NCPD
1.5
ANCC
Contact
Hours
OPEN

Acute Popliteal Artery Thrombosis Resulting From a Closed Comminuted Tibia Fracture

A Case Report

Shuliang Zhang ▼ Bin Xu

Acute popliteal artery thrombosis is a rare and limb-threatening traumatic event. It can lead to soft-tissue necrosis or even amputation of the lower limb. In patients suffering from trauma around the knee joint, the clinician should be highly vigilant to risk of popliteal artery acute thrombosis. It is essential to detect and treat acute popliteal artery thrombosis timely for limb salvaging. We present a case of acute popliteal artery thrombosis resulting from a closed comminuted tibia fracture and discuss its injury mechanism, diagnostic methods, and treatment measures.

Introduction

Popliteal artery injury is one of the less common traumas; its incidence in civilian is 0.00246% per year (Ramdass et al., 2018). But popliteal artery injury is one of the most limb-threatening traumas, and it has been reported to result in amputation rates of nearly 30%–60% (Imerci et al., 2014). The main forms of popliteal artery injury include transection, occlusion, intimal injury, pseudoaneurysm, or fistula formation (Cooper et al., 2018). However, the most common form of popliteal artery injury is transection. Wound-induced popliteal artery occlusion and thrombosis are rare. It has been reported in the literature that only one popliteal artery thrombosis was found in 32 cases of popliteal artery injury over a 10-year period (Ramdass et al., 2018). Other patients of traumatic popliteal artery thrombosis comprise several sporadic cases reported (Macedo et al., 2015; McGuigan et al., 1984). It is very important to recognize and treat promptly patients with traumatic popliteal artery thrombosis in order to salvage the limb. We present a case of a patient who developed acute popliteal artery thrombosis after closed trauma.

Case Presentation

A 50-year-old man was hit by a car and arrived at the emergency department of our hospital half an hour later. On physical examination, his right calf was positive for tenderness and percussion. His skin was intact, and the dorsal foot artery pulse in the lower extremities was normal. Radiography was performed at once and revealed a comminuted fracture of the upper right tibia (see Figure 1A). He was transferred to the inpatient department. Three hours after the accident, the patient felt cold and numb in the right foot. Physical examination was done once again, and it indicated hypoesthesia on his right calf, which was cold and pale and the pulsation of the right dorsal foot artery disappeared. An emergent computed tomography angiography (CTA) scan confirmed total occlusion of the right popliteal artery (see Figures 1B and 1C). Ultrasonography detected a hypoechoic mass in the right popliteal artery, which indicating thrombosis. The patient was taken into the operating room.

Management

The patient was given an initial intravenous bolus of 3,000 units of heparin, and the endovascular procedure was performed. The ipsilateral femoral artery was punctured under ultrasound guidance. When thrombus suction catheter arrived at the site of popliteal arterial thrombosis, a dilute solution of urokinase solution (NS 250 ml + 200000 IU urokinase) was jetted in pressure mode to the thrombus; local thrombolysis in the artery,

Shuliang Zhang, MS, Department of Orthopaedics, Tongde Hospital of Zhejiang Province, Hangzhou, China.

Bin Xu, MS, Department of Orthopaedics, Tongde Hospital of Zhejiang Province, Hangzhou, China.

The authors have no funding and conflicts of interest to disclose.

Correspondence: Bin Xu, MS, Department of Orthopaedics, Tongde Hospital of Zhejiang Province, 280# Xiang-shan Rd, Hangzhou 310012, China (spot125@163.com).

