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Case Report

Traumatic popliteal artery spasm diagnosed using intraoperative angiography: A case report

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ABSTRACT

There are few reports of traumatic arterial spasm in large-sized vessels in the extremities, and many surgeons are skeptical of its existence. We report a case of traumatic popliteal artery injury (PAI), which was later diagnosed as traumatic popliteal artery spasm on intraoperative angiography.

A male patient, aged 54 years, was injured when a heavy object weighing approximately 100 kg fell on his right knee. Three hours after the injury, the patient was transported to our trauma center. The dorsalis pedis and posterior tibial arteries were not palpable, and his right lower leg was cold. However, he could move his ankle and toes completely and had no numbness or paresthesia in his right lower limb. Computed tomography angiography showed an interruption of the popliteal artery at the knee joint level and an enhancement on the distal side of the injury site. We diagnosed lower limb ischemia resulting from PAI and operated for revascularization.

Under general anesthesia, the popliteal artery was explored via a posterior S-shaped incision in the prone position. No arterial abnormalities were observed macroscopically, and the injured area remained unidentified. Therefore, a contrast medium was injected into the popliteal artery using a 20-gauge intravascular needle, and angiography was performed, which revealed that the popliteal artery was patent; however, there was circumferential arterial stenosis at the level of the knee joint. At this point, the right lower limb's coldness had disappeared. Arterial spasm was speculated to cause the transient popliteal occlusion and lower leg ischemia.

Immediate revascularization should be attempted when PAI is suspected. If no gross vascular abnormalities are confirmed, intraoperative angiography is useful for diagnosing arterial spasm.

Introduction

The incidence of popliteal artery injury (PAI) in trauma around the knee joint is rare (0.2–1%), but the rate of amputation of the lower extremities is reportedly 10–16% [1]. PAI is a challenging trauma that requires prompt and accurate treatment because the probability of lower-limb amputation increases as ischemic time increases. For salvaging the limb, revascularization should be performed as soon as possible after diagnosis.

Lower limb ischemia resulting from PAI is caused by an intimal flap, thrombosis, embolus, or complete transection of a vessel. For revascularization, it is necessary to resect the injured part of the artery and repair it by using end-to-end anastomosis or vein grafting.

Traumatic arterial spasm is one of the causes of peripheral ischemia. Vasospasm of the small- or medium-sized arteries, such as the

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Fig. 1. Appearance at the time of transportation. A bruise is visible on the lateral side of the right knee joint.

coronary, carotid, and cerebral arteries, has been well documented in the literature. However, there are few reports of traumatic arterial spasm in relatively large-sized vessels in the extremities, and many surgeons are skeptical of its existence [2]. A review by Samson et al. on traumatic vasospasm in the extremities highlighted its existence as a rare but distinct pathophysiological entity [3].

We report a case that was initially diagnosed as traumatic PAI and explored for vascular repair but was finally diagnosed as traumatic popliteal artery spasm using intraoperative angiography.

Case report

A male patient, aged 54 years, was injured when a heavy object weighing approximately 100 kg fell on his right knee while servicing a car. Three hours after the injury, the patient was transported to our trauma center. A bruise was observed on the lateral side of the right knee joint (Fig. 1). At the time of transportation, the dorsalis pedis and posterior tibial arteries were not palpable, and his right lower leg was cold. He could move his ankle and toes completely and had no numbness or paresthesia in his right lower limb. However, radiography revealed a fracture in the neck of the fibula. Computed tomography angiography (CTA) showed an interruption of the popliteal artery at the knee joint level. The artery on the distal side of the injured site was enhanced, and the remaining collateral circulation was evaluated (Fig. 2). We diagnosed lower limb ischemia resulting from PAI. Therefore, we performed revascularization surgery after 3 h 30 min of the injury.

