

Popliteal artery occlusion concomitant with a tibial plateau fracture and posterior cruciate ligament avulsion fracture

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Abstract

In acute trauma, posterior cruciate ligament (PCL) injury may occur concomitantly with a bony fracture and be easily overlooked. A popliteal artery injury associated with a tibial plateau fracture and PCL avulsion fracture is rare. Missed or delayed diagnosis of this condition leads to a high amputation rate. Therefore, close attention is required with this type of injury. The limb can be saved though early detection and immediate reconstruction of the injured artery, followed by fasciotomy. We report here a rare case of popliteal artery occlusion proximal to the surgical zone, which was diagnosed after fixation of a medial tibial plateau fracture and posterior cruciate avulsion injury. In dashboard injuries without knee dislocation, the arterial intima may be injured and become vulnerable, even with an initial ankle brachial index greater than 0.9. This can cause concomitant occlusion of the popliteal artery due to iatrogenic retraction during surgery. Therefore, a neurovascular examination should be repeated to prevent delayed-onset thrombosis. To the best of our knowledge, this is the first case of popliteal artery injury concomitant with a tibial plateau fracture and PCL avulsion owing to initial dashboard injury-related arterial intima injury, which can present with a normal ankle brachial index.

Keywords

Popliteal artery occlusion, tibial plateau fracture, posterior cruciate ligament avulsion fracture, arterial intima, thrombosis, knee, foot pulse

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Introduction

In acute trauma, posterior cruciate ligament (PCL) injury may occur in combination with bony fractures and is easy to overlook.¹ The prevalence of arterial injury after blunt lower extremity fractures has been reported as 1.04%.^{2,3} Popliteal artery injury associated with a tibial plateau fracture with PCL avulsion fracture is a rare condition. Therefore, close monitoring of this condition is required. Popliteal artery injury can result from five types of injury, including occlusion, transection, laceration, intimal, and iatrogenic injuries.² In arterial injuries secondary to blunt trauma, vascular damage can occur from direct and indirect forces related to the fractured bone. Direct injuries can be caused by bony fragments or through a crushing-type mechanism, whereas indirect injuries can result from vessel traction with secondary disruption of the intima.³ Blunt trauma with delayed onset of limb ischaemia requires prompt and immediate diagnosis because a missed or delayed diagnosis is associated with a high amputation rate. The limb can be saved through early detection and immediate reconstruction of the injured artery, followed by fasciotomy. We report here a rare case of popliteal artery occlusion that was diagnosed after surgery for a medial tibial plateau fracture and posterior cruciate avulsion injury. The occlusion site was proximal to the surgical zone of the PCL avulsion site without intra-surgical visualization.

Case report

A 52-year-old man sustained high-energy knee trauma caused by a dashboard injury that was obtained in a traffic accident. He was diagnosed with severe left knee trauma with a concomitant medial tibial plateau fracture classified as Schatzker classification type IV with anteromedial column involvement and a severe displaced PCL avulsion

injury (Figure 1). Upon presentation to the Emergency Department, a neurovascular examination showed no obvious abnormalities, with an ankle brachial pressure index (ABI) higher than 0.9. Because no soft tissue was compromised, the patient underwent open reduction and internal fixation under general anaesthesia on the following day. He was placed in the prone position and a 250-mmHg tourniquet was applied. A reverse L incision was used, and deep dissection was performed within the medial gastrocnemius and the semi-membranous interval to identify the medial tibial plateau fragment.⁴ The fragment was then fixed using a medial 4.5-mm locking compression plate (Synthes, Paoli, PA, USA). Because of the large amount of muscle tension caused while exploring the PCL avulsion fragment, the head of the medial gastrocnemius was split.⁵ Capsulotomy was created to identify the PCL avulsion fragment. Two fragments were identified, and these were reduced and fixed with two 3.5-mm screws with washers for rigid fixation. The wound was closed layer by layer. Upon wound closure, soft tissue contents were acceptable. After recovery from general anaesthesia, the patient complained of a severe painful sensation, and the dorsalis pedis pulsation was confirmed as intact. The patient was asked to move his lower extremity, and limited motion was observed because of severe pain. The affected lower extremity remained warm, but paralysis and pulselessness developed 6 hours postoperatively. Emergency computed tomography angiography was performed, and one segment of the popliteal artery proximal to the level of the screws was found to be occluded (Figure 2).