DOI: 10.1097/NOR.0000000000000865

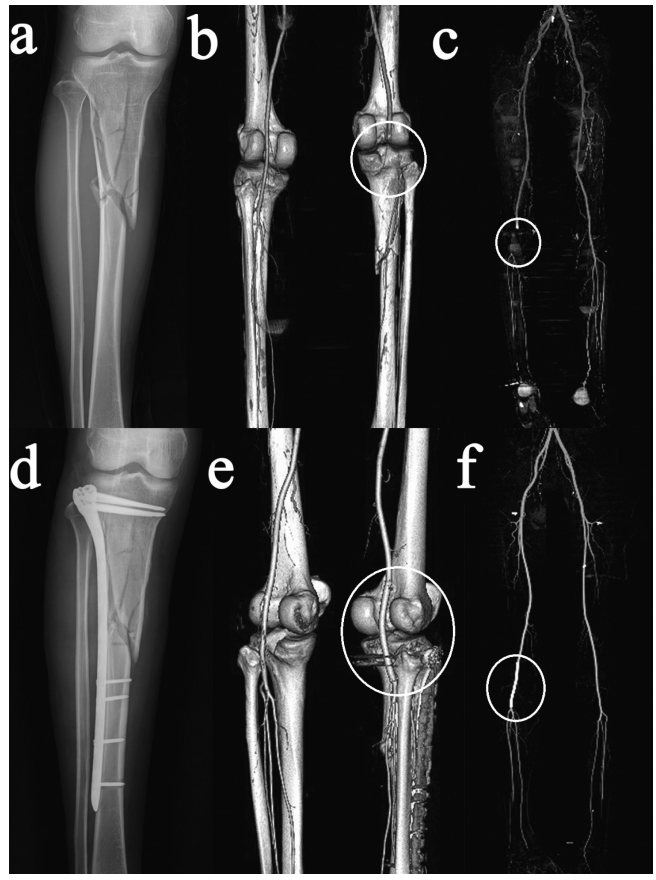

Figure 1. Radiography and CTA of a 50-year-old man. (A) Radiograph showed a comminuted fracture of the upper right tibia. (B, C) CTA scan revealed occlusion of the right popliteal artery. (D) Radiograph showed internal fixation of the upper right tibia fracture with a locking plate. (E, F) The postoperative CTA scan demonstrated that a stent was seen in the right popliteal artery, and the blood flow was unobstructed. CTA = computed tomography angiography.

followed by mechanical thrombectomy, was performed. After thrombectomy, an intraoperative angiogram showed the middle of the popliteal artery with a significant irregular stenosis, so a balloon dilatation angioplasty was performed. However, it remained as an abnormal stenosis due to the right popliteal artery intimal lesion. To avoid the recurrence of popliteal artery occlusion, an endovascular stent was implanted to restore blood flow patency. The palpable pulse in the right popliteal and dorsalis pedis arteries was returned, and the cold and pallor of the right leg disappeared. Excision and internal fixation for the fracture of the upper right tibia were performed 2 weeks later (see Figure 1D). A 102-mm long stent can be seen in the right popliteal artery on the postoperative CTA, and the blood flow was unobstructed (see Figures 1E and 1F).

Discussion

The main mechanisms of popliteal artery injury are blunt trauma and penetrating injury. The most common blunt mechanism was traffic accidents, and the most common penetrating mechanism was a gunshot injury (Grigorian et al., 2019). Because of the strict control of guns in our country, popliteal artery injuries are mainly caused by blunt trauma in traffic accidents. When a traffic accident happens, the high energy can lead to knee dislocations, distal femur fractures, proximal tibia fractures, and tibial plateau fractures. All these injuries cause stretch lesion and intimal disruptions of the popliteal artery, which tend to develop popliteal artery thrombosis. Godfrey et al. (2017) reported acute thrombotic occlusion of the right popliteal artery following the right knee dislocation in a patient who was injured in a car crash. Occlusion of the popliteal artery can be seen in about 30%–50% of patients with knee dislocation (Wright et al., 2004). Furthermore, iatrogenic injury is a mechanism for popliteal artery thrombosis. Imanaka et al. (2013) and Kovacs et al. (2012) have reported cases of popliteal artery thrombosis resulting in occlusion after total knee arthroplasty. Considering our patient, in combination of a comminuted closed fracture of the upper tibia caused by high-energy trauma, his popliteal artery thrombosis mechanism was blunt trauma caused by a car crash injury.

The popliteal artery is a true end artery that continues from the femoral artery; it is short, and its collateral supply network is frail. The blood flow of the collateral supply is insufficient to maintain the vitality of the lower limbs. If the limb is ischemic for more than 6 hours, irreversible injury will occur (Imerci et al., 2014). As a result, there is a high amputation rate when popliteal artery occlusion occurs. One study reported an amputation rate of nearly 30%–60% (Imerci et al.,

2014). However, the rate of amputation can be reduced to 10% if the popliteal artery occlusion can be treated within 6 hours (Lee et al., 2019). Consequently, timely diagnosis and management are critical to decreasing the amputation rate.

Although the sign of popliteal artery occlusion is obvious, it may result in a missed diagnosis if the patient is not actively examined. When six Ps clinical signs (pain, pulseless, pallor, perishing cold, paraesthesia, and paralysis) (Godfrey et al., 2017) of acute ischemia in the injured limb are present, it is urgent to conduct imaging examination to detect the status of the popliteal artery. Earlier, angiography was the gold standard for detecting damage of blood vessels. However, its use has been gradually reduced because of its longer acquisition time and resource burden associated with subtraction angiography (Cooper et al., 2018). Compared with angiography, CTA is more cost-effective and accessible. It was reported that patients could save up to $1,166 per limb in hospital costs and spend less than $12,922 in total hospital expenses when using CTA instead of angiography (Lee et al., 2019). In the past 10 years, CTA had been widely used for a rapid diagnosis of lower extremity arterial trauma. It can achieve 100% sensitivity and 100% specificity for the exploration of arterial injury (Grigorian et al., 2019). Duplex ultrasonography is also a meaningful way of assessing popliteal artery injury. It has a sensitivity of 95%–100% and a specificity of 99%–100% when used to assess vessel stenosis and occlusion (Lee et al., 2019). In our patient, CTA was performed to find right popliteal artery occlusion at first and then ultrasonography confirmed the existing thrombotic mass in the right popliteal artery.