Under general anesthesia, a knee joint stress test was performed in the supine position to confirm no significant instability. During this time, the ischemic symptoms in the lower extremities remained unchanged from those observed in the emergency room. After changing to the prone position and inflating the tourniquet, the popliteal artery was explored via a posterior S-shaped incision. No arterial abnormalities were observed macroscopically at the knee joint level; however, preoperative examination suggested arterial injury. Therefore, to identify the injured area, the skin incision was distally extended to the mid-calf level, and the popliteal artery was exposed. However, no abnormalities of the artery were observed, and the injured area could not be identified. Therefore, a contrast medium was administered to the popliteal artery using a 20-gauge intravascular needle at the femoral supracondylar level, and the tourniquet was deflated. Angiography revealed that the popliteal artery was patent, although there was circumferential arterial stenosis at the knee joint level (Fig. 3). At this point, the coldness of the right lower limb had disappeared. Arterial spasm was speculated

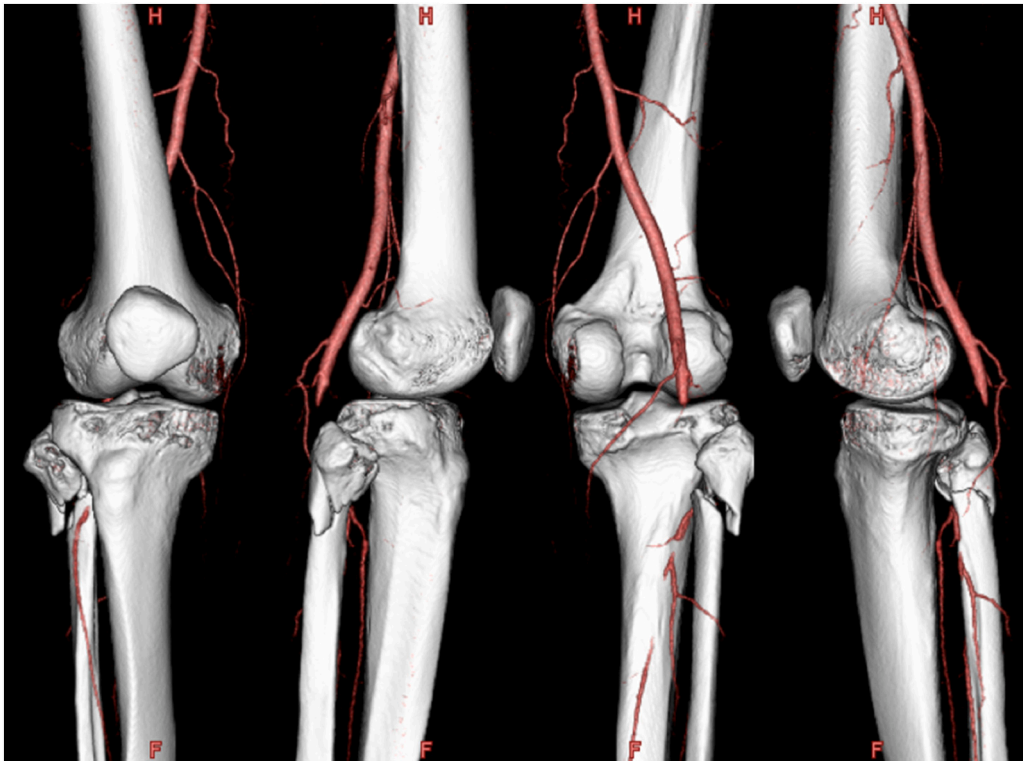


Fig. 2. Computed tomography angiography at the time of transportation. It shows interruption of the popliteal artery at the knee joint level and extension of the artery on the distal side of the injury site. The remaining collateral circulation was evaluated.

to cause the transient popliteal occlusion and lower leg ischemia. The intravascular needle was removed and the inserted needle was repaired by suturing with a 9-0 nylon thread. Immediate postoperative CTA showed that the popliteal artery was patent, without stenosis (Fig. 4).

Discussion

The smooth muscle in the arterial media contracts in response to systemic factors such as shock, drugs, and environmental factors such as cold, as well as local stimulation due to iatrogenic manipulation and trauma [4]. Iatrogenic manipulations that contract smooth muscle cells are caused by compression or stretching of vessels during intraoperative deployment and endothelial injury from arterial punctures. Traumatic arterial spasm is caused by bone fragments or transmitted shock waves, which sometimes induce transient ischemia [5]. The first description of arterial spasm was among the ballistic injury victims of World War I [6]. Recently, there have been reports of traumatic arterial spasm of the popliteal, anterior tibial, and peroneal arteries due to bullet injuries. In a case report of transient popliteal artery occlusion after posterior cruciate ligament reconstruction, popliteal artery spasm was considered the cause [7]. However, popliteal artery spasm due to blunt trauma has not been reported, and is extremely rare.