A radiologist was consulted regarding whether percutaneous arterial angioplasty could be performed immediately. During thrombectomy, a 1.5-cm blood clot was removed (Figure 3). Eight to 12 hours

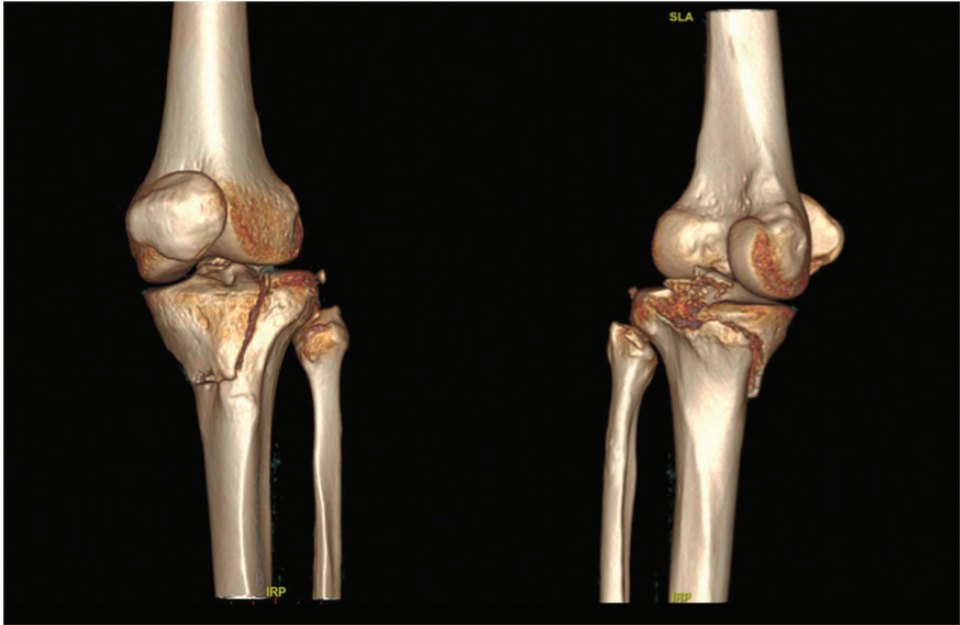


Figure 1. Three-dimensional computed tomography shows a medial tibial plateau fracture and severe displaced posterior cruciate ligament avulsion injury.



Figure 2. Emergency computed tomography angiography shows occlusion of one segment of the popliteal artery proximal to the level of the screws.

after reperfusion, angiography was repeated as a second-look procedure. All three main vessels around the lower extremity remained patent. During this period, terminal perfusion and dorsalis pedis pulsation were checked at 1-hour intervals. Prophylactic fasciotomy was performed after reperfusion (Figure 4). Negative pressure wound therapy was applied several times for wound care, and a volume expander (a large volume of crystalloid fluid and dextran) and anti-coagulation agents (intravenous heparin infusion 19,200 U once a day for 2 days) were also administered. Pulsation at the extremities was monitored and no pulsation loss occurred again. Furthermore, the patient was prescribed oral aspirin for 1 month. After 1 week, a skin graft was completed for wound management (Figure 5). Six months after the trauma, the patient regained good ambulatory capacity without assistance.



Figure 3. During thrombectomy, a 1.5-cm thrombosis was removed.



Figure 5. After 1 week of thrombectomy, a skin graft was completed for wound management.

We obtained consent from the patient for every procedure, and the patient was informed about what was involved in these procedures before they were performed. The patient provided consent for publication.

Discussion

To the best of our knowledge, this is the first report to describe a concomitant medial tibial plateau and PCL avulsion fracture associated with popliteal artery occlusion. Findings of the present case suggested that, although foot pulses might initially be present, surgeons must consider the possibility of popliteal artery injury in cases of trauma near the knee joint. Additionally, trained staff should frequently observe the limbs and assess the foot pulse repeatedly using ultrasonography.

