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Delayed Management of Popliteal Artery Injury Following Knee Dislocation—A Case Report

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Abstract

Knee dislocations frequently involve vascular injuries that demand early diagnosis and timely intervention. Time of ischemia is pivotal in determining the outcome for the limb, delays in treatment beyond 8 hours significantly increase the risk of limb loss. Unfortunately, this critical window is often missed in resource-limited settings. Here we report a 25-year-old female sustained a left knee injury after falling into a trench. She was diagnosed with an open knee dislocation accompanied by a popliteal artery injury. However, revascularization was delayed for 18 hours due to limited resources, including the unavailability of a thrombectomy catheter. Postoperatively, the patient received anticoagulation therapy with serial limb assessments and after 3 weeks the laceration healed and the limb was still viable. Knee dislocations frequently result in vascular injury (popliteal artery most common), making prompt diagnosis and intervention essential for limb preservation. In settings with limited resources, like ours, delayed presentation and transfer to specialized centers contribute to prolonged ischemic times. Nonetheless, viable limbs should be revascularized in stable patients, even with prolonged ischemia. This case highlights the importance of limb revascularization despite delay. Efforts should be made to improve prompt diagnosis, timely referral, and availability of necessary equipment for vascular repair to optimize outcomes in similar cases.

Keywords

Knee Dislocation, Popliteal Artery Injury, Delayed Repair, Vascular Injury, Limb Salvage, Ischemic Time

1. Introduction

Knee dislocation is a relatively uncommon injury accounting for about 0.02% of

all orthopedic injuries [1] its true incidence is underestimated however, because a knee that was dislocated or subluxed at the time of trauma will very often spontaneously reduce prior to assessment [2]. It is usually a high energy injury except in obese patients where a simple fall from standing height may result in knee dislocation [3].

High energy knee dislocations are usually associated with other injuries and these include vascular and nerve injuries 18%, fractures 57% (including open fractures 27%), and other life-threatening injuries 27% [4] [5], hence all patients sustaining high energy injuries warrant thorough examination following ATLS protocol to detect associated life-threatening injuries and a methodical neurovascular exam of the limb. In the setting of knee dislocation prompt diagnosis of vascular injury and intervention is essential for limb survival. time of ischemia is a crucial factor determining the outcome of the limb and some recommend less than 8 hrs while others 4 - 6 hours, beyond which is considered delayed and the likely hood of limb loss is so high [6] [7], this window is usually not met for the majority of patients in resource limited settings like our own [8].

This case underscores the importance of limb revascularization, even when ischemic time is beyond 8 hours, particularly in non-gangrenous limbs, however, clinicians should ideally aim to initiate revascularization within 8 hours of vascular injury.

2. Case Presentation

2.1. History

We present a 25-year-old female who sustained a left knee injury when she fell into a trench, landing on her flexed knee. Approximately 7 hours before she sought medical attention at our facility.

The patient presented with severe pain, bleeding from the injury site, and inability to bear weight on the affected limb. Subsequently, swelling of the knee occurred. No additional injuries were reported in association with this incident.

2.2. Examination

Upon examination of the limb in the Emergency room, it was observed that the left knee joint was significantly swollen, accompanied by a sutured transverse laceration measuring 3 cm on the posterior knee, with no active bleeding, and the swelling displayed a non-pulsatile nature. Additionally, the knee exhibited an evident deformity, and global instability was noted. The pulses for both the Dorsalis pedis and Posterior tibial arteries were not palpable, although sensation to pain and touch remained intact distal to the injury site.

Efforts were made to realign the limb, yet the distal pulses remained non-palpable. To ensure stability and support, the limb was immobilized using a splint. However, despite these measures, the distal pulses remained non-palpable, and an Ankle Brachial Index (ABI) measurement was 0.

2.3. Imaging

A plain radiograph of the knee was taken which demonstrated an anterior knee dislocation a diagnosis of knee dislocation with popliteal artery injury was made and at this point a vascular surgeon was called.

A CT angiograph was perfumed and it reviled popliteal artery occlusion with patent poplitea vein and presence of collaterals on the leg see Figure 1.

2.4. Management and Follow-Up

A delay of 14 hours had occurred (making it a total of 18 hours from the time of injury) primarily due to the investigative process, including the CT Angiogram, and the efforts to procure a thrombectomy catheter for the patient's treatment. Subsequently, the patient was taken to the operating theater for surgical debridement, exploration and a thrombectomy procedure.

Partial thrombectomy was carried out due to the unavailability of a thrombectomy catheter. Then 80 mls of heparinized saline was flushed distally.

Following this procedure, a Trans-knee external fixator was applied, after knee reduction.

Postoperatively, the patient's care regimen included:

- Subcutaneous heparin (5000 IU) administered every 8 hours.
- Aspirin (75 mg) taken once daily for 5 days.
- Elevation of the limb at a 45-degree angle.
- Ceftriaxone (1 g) administered once daily.
- Analgesics.

Figure 1. A CT angiograph showing a completely occluded left popliteal artery and presence of collaterals distally.

9 hours after the surgical procedure, the limb exhibited swelling extending down to the foot, with a capillary refill time exceeding 2 seconds. The SpO_2 (oxygen saturation) reading was unrecordable. However, the neurological examination revealed no abnormalities. The limb continued to be elevated at 45 degrees, and heparin was administered. A Doppler examination was not conducted at this time.

After 24 hours, the capillary refill time improved to 2 seconds, and the SpO_2 ranged between 72% and 80%.

7 days following the procedure, the swelling had subsided, there was notably improved perfusion, sensation, and motor function in the distal leg Figure 2.