The general duration of traumatic arterial spasm in large-sized vessels has not been documented in literature. In case reports of arterial spasm in lower extremities due to bullet injuries, arterial spasm disappeared and blood flow in the lower extremities recovered in about 1.5 to 2 h after the injury [2,4]. In our case, CTA performed 3 h after injury confirmed occlusion of the popliteal artery, and intraoperative angiography performed 4 h after injury showed patency of the popliteal artery. Therefore, it may be speculated that the arterial spasm continued for about 3–4 h after the injury in our case. Taking into account the fact that there are cases in which transient traumatic arterial spasm occurs at the time of injury but disappears before transportation to the hospital, traumatic arterial spasm in lower extremities can be presumed to last from several minutes to several hours.

Usually, intimal damage or thrombus formation in an artery can be visually observed as a change in the color tone of the vascular wall. If there are no gross abnormalities in the area presumed to be occluded preoperatively, it can be assumed that the arterial wall itself is intact. Intraoperative angiography is useful for confirming blood flow if there are no gross abnormalities in the arterial wall. Improvement from transient ischemia can be confirmed, and spasms can be evaluated. Angiography can reveal the smooth tapering and concentric narrowing of a vasospasm.

Early reperfusion is essential for limb salvaging in patients with ischemic limb trauma including PAI. Hossny et al. reported that amputation is anticipated in PAI if the ischemic time exceeds 6 h [8]. Our patient was diagnosed with PAI based on the physical findings suggestive of peripheral ischemia and popliteal artery interruption on CTA at the time of transportation, and immediate

