



Case Report

Iatrogenic acute limb ischemia with complete traumatic rupture of the popliteal artery associated with total knee arthroplasty



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ABSTRACT

Acute limb ischemia (ALI) related to total knee arthroplasty (TKA) is rare. Most occlusions are caused by thrombus formation in the popliteal artery (PA). Currently such cases are revascularized using less invasive approaches such as endovascular therapy or Fogarty thrombectomy. We report a case of ALI in a 65-year-old woman with complete rupture of the PA due to a TKA procedure. She had resting pain and motor paralysis in her right lower extremity after TKA. Contrast-enhanced computed tomography showed occlusion of the right femoropopliteal artery. Subsequently, she was referred to our hospital with a diagnosis of ALI. Initially, a less invasive revascularization procedure was unsuccessfully attempted. Therefore, we performed an emergency distal bypass and succeeded in revascularization. Intraoperative examination revealed a complete rupture of the PA. Postoperatively, the patient exhibited no signs of myonephropathic metabolic syndrome. Although there was significant motor impairment, the affected limbs were successfully salvaged. ALI with complete rupture of the PA associated with TKA has not been reported previously. In cases of iatrogenic ALI after TKA, it would be essential to consider diagnostic and revascularization methods that account for the possibility of severe injury to the PA.

Learning objective: Acute limb ischemia after total knee arthroplasty is a rare and life- and limb-threatening condition. The underlying pathological mechanism is often thrombus occlusion due to mechanical stimuli of the popliteal artery (PA). There are no established treatments for this condition, and less invasive approaches such as endovascular procedures and Fogarty thrombectomy are often used. However, in cases involving severe damage to the PA, bypass surgery may be necessary, and revascularization procedures should be considered accordingly.

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Introduction

Iatrogenic vascular injuries related to total knee arthroplasty (TKA) are rare, with a reported incidence of 17 per 100,000 cases [1]. Acute limb ischemia (ALI) due to popliteal artery (PA) occlusion is the second most frequent postoperative complication of TKA after pseudoaneurysm of the PA [2]. ALI is a life-threatening condition, and revascularization within 6 h is desirable, if possible [3]. The etiology of TKA-induced ALI is believed to be traction injury or direct trauma that triggers

thrombus formation. Many cases can be successfully revascularized by peripheral intervention or Fogarty thrombectomy [4].

This case report describes a patient with ALI complicated by complete rupture of the PA and thrombus formation due to mechanical stimulation after TKA. Endovascular intervention and surgical thrombectomy were unsuccessful, and the patient underwent conversion to emergency distal bypass. The intraoperative findings revealed a complete transection of the PA.

Case report

A 65-year-old woman who had undergone TKA was diagnosed with ALI and was transferred to our hospital 12 h after surgery. The preoperative ankle-brachial index was 1.0 on the right side and 1.1 on the left

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side, both in the normal range. The patient had been complaining of foot pain since TKA surgery at her previous hospital. However, it was considered to be postoperative pain, and the patient was under observation with analgesics. Subsequently, the patient was observed to have pallor and motor impairment in the right lower limb, and consulted our cardiovascular center for specialized treatment. Upon presentation, she complained of severe resting pain and motor palsy in the right lower leg. Physical examination revealed skin pallor and loss of arterial palpation of the PA. Thrombotic occlusion of the right superficial femoral artery (SFA) and an unclear vessel wall structure in the PA were suspected following duplex ultrasound examination (Fig. 1A). Contrast-enhanced computed tomography (CT) showed a loss of contrast below the right SFA (Fig. 1B). The short-axis CT image showed loss of contrast in the right PA and a peri-arterial hematoma (Fig. 1C). However, evaluation of the middle part of the PA was difficult due to artifacts of the joint prosthesis (Fig. 1D). At the time of presentation, her blood creatinine kinase was 8550 IU/L. Although over 6 h had passed, the sensory nerves were not severely damaged; therefore, we planned an emergency revascularization procedure with the possibility of limb salvage. Based on the contrast-enhanced CT findings, we speculated that a combination of Fogarty thrombectomy and endovascular treatment (EVT) was feasible for revascularization. Consequently, lower extremity angiography was performed as the initial step.