The patient received continued follow-up care. At two weeks post-operation, the wound had healed sufficiently for the removal of stitches. By the third week, the external fixator was removed, and an MRI of the knee was conducted, which revealed a multiligamentous left knee injury involving bicruciate and lateral collateral ligament rupture (KDIIIL) see Table 1. She was scheduled for ligament reconstruction in the fourth week.

Figure 2. A clinical picture of the limb 7 days after injury.

Table 1. Classification of knee dislocations (KD) using Schenck system with Wascher modification.

Type	Description
KDI	Multi-ligamentous injury with either cruciate intact
KDII	Bi-cruciate injury only
KDIIIM	Multi-ligamentous injury involving bi-cruciate and MCL[a] rupture
KDIIIL	Multi-ligamentous injury involving bi-cruciate and LCL[b] rupture
KDIV	Pan ligament rupture
KDV	Fracture dislocation

a. Medial collateral ligament (MCL); b. Lateral collateral ligament.

3. Discussion

The incidence of vascular injury in knee dislocation varies between studies, ranging from 22% to 32% [1] Vascular injuris are commonly seen in KDIIIL type (32%) and posterior types (25%) of knee dislocations [1], according to modified Schenk and Kenedy classification see **Table 1**. The most commonly injured vessel in knee dislocation is the popliteal artery, primarily due to its anatomical predisposition [6] [9]. The popliteal artery is closely associated with the distal femur and proximal tibia, with ligamentous fixations both proximally and distally, making it relatively immobile. It originates at the tendinous hiatus of the Adductor Magnus muscle and is firmly anchored by the tendinous arch of the Soleus muscle distally [6].

Timely diagnosis and intervention are crucial in determining whether to salvage or amputate a limb. Literature suggests that a prognosis becomes poor if the ischemia time exceeds 8 hours, leading to irreversible damage and potential reperfusion injury upon limb revascularization [7]. Total ischemic time has a direct correlation with the rate of amputation [10] and 86% amputation rate has been reported when ischemic time exceeds 8 hours [7].

Therefore, quick and accurate diagnosis is vital, the diagnostic approach to vascular injuries following trauma remains a subject of ongoing debate. Conventional angiography has traditionally been regarded as the gold standard for diagnosis in this context [6]. Some studies recommend routine angiography for all patients with knee dislocation [11] [12], while newer studies advocate for selective angiography in patients with abnormal pulses or ankle-brachial indexes (ABIs) [13]. The rationale behind this approach is that routine angiography may lead to side effects such as hematoma, pseudoaneurysm, arteriovenous fistula formation, and contrast-induced nephropathy, as well as increased hospital costs and delayed diagnosis. Ankle Brachial Index (ABI) is a more cost-effective, reliable, and quick investigation which has demonstrated sensitivity of 95% to 100% and specificity of 80% to 100% in detecting vascular injuries requiring surgical repair [14], relying on pulse examination can sometimes be misleading and the presence of palpable distal pulse does not exclude the possibility of a major vascular injury requiring surgical repair [15].

In cases where "hard" signs (**Table 2**) of ischemia are present, and the injury zone is clearly defined (e.g., knee dislocation with involvement of the popliteal

Table 2. Signs of vascular injuries.

Hard signs	Soft signs
Absent pulse	History of active bleeding
Ischaemic limb	Decreased pulse
Pulsatile bleeding	Non-expanding haematoma
Expanding haematoma	Injury to an adjacent nerve
Shock with ongoing bleeding	Penetrating injury in close proximity to a major vessel

artery), it is advisable for the vascular surgeon to proceed with immediate arterial exploration at the knee level without the need for additional diagnostic studies. However, in situations where the precise injury zone is uncertain, such as a gunshot wound to the lower extremity with a wide "blast zone," arteriography is typically conducted to pinpoint the exact location of the vascular lesion. This approach helps guide further treatment decisions and interventions.

Regarding the sequence of treatment in the operating room, especially the order between vascular repair and skeletal stabilization, there is no definitive consensus. One perspective emphasizes vascular repair as the initial step to reduce ischemic time, followed by skeletal stabilization. On the other hand, an alternative viewpoint suggests, skeletal stabilization should come first to prevent stretching and further injury to the repaired vessel. However, it's important to note that a meta-analysis has shown that this sequence does not significantly affect amputation rate [16].

In resource limited settings, patients rarely meet the 8-hour window for timely intervention due to delays in accessing well-equipped trauma centers, delayed diagnosis, and unavailability of proper equipment for vascular repair [8] [17], all of which were contributing factors in our patient's case. In a recent study conducted in India where the mean time of limb revascularization was 30.8 hours, 95% of the patients with >8 hours delay had good outcome [8]. The study recommended revascularizing viable limbs in otherwise stable patients, even with prolonged periods of ischemia.

4. Conclusions

It is crucial to emphasize the need for improving prompt diagnosis and timely referral for limb revascularization, ideally within the first 8 hours following injury. However, we acknowledge in resource-limited settings, meeting this timeframe may be challenging. In cases where patients with vascular injury arrive at referral centers after 8 hours have elapsed since the injury, a thorough assessment of limb viability should be conducted. If the limb is found to be viable, revascularization procedures should be initiated without delay.

To enhance patient outcomes in similar cases, hospitals should prioritize equipping their emergency care physicians with the necessary tools and equipment for vascular repair. This proactive approach ensures that healthcare providers can promptly and effectively address vascular injuries, thus optimizing the chances of limb salvage and reducing the risk of complications associated with delayed intervention.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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