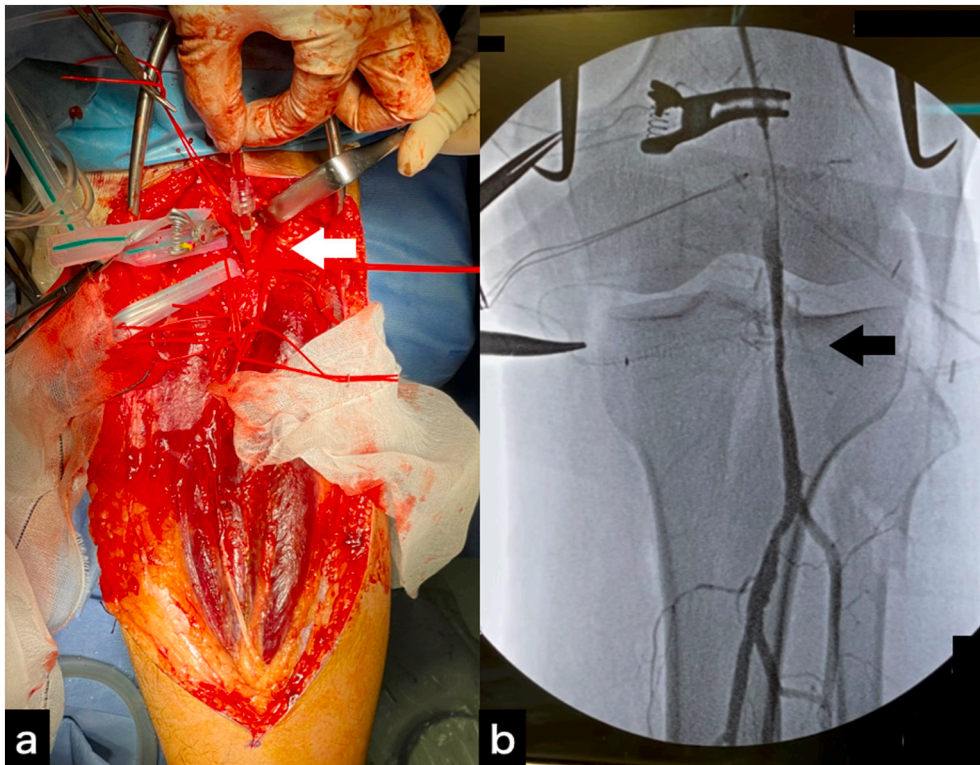


Fig. 3. a. Intraoperative appearance. There are no abnormalities in the artery, and the injured area remains unidentifiable. A 20-gauge intravascular needle was inserted into the popliteal artery at the femoral supracondylar level (white arrow) to administer a contrast medium.
 b. Intraoperative angiography. Angiography revealed that the popliteal artery was patent, although circumferential arterial stenosis is visible at the level of the knee joint (black arrow).

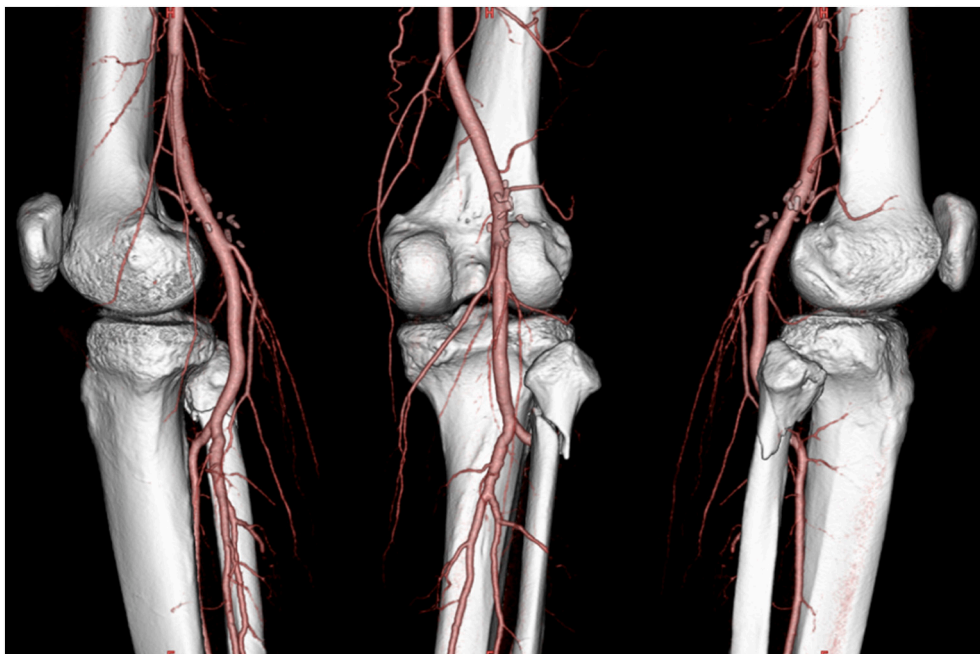


Fig. 4. Immediate postoperative computed tomography angiography (CTA). It shows that the popliteal artery is patent and without stenosis.

revascularization was deemed necessary. Although it was transient ischemia due to traumatic arterial spasm, arterial spasm should not be suspected during the initial treatment of patients with limb ischemia. McCoy suggested that attributing diminished pulses to arterial spasm should be condemned, and the term arterial spasm should never be used for injuries to the lower limb [9]. Connell, writing about arterial injuries, stated: "There is no room for procrastination in the hope that the circulation may recover. The possibility that the ischemia is due to arterial spasm has often been used as an excuse for delay. This is a futile and dangerous policy, for spasm cannot be diagnosed with certainty, and even if it does exist it is best dealt with by direct exposure of the involved vessel [10]."

We encountered a rare case of transient ischemia due to a popliteal artery spasm associated with blunt trauma. Immediate revascularization should be attempted when PAI is suspected, and intraoperative angiography is useful for diagnosing arterial spasm if no gross vascular abnormalities are confirmed.

Informed consent

The patient's informed consent has been obtained and can be made available on request.

Details of any meeting at which the work was presented, wholly or in part

None.

Declaration of competing interest

None.

Acknowledgement

None.

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