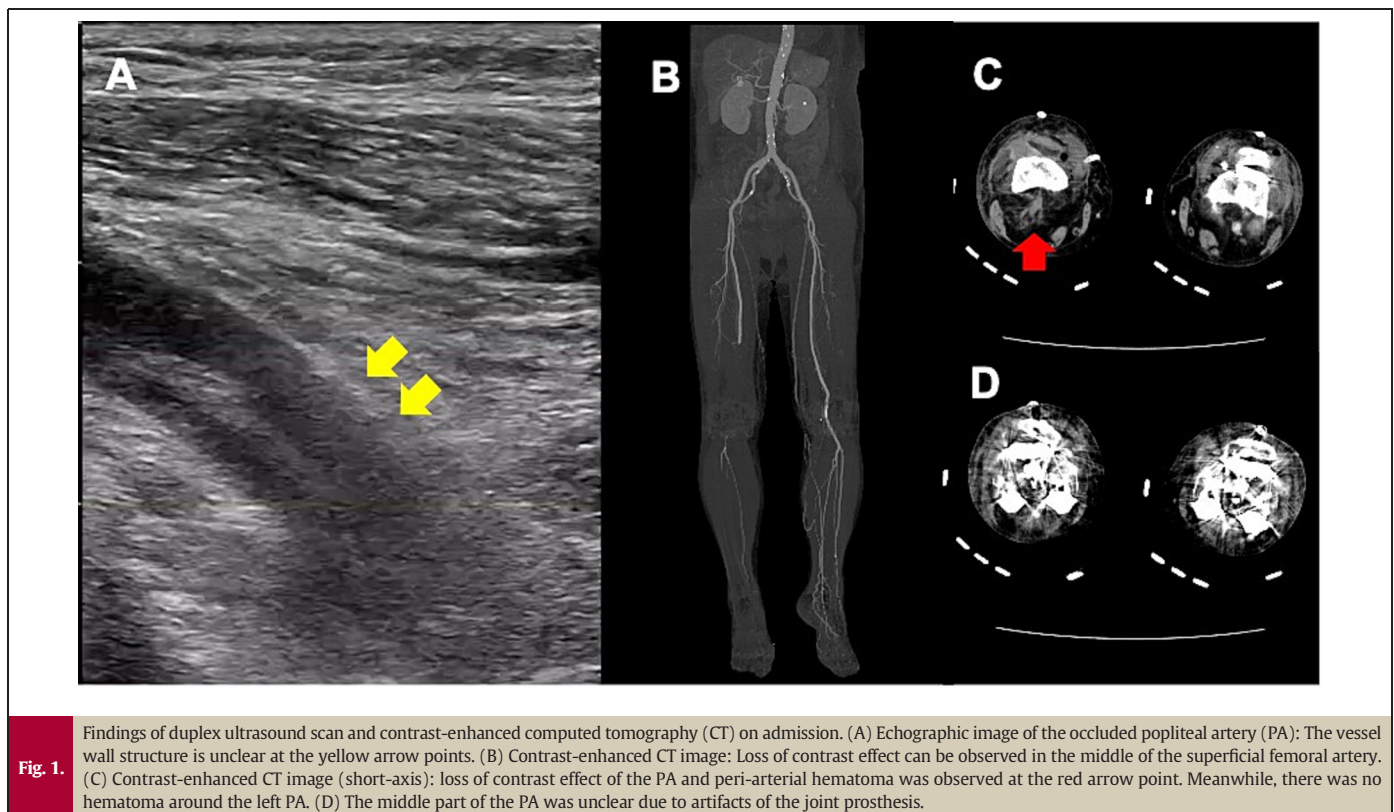
A 6Fr Destination guiding sheath (Terumo Corporation, Tokyo, Japan) was inserted through the left groin and delivered to the left common femoral artery (CFA) using a crossover approach. Lower extremity angiography revealed occlusion in the middle of the right SFA. Based on these findings, arterial occlusion due to a massive thrombus was suspected, and Fogarty thrombectomy was selected. To reduce the risk of vascular injury from the procedure, we decided to use an over-the-wire Fogarty catheter after passing the occluded lesion with a guidewire. The right CFA was exposed using a cut-down approach, and a 6Fr sheath was inserted. We then advanced a 300-cm Regalia guidewire (Asahi Institute Corporation, Aichi, Japan) through the exposed CFA. However, the Regalia

