Case Report

J Trauma Inj 2023;36(2):142-146
https://doi.org/10.20408/jti.2022.0064

Journal of Trauma and Injury JTI

pISSN 2799-4317 • eISSN 2287-1683

Delayed diagnosis of popliteal artery injury after traumatic knee dislocation in Korea: a case report

Chung-Eun Lee, MD[1], In-Seok Jang, MD[1], Sang-Yoon Song, MD[2], Jung-Woo Lim, MD[3], Kun-Tae Kim, MD[2]

[1]Department of Thoracic and Cardiovascular Surgery, Gyeongsang National University Hospital, Gyeongsang National University College of Medicine, Jinju, Korea
[2]Division of Orthopedic Surgery, Regional Trauma Center, Gyeongsang National University Hospital, Gyeongsang National University College of Medicine, Jinju, Korea
[3]Division of General Surgery, Regional Trauma Center, Gyeongsang National University Hospital, Gyeongsang National University College of Medicine, Jinju, Korea

The popliteal artery damage is present to range from 1.6% to 64% of patients with knee dislocation, and it is crucial to evaluate vascular damage even if there are no prominent ischemic changes in the distal area. The injury of the popliteal artery by high-energy forces around the knee caused by a fall or traffic accident is a potentially limb-threatening complication in traumatic knee dislocation. The popliteal artery injury by blunt trauma has a high risk of limb amputation because the initial symptoms can show normal vascular circulation without urgent ischemia or obvious vascular injury signs. Since the collateral branches can delay the symptoms of decisive ischemia or pulseless extremity, the vascular damage is a major cause of limb amputation. In the present study, we describe a rare case of delayed diagnosis of popliteal artery injury after traumatic knee dislocation, requiring urgent limb revascularization surgery. After revascularization of the occluded popliteal artery, graft interposition was performed, and successful restoration was confirmed. This case illustrates that, even if ankle-brachial index >0.9 or equal pedal pulse to the uninjured extremity, serial vascular evaluation is required if there are soft signs such as diminished pulses, neurologic signs, or high-energy damage such as multiple ligament ruptures since delayed diagnosis of artery injury can be the major cause of limb amputation. The clinicians need to regard high-energy trauma such as multiple ligament rupture around the knee as a hard sign, and immediate computed tomography angiography can be helpful for accurate diagnosis and treatment.

Keywords: Popliteal artery; Knee dislocation; Computed tomography angiography; Physical examination; Case reports

Received: November 1, 2022
Revised: November 15, 2022
Accepted: November 18, 2022

Correspondence to
Kun-Tae Kim, MD
Department of Orthopedic Surgery, Regional Trauma Center, Gyeongsang National University Hospital, Gyeongsang National University College of Medicine, 79 Gangnam-ro, Jinju 52727, Korea
Tel:*** _ **** _ ****
Email: ostramua@gnuh.co.kr

INTRODUCTION

The popliteal artery is vulnerable to blunt trauma, such as knee dislocation or complex fracture of the proximal tibia or distal femur. The popliteal artery injury by blunt trauma has a high risk of limb amputation because the initial symptoms can show nor-

mal vascular circulation without urgent ischemia or obvious vascular injury signs [1]. Since the collateral branches can delay the symptoms of decisive ischemia or pulseless extremity, the vascular damage is a major cause of limb amputation [2]. In the present study, we describe a rare case of delayed diagnosis of popliteal artery injury after traumatic knee dislocation, requiring urgent limb revascularization surgery.

CASE REPORT

A 54-year-old male patient was referred to the emergency department of Gyeongsang National University Hospital (Jinju, Korea) with acute ischemia, such as weak presence of a dorsalis pedis artery pulse, coldness, motor weakness, and sensory loss in the left lower leg, 9 hours after he suffered a knee dislocation by fallen from an embankment.

The patient's history revealed that he promptly presented to the local hospital after knee dislocation. Before local hospital presentation, the dislocated knee was spontaneously reduced. Investigation of the local hospital records revealed that the left lower leg showed that no evidence of acute ischemia and normal dorsalis pedis artery pulse on Doppler ultrasound, but common peroneal nerve injury symptoms including decreased sensation in the top of the foot and unable to hold the foot up on the initial examination. There were no differences in the pulses of the wrist or ankle compared to those in the contralateral uninjured extremity. A plain radiograph had no evidence of fracture of dislocation (Fig. 1). As a positive Lachman test finding, magnetic resonance imaging (MRI) was performed to confirm around knee ligament continuity. There was complete rupture of the bicruciate ligament, and injury of medial collateral ligament (Fig. 2). In addition, there was a lesion suspected of being minor intimal injury, but the overall patency was maintained in the MRI (Fig. 3). As the pedal pulse was equal to the sound side, close observation was performed, and the patient was scheduled to multiple ligaments reconstruction after swelling control. Without serial physical examination and Doppler ultrasound, the clinician discovered ischemic changes such as weakness of pedal pulse and cyanosis of toes, about 7 hours after the injury. The computed tomography angiography (CTA) was immediately performed, which showed complete segmental occlusion of popliteal artery, and fortunately, well developed genicular artery revealing proper collateral flow to the foot (Fig. 4).

