successfully saved the limb. This suggests that endovascular treatment with a covered stent-graft is effective for peripheral arterial injury; however, it is necessary to accumulate further cases and investigate the hemostatic effect and long-term outcomes.

ACKNOWLEDGMENTS

We thank Kelly Zammit, BVSc, from Edanz Group for editing a draft of this manuscript.

DISCLOSURE

Approval of the research protocol: N/A.

Informed consent: Written informed consent was obtained from the patient.

Registry and the registration no. of the study/trial: N/A.

Animal studies: N/A.

Conflict of interest: None.

REFERENCES

1. Franz RW, Shah KJ, Haharavi D, Franz ET, Hartman JF, Wright ML. A 5-year review of management of lower extremity arterial injuries at an urban level I trauma center. J. Vasc. Surg. 2011; 53: 1604–10.
2. Johnson CA. Endovascular management of peripheral vascular trauma. Semin. Intervent. Radiol. 2010; 27: 58–43.
3. Reuben BC, Whitten MG, Sarfati M, Kraiss LW. Increasing use of endovascular therapy in acute arterial injuries: analysis of the National Trauma Data Bank. J. Vasc. Surg. 2007; 46: 1222–6.
4. Hafez HM, Woolgar J, Robbs JV. Lower extremity arterial injury: results of 550 cases and review of risk factors associated with limb loss. J. Vasc. Surg. 2001; 33: 1212–9.
5. White R, Krajcer Z, Johnson M, Williams D, Bacharach M, O’Malley E. Results of a multicenter trial for the treatment of traumatic vascular injury with a covered stent. J. Trauma 2006; 60: 1189–96.
6. Worni M, Scarborough JE, Gandhi M, Pietrobon R, Shortell CK. Use of endovascular therapy for peripheral arterial lesions: an analysis of the National Trauma Data Bank from 2007 to 2009. Ann. Vasc. Surg. 2013; 27: 299–305.
7. DuBose JJ, Savage SA, Fabian TC et al. The American Association for the Surgery of Trauma PROspective Observational Vascular Injury Treatment (PROOVIT) registry: multicenter data on modern vascular injury diagnosis, management, and outcomes. J. Trauma Acute Care Surg. 2015; 78: 215–23.
8. Stewart DK, Brown PM, Tinsley EA Jr, Hope WW, Clancy TV. Use of stent grafts in lower extremity trauma. Ann. Vasc. Surg. 2011; 25: 264–e9.
9. Simmons JD, Walker WB, Gunter II JW, Ahmed N. Role of endovascular grafts in combined vascular and skeletal injuries of the lower extremity: a preliminary report. Arch. Trauma Res. 2013; 2: 40–5.
10. Paulson EK, Hertzberg BS, Paine SS, Carroll BA. Femoral artery pseudoaneurysms: value of color Doppler sonography in predicting which ones will thrombose without treatment. AJR Am. J. Roentgenol. 1992; 159: 1077–81.
11. Patel SR, Hughes CO, Jones KG et al. A systematic review and meta-analysis of endovascular popliteal aneurysm repair using the hemobahn/viabahn stent-graft. J. Endovasc. Ther. 2015; 22: 330–7.