wire failed to pass through the obstruction. The wire passage was unsuccessful despite changing to a Gladius wire (Asahi Institute Corporation) (Fig. 2A). Contrast examination through the tip of the microcatheter was performed in the occluded lesion because no wires advanced further than the SFA. The findings suggested thrombus and arterial dissection (Fig. 2B). ALI was determined to involve severe tissue damage rather than acute occlusion due to simple thrombus formation.

Accordingly, we decided to perform emergency distal bypass surgery. A nearly full-length saphenous vein was harvested from the left lower extremity under general anesthesia. After exposing the PA, we attempted to surgically remove the thrombus in the artery to create a proximal anastomosis of the PA. However, the operative field exhibited suboptimal visibility because of the massive hematoma around the PA, and anastomosis with the PA was deemed unfeasible. A saphenous vein graft was anastomosed from the middle of the SFA through a subcutaneous tunnel to the distal posterior tibial artery. Subsequent monitoring confirmed the restoration of blood flow. Massive bleeding was observed in the exposed PA immediately after revascularization. A search around the bleeding site revealed a complete transection of the PA, reflux hemorrhage, and a portion of the blunt-transected PA.

Bleeding was stopped with a surgical clip, and a fasciotomy was performed, suspecting compartment syndrome. The wound was closed, except at the fasciotomy site, and the surgery was completed. The bluntly transected PA showed gross dissection findings (Fig. 3A). Pathologically, the dissected lumen was consistent with the elastic plate. This finding differed from that of the arterial dissection due to the fragility of the tunica media, which was suspected of having been injured by an external force (Fig. 3B).

Following surgery, the patient exhibited no signs of myonephropathic metabolic syndrome (MNMS), such as metabolic acidosis or hyperkalemia. Since adequate urine output was observed from the day after revascularization, neither continuous hemodiafiltration nor continuous renal replacement therapy was performed. Despite the significant motor impairment, the affected limbs were successfully salvaged. One