For emergency exploration of the popliteal artery, the patient was transferred to our hospital. Immediately, we carried out surgical intervention to salvage the limb, 10 hours after the injury. The popliteal artery was found to be transected with thrombus and the damaged artery was excised. The graft interposition was performed by using a reversed saphenous vein graft with restoration of distal pulses within 12 hours of the injury. Postoperatively, intravenous heparin was administered for 7 days before replacing to prophylactic low molecular weight heparin. Low molecular weight heparin was kept for 7 days. During the period of observation, aspirin was retained. One week after surgery, follow-up CTA revealed successful restoration of the flow without any complication such as postoperative stenosis, thrombotic occlusion (Fig. 5).

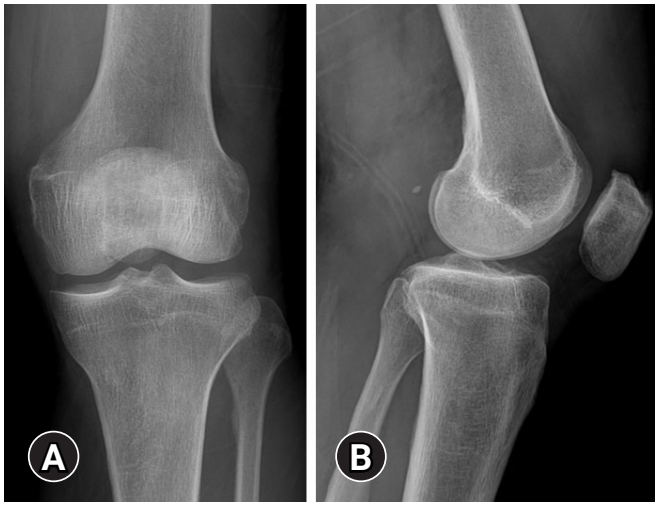

Fig. 1. Initial knee plain radiograph of (A) anteroposterior and (B) lateral. The initial knee X-ray showed no dislocation and bony abnormalities.

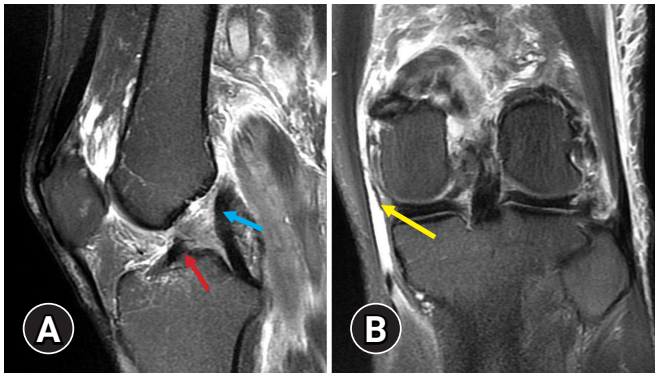

Fig. 2. Knee magnetic resonance imaging of (A) sagittal and (B) coronal views. The knee magnetic resonance imaging showed (A) complete rupture of bicruciate ligaments on the sagittal view (red arrow, anterior cruciate ligament; blue arrow, posterior cruciate ligament) and (B) injury of medial collateral ligament on coronal view (arrow).

Fig. 3. Knee magnetic resonance imaging (popliteal artery) of (A) sagittal and (B, C) coronal views. (A, B) There was a lesion suspected of being minor intimal injury (black circles), but (C) the overall patency of popliteal artery and distal flow (white circle) were maintained in the magnetic resonance imaging.