Conventional open approaches to PCL avulsion fixation can be performed using the three access directions of midline, medial, and lateral.⁶ Among these, the medial-based surgical approach, first described by Burks and Schaffer, is the most popular, although only two cases were included in the first report of this approach.⁴ Abdallah and Arafa⁷ applied the same technique to 27 patients, and this resulted in great functional outcome with



Figure 4. Prophylactic fasciotomy was performed after reperfusion.

no surgery-related comorbidity. This approach requires retracting the medial gastrocnemius muscle to expose the PCL insertion site, which may be difficult in obese or muscular individuals. Moreover, fixation stability may be compromised by the limited exposure of the lateral PCL base and difficulties in placing screws perpendicular to the fracture plane. Nicandri et al.⁸ modified this approach using the interval between the two heads of the gastrocnemius muscle during exposure. The modified approach requires identifying the medial sural cutaneous branch, the short saphenous vein, and motor branch innervation from the tibial nerve to the gastrocnemius. This process can be time-consuming and technically demanding. Attia et al.⁹ further modified the technique through changes to the posterior L incision by splitting the gastrocnemius medial head. This procedure is similar to that followed in the Trickey approach,⁵ and one of its advantages is that the lateral half of the medial head can be pulled to improve exposure of more than one bony fragment or lateral extension of the bony fragment, with little tension compared with Burks and Schaffer's approach. Additionally, this modified procedure by Attia et al.⁹ has a low rate of neurovascular injury compared with Nicandri et al.'s⁸ approach. Qiu et al.¹⁰ conducted a prospective study on complications related to the posterior reversed L-shaped approach and reported one case of popliteal artery injury resulting from an antero-posteriorly drilled K-wire. These authors indicated that all dissections, from medial to lateral, should be performed beneath the proximal part of the popliteus muscle to prevent neurovascular bundle injury. Moreover, dissection should involve raising a full-thickness fasciocutaneous flap to prevent sural nerve injury. The soft tissue is sutured with the knee in full extension to reduce tension after wound closure. In the present case, the mechanism of popliteal

artery injury involved soft tissue distraction, which caused the occlusion site to be at a different level from our surgical zone and not the same as that in previous reports. Sufficient muscle relaxant administration has been suggested to release tension of the medial gastrocnemius, allowing better visualization of the posterior column for avulsion site fixation.¹⁰ Alternatively, the medial head of the medial gastrocnemius can be cut.

In the present case, development of popliteal artery occlusion can be explained as follows. This injury may have arisen from the initial dashboard injury, where the arterial intima was vulnerable, but not occluded. The ABI, which was measured on presentation to the Emergency Department, was higher than 0.9, and thus did not require additional evaluations with angiography or duplex ultrasound.¹¹ Occlusion developed postoperatively with retraction because no approach would have allowed the limb to remain tension-free. Other possible predisposing factors could have been the use of a tourniquet or some intraoperative irritation that we were unaware of. In the present case, two approaches were combined to minimize muscle tension as follows. Deep dissection was performed in the gastrocnemius medial head and semi-membranous interval for the medial part of the fragment, and the gastrocnemius medial head was split for the lateral part of the fragment. The neurovascular bundle was protected by this combined approach. Moreover, although a muscle relaxant had been administered during surgery, postoperative popliteal artery occlusion occurred. We did not find any similar cases after an extensive review of previous literature. If iatrogenic complications occur, the occlusion site might be at the same level as the surgical field. However, popliteal artery occlusion developed above the surgical zone in our patient. Findings in the present case highlight that

cases of dashboard knee blunt trauma should be carefully monitored for the rare occurrence of popliteal artery occlusion pre/postoperatively. This requires repeated physical examinations, even without initial presentation of knee dislocation or with an initial ABI greater than 0.9.

Conclusion

Although rare, popliteal artery injury needs to be considered in proximal tibial fracture. Neurovascular examinations should be repeated in cases of high-energy, blunt dashboard injuries, even without initial knee dislocation because the arterial intima may be injured and become vulnerable. This may cause concomitant occlusion of the popliteal artery due to iatrogenic retraction during surgery.

Declaration of conflicting interest

The author(s) declare that there is no conflict of interest.

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