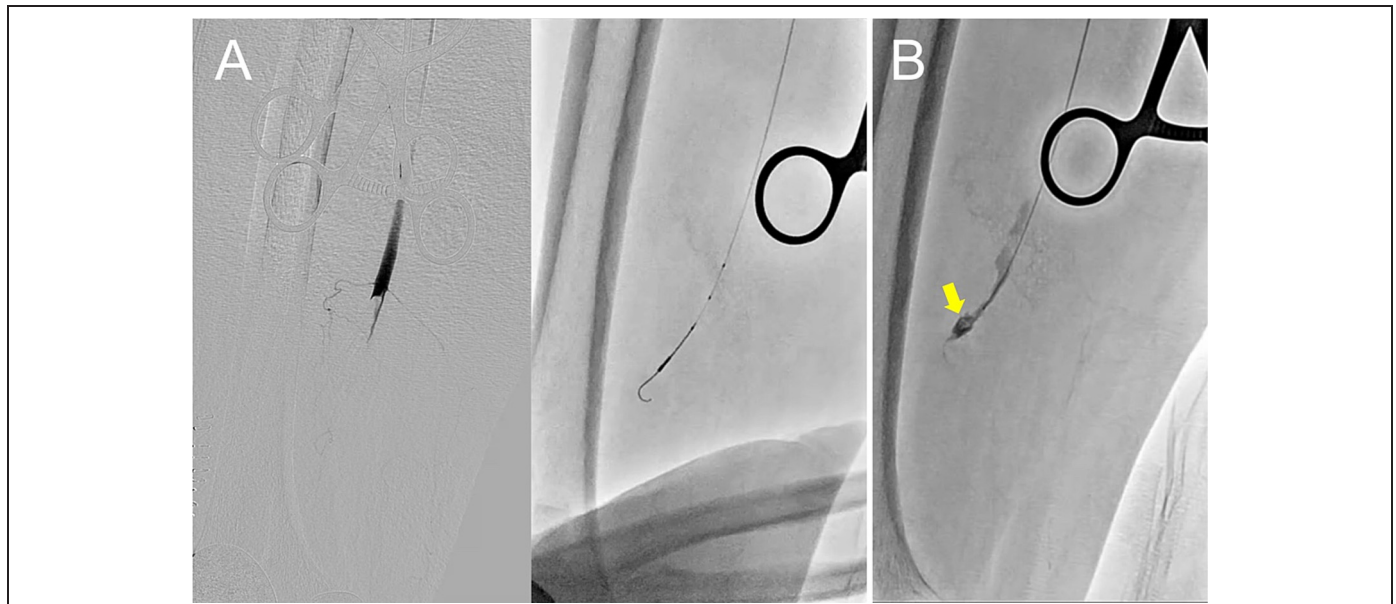


Fig. 2. Procedures during Fogarty thrombectomy. (A) Lower limb angiography: The findings suggest the presence of a thrombus, although the guidewire did not pass. (B) Injection of the contrast medium from the microcatheter tip within an occluded lesion. The arrowed area shows findings suggestive of thrombus and vascular dissection.