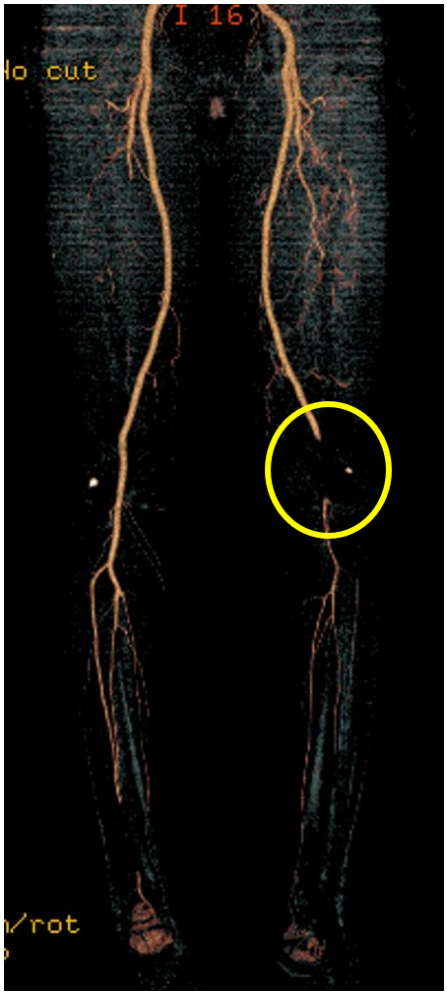

Fig. 4. Lower extremity computed tomography angiography showed complete segmental occlusion of left of popliteal artery (circle).

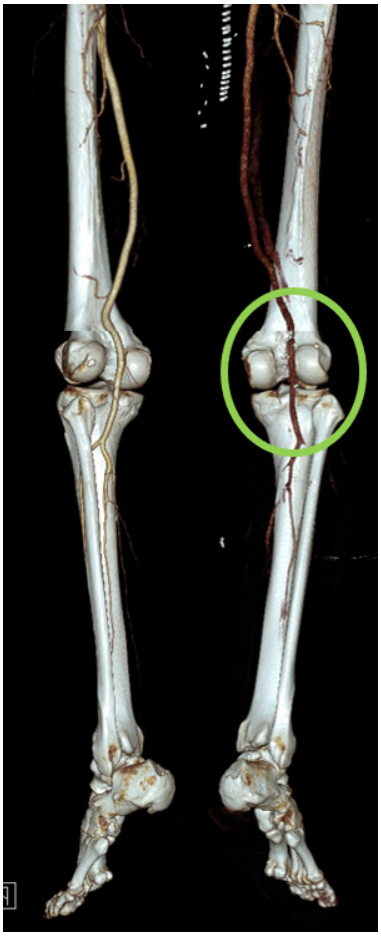

Fig. 5. Lower extremity follow-up computed tomography angiography after vein graft interposition surgery revealed successful restoration of the flow (circle) without any complication such as postoperative stenosis and thrombotic occlusion.

https://doi.org/10.20408/jti.2022.0064

Ethics statements

The case report was approved by the Institutional Review Board of Gyeongsang National University Hospital (No. GNUH 2022-10-016). The data were collected and analyzed in an ethical manner while protecting the patient`s right to privacy. Informed consent was waived since this was a retrospective study using medical records.

DISCUSSION

In the event of knee dislocation, the popliteal artery is particularly vulnerable to damage due to its anatomical location. At the point of the tendinous hiatus of the adductor magnus, the popliteal artery originates; before separating into the anterior and posterior tibial arteries, the tendinous arch of the soleus muscle anchors it firmly at the popliteal fossa. The artery is thus quite vulnerable to injury because of its position above and below the knee [3]. An irreversible injury could result in the need for amputation above the knee if a vascular injury is not detected and repaired in a timely manner. There are also other complications associated with knee dislocations, such as compartment syndrome, deep vein thrombosis, and most commonly, neurologic damage. The peroneal nerve injury is not a surgical emergency but may result in foot drop and impaired gait if it damages the dorsiflexion of the foot. Furthermore, sensory loss and paresthesia may also occur on portions of the dorsal side of the foot. Dislocations can spontaneously reduce in 50% of cases before they are evaluated, making diagnosis challenging [4]. When treating such patients, clinicians should confirm the history of leg deformity, the mechanism of injury, and any prehospital reduction attempts. Also, clinical assessments should be made to determine if the affected extremity is weak, cool, paresthesia, or bleeding. An evaluation of knee instability including ligamentous injury should be conducted after the reduction. Due to pain or muscular spasm, the initial ligament examination may be limited, which means a normal examination should be interpreted cautiously.