Currently available measures for the treatment of popliteal artery occlusion include systemic thrombolysis and anticoagulation therapy, surgical embolectomy, interventional thrombolysis, and mechanical thrombectomy (Wright et al., 2004). Systemic thrombolytic and anticoagulant therapy can aggravate bleeding at the site of fractures and knee dislocation, so it is not suitable for patients with high-energy injuries. To reduce bleeding and trauma, we used the combination treatment with interventional intra-arterial local thrombolysis and thrombectomy. After balloon dilatation angioplasty, the right popliteal artery was still narrow; hence, to avoiding subsequent fibrosis making the vessel susceptible to thrombosis, an endovascular stent was implanted.

The consequences of popliteal artery occlusion are frightening. With close attention, rapid diagnosis with CTA, immediate treatment, and active use of various effective measures, amputation can be avoided.

References

Cooper, N., Roshdy, M., Sciarretta, J. D., Kaufmann, C., Duncan, S., Davis, J., & Igor Macedo, F. (2018). Multidisciplinary team approach in the management of popliteal artery injury. *Journal of Multidisciplinary Healthcare*, *11*, 399–403. https://doi.org/10.2147/JMDH.S151498

Godfrey, A. D., Hindi, F., Ettles, C., Pemberton, M., & Grewal, P. (2017). Acute thrombotic occlusion of the popliteal artery following knee dislocation: A case report of management, local unit practice, and a review of the literature. *Case Reports in Surgery*, *2017*, 5346457. https://doi.org/10.1155/2017/5346457

Grigorian, A., Wilson, S. E., Kabutey, N. K., Fujitani, R. M., de Virgilio, C., Schubl, S. D., Gabriel, V., Chen, S., Joe, V., & Nahmias, J. (2019). Decreased national rate of below the knee amputation in patients with popliteal artery injury. *Annals of Vascular Surgery*, *57*, 1–9. https://doi.org/10.1016/j.avsg.2018.07.002

Imanaka, T., Fujii, K., Fukunaga, M., Miki, K., Kawasaki, D., Tamaru, H., Masutani, M., Ohyanagi, M., & Masuyama, T. (2013). A case of acute thrombotic occlusion of the popliteal artery occurring immediately after the total knee arthroplasty recanalized by ballooning alone. *Journal of Cardiology Cases*, *8*(6), 190–192. https://doi.org/10.1016/j.jccase.2013.08.008

Imerci, A., Ozaksar, K., Gurbuz, Y., Sugun, T. S., Canbek, U., & Savran, A. (2014). Popliteal artery injury associated with blunt trauma to the knee without fracture or dislocation. *Western Journal of Emergency Medicine*, *15*(2), 145–148. https://doi.org/10.5811/westjem.2013.12.18223

Kovacs, F., Pollock, J. G., & DeNunzio, M. (2012). Endovascular stent graft repair of iatrogenic popliteal artery injuries—A report of 2 cases. *Vascular and Endovascular Surgery*, *46*(3), 269–272. https://doi.org/10.1177/1538574411434163

Lee, C. J., Loo, R., Wohlauer, M. V., & Patel, P. J. (2019). Diagnostic workup and endovascular treatment of popliteal artery trauma. *Vasa*, *48*(1), 65–71. https://doi.org/10.1024/0301-1526/a000756

Macedo, F. I., Sciarretta, J. D., Salsamendi, J., Karmacharya, J., Romano, A., & Namias, N. (2015). Repair of an acute blunt popliteal artery trauma via endovascular approach. *Annals of Vascular Surgery*, *29*(2), 366.e5–366.e10. https://doi.org/10.1016/j.avsg.2014.10.017

McGuigan, J. A., O'Reilly, M. J., & Nixon, J. R. (1984). Popliteal arterial thrombosis resulting from disruption of the upper tibial epiphysis. *Injury*, *16*(1), 49–50. https://doi.org/10.1016/0020-1383(84)90116-5

Ramdass, M. J., Muddeen, A., Harnarayan, P., Spence, R., & Milne, D. (2018). Risk factors associated with amputation in civilian popliteal artery trauma. *Injury*, *49*(6), 1188–1192. https://doi.org/10.1016/j.injury.2018.04.028

Wright, L. B., Matchett, W. J., Cruz, C. P., James, C. A., Culp, W. C., Eidt, J. F., & McCowan, T. C. (2004). Popliteal artery disease: Diagnosis and treatment. *Radiographics*, *24*(2), 467–479. https://doi.org/10.1148/rg.242035117