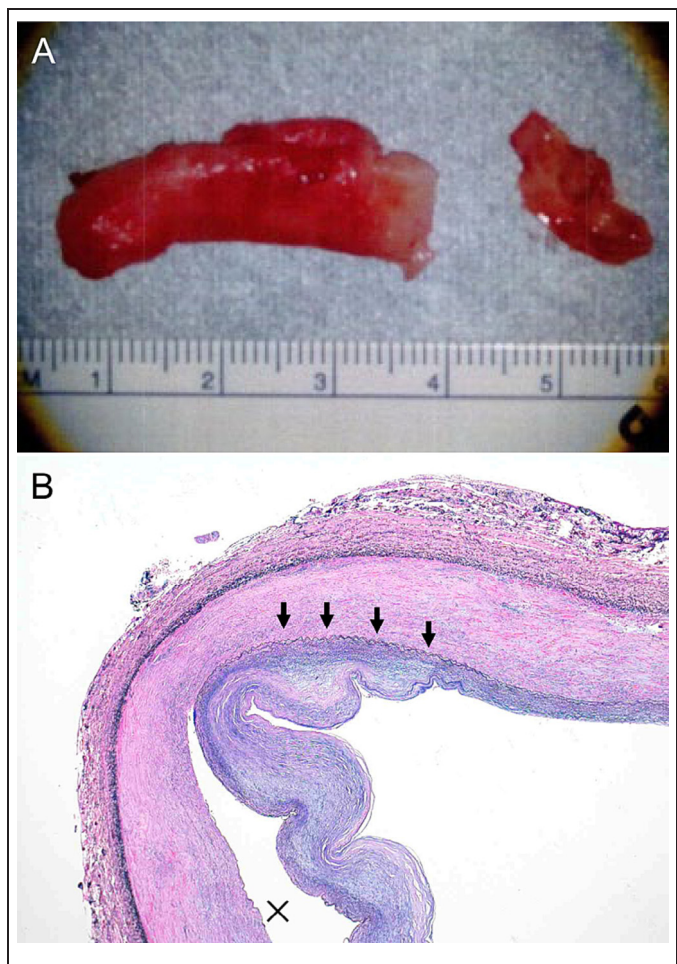


Fig. 3. Specimens of the popliteal artery (PA). (A) Gross findings of the transected PA: blunt damage can be observed at the edge of the transection. (B) Pathology image (Victoria blue stain, 100 \times): Arrows indicate internal elastic lamina. The \times mark indicates the dissection lumen just below the internal elastic lamina.

year has passed since the treatment, and the patient is currently under outpatient follow-up.

Discussion

This report describes a case of iatrogenic ALI complicated by complete rupture of the PA following TKA. In this case, severe damage to the PA during TKA may have triggered ALI. The presence of typical symptoms of ALI after TKA and a hematoma around the right PA on CT strongly suggests this etiology. In the first endovascular revascularization attempt, the guidewire did not advance to the PA and a balloon catheter was not inserted. Therefore, it is unlikely that the first revascularization attempt caused severe arterial injury. A previous study showed that thrombus formation and blunt trauma to the PA associated with TKA were caused by retractor damage and knee hyperextension [5]. As revascularization for ALI after TKA is a complication in patients who have already undergone major surgery, less invasive approaches, such as EVT or hybrid therapy combining Fogarty thrombectomy and EVT, have been proposed and reported [4,6]. The limb salvage rates with these treatments were also favorable. This is because the occlusion mechanism of the lower extremity arteries is mainly due to thrombus formation. In the present case, we first attempted a less invasive approach. Although the guidewire failed to pass, we switched to an urgent bypass procedure. The mechanism of iatrogenic ALI in this patient may have been a blunt trauma that ruptured the PA, causing severe dissection and thrombus formation in the SFA. There was also no thrombophilic disease or malignancy indicated in this patient. EVT or Fogarty thrombectomy may not be suitable for these mechanisms, and emergency distal bypass is likely appropriate. After bypass surgery, an attempt was made to evaluate the right PA using contrast-enhanced CT, which was unfortunately difficult due to artifacts from the joint prosthesis. Although the PA is not completely ruptured, there have been a few reports of bleeding and arterial occlusion due to partial transection or severe damage to the PA caused by TKA procedures [7–9]. Therefore, when iatrogenic ALI related to TKA is encountered and revascularization is needed, mechanisms such as those described in this case may be considered.

The patient had elevated creatinine kinase levels, although fortunately, she did not progress to MNMS. The efficacy of continuous hemodiafiltration for MNMS after ALI has been reported [10]. If this

patient had developed MNMS with metabolic acidosis and hyperkalemia during the procedure or immediately after revascularization, we would have introduced continuous hemodiafiltration as soon as possible.

Conclusion

Herein, we report a case of ALI with complete PA rupture. In cases of iatrogenic ALI associated with TKA, initial interventions such as EVT or Fogarty thrombectomy are commonly performed because of their minimally invasive nature and faster reperfusion time. However, patients with extensive mechanical injury to the PA may require urgent conversion to bypass surgery.

Presentation information

This case was presented at the thirtieth Annual Meeting of the Japanese Association of Cardiovascular Intervention and Therapeutics, Yokohama, Kanagawa, Japan.

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Informed consent

Written informed consent was obtained from the patient and her family for the publication of this case report and images.

Author contributions

Tatsuro Takei collected and analyzed examination and treatment data and wrote the manuscript. Takashi Kajiya provided comprehensive opinions and interpretations of the case and assisted in writing the manuscript. All authors provided opinions on the case reviewed and approved the final manuscript.

Data availability

The datasets generated in this study are available from the corresponding author upon reasonable request.

Declaration of competing interest

The authors declare that there are no conflicts of interest.

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