As a tool for assessing limb perfusion, the ankle-brachial index (ABI) is calculated by dividing the systolic blood pressure in the injured extremity by the systolic blood pressure in the uninjured upper extremity. Although the ABI values of >0.9 indicate intact vasculature, monitoring and repeat vascular examinations are recommended to avoid the missed diagnosis [5]. On physical examination, hard signs of arterial injury (pulselessness, rapidly expanding hemorrhage, massive bleeding, or palpable or audible bruit) help to diagnose vascular compromise requiring surgical treatment [6]. For patients without hard signs on physical examination, serial examination by a physician over 24 to 48 hours has proven to be highly sensitive and specific for detecting vascular injury in knee dislocations [3]. Stannard et al. [3] recommended that a surgeon should perform a vascular examination upon admission, 4 to 6 hours after admission, and again 24 and 48 hours later. However, due to the risk of complications (i.e., progression of occlusion or late pseudoaneurysm) associated with missed diagnosis, use of CTA has been recommended when soft signs (diminished pulse, a neurological findings and small nonpulsatile hematoma adjacent to named arteries) of vascular injury are present [7]. In the initial evaluation of this case, there were no hard signs like pulselessness, but only soft signs such as common peroneal nerve palsy at the local hospital. An ABI was not measured, but the same pulse as that of the contralateral side was confirmed. Whenever vascular damage is suspected, serial vascular examinations are required, and CTA is recommended if abnormal findings of ABI or Doppler ultrasound are observed.

An increase in the level of energy in injuries may explain the higher frequency of vascular damage. Especially in cases of high-energy damage such as multiple ligament rupture, vascular damage should be strongly suspected. Since thrombotic occlusion progresses slowly after intimal injury in this rare cases, close observation is necessary when vascular damage is suspected. The best diagnostic method for detecting vascular injuries was under debate in the literature. It is suggested that only patients with abnormal pulses or ABI undergo CTA in patients with knee dislocation [8], in contrast to some studies that recommended routine angiography for all patients [9]. Due to the difficulty of establishing the natural history of minor injuries resulting in healing or occlusion, we agree the "liberal use of angiography" for knee dislocation injuries [10]. The clinicians need to regard high-energy trauma such as multiple ligament rupture around the knee as a hard sign, and immediate CTA can be helpful for accurate diagnosis and treatment.

In summary, knee dislocation can result in vascular injuries, which can be potentially limb-threatening complication. About half of all dislocations can be reduced before arrival, so understanding of injury mechanism and thorough physical examination are essential. The equal pulses do not necessarily exclude vascular injury. In addition, even if ABI of >0.9, serial vascular evaluation is required if there are soft signs such as diminished pulses, neurologic signs, or high-energy damage such as multiple ligament ruptures since delayed diagnosis of artery injury can be the major cause of limb amputation. Traumatic knee dislocation

should be considered as a hard sign and prompt CTA can provide accurate diagnosis of vascular damage.

NOTES

Conflicts of interest
The authors have no conflicts of interest to declare.

Funding
None.

Data sharing statement
Not applicable.

Author contributions
Conceptualization: all authors; Data curation: CEL, KTK; Formal analysis: CEL, KTK; Methodology: SYS, JWL; Project administration: SYS, JWL; Writing–original draft: CEL, ISJ, KTK; Writing–review & editing: all authors. All authors read and approved the final manuscript.

REFERENCES

1. Wagner WH, Calkins ER, Weaver FA, Goodwin JA, Myles RA, Yellin AE. Blunt popliteal artery trauma: one hundred consecutive injuries. J Vasc Surg 1988;7:736–43.
2. Kim JW, Sung CM, Cho SH, Hwang SC. Vascular injury associated with blunt trauma without dislocation of the knee. Yonsei Med J 2010;51:790–2.
3. Stannard JP, Sheils TM, Lopez-Ben RR, McGwin G Jr, Robinson JT, Volgas DA. Vascular injuries in knee dislocations: the role of physical examination in determining the need for arteriography. J Bone Joint Surg Am 2004;86:910–5.
4. Seroyer ST, Musahl V, Harner CD. Management of the acute knee dislocation: the Pittsburgh experience. Injury 2008;39:710–8.
5. Boyce RH, Singh K, Obremskey WT. Acute management of traumatic knee dislocations for the generalist. J Am Acad Orthop Surg 2015;23:761–8.
6. Compton C, Rhee R. Peripheral vascular trauma. Perspect Vasc Surg Endovasc Ther 2005;17:297–307.
7. Feliciano DV, Moore FA, Moore EE, et al. Evaluation and management of peripheral vascular injury: part 1. Western Trauma Association/Critical Decisions in Trauma. J Trauma 2011;70:1551–6.
8. Warwick H, Cherches M, Shaw C, Toogood P. Comparison of computed tomography angiography and physical exam in the evaluation of arterial injury in extremity trauma. Injury 2021;52:1727–31.
9. Mills WJ, Barei DP, McNair P. The value of the ankle-brachial index for diagnosing arterial injury after knee dislocation: a prospective study. J Trauma 2004;56:1261–5.
10. Barnes CJ, Pietrobon R, Higgins LD. Does the pulse examination in patients with traumatic knee dislocation predict a surgical arterial injury? A meta-analysis. J Trauma 2002;53:1109–14.

https://doi.org/10.20408/jti.2022.0064