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## ORIGINAL ARTICLE

# Knee dislocations and popliteal artery injury: A single centre experience from Karachi

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#### **Abstract**

**Objective:** To determine the association of popliteal artery injury with simple knee dislocations or knee fracture dislocations, and to evaluate the role of clinical assessment and colour Doppler ultrasound examination in diagnosing these injuries.

**Methods:** The prospective case series study was done at the Liaquat National Hospital, Karachi, and comprised patients with simple knee dislocations or knee fracture dislocations presenting between February 2013 and April 2014. All patients underwent clinical assessment including distal pulse examination and signs of vascular trauma. Following reduction of dislocation, repeat clinical examination and assessment of limb with colour Doppler ultrasound was carried out.

**Results:** Out of 9 patients in the study, 6(66.7%)had simple dislocations, while 3(33.3%) sustained fracture dislocations of the knee. Two (22%) patients sustained injury to the popliteal artery which was effectively managed via surgical treatment. Clinical examination of the affected extremities effortlessly revealed the 2(22%) vascular trauma cases. Doppler ultrasound was carried out in 8(89%) cases and it successfully excluded 7(78%) cases for vascular trauma and identified 1(11%) injury with reduced flow. This case underwent computed angiography scan and later surgery revealed popliteal artery trauma. Doppler ultrasound was not carried out in 1(11%) case which was a spontaneously relocated knee with hard signs of vascular injury.

**Conclusion:** Popliteal artery injury can be a limb-threatening complication following trauma to the knee. Carefully performed clinical examination and colour Doppler ultrasound are effective tools for identification of such cases. **Keywords:** Incidence, Knee dislocation, Complications, Politeal artery, Injuries, Ultrasonography, Doppler utilisation, Physical examination, Diagnosis. (JPMA 64: S-91 (Suppl. 2); 2014)

#### Introduction

The most devastating complication of knee dislocation or fracture dislocation is the risk of vascular injury because of the vulnerable position of the popliteal artery. Initial studies in literature reported an incidence of vascular trauma associated with knee dislocations up to an astounding 64%.¹ But as the number of spontaneously reduced knee dislocations was increasingly discovered, this percentage came down remarkably. However, recent publications and reviews still have wide discrepancies in their reported incidences of vascular injury with knee dislocations ranging from 1.6%² to 18%.³

Moreover, the methods for screening and identification of vascular trauma in such cases have remained debatable. Some authors completely rely on clinical examination for the identification of vascular trauma,<sup>4</sup> while others opt for mandatory arteriography in every case of knee dislocation.<sup>5</sup> Other diagnostic modalities such as Ankle Brachial Index (ABI), Doppler ultrasound, computed

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angiographic scanning and Magnetic Resonance Angiography (MRA) are also extensively used.

In these days of fast vehicular trauma, knee dislocation is not an uncommon finding and an emergency physician or an orthopaedic surgeon faces the challenge of treating this major injury from time to time. As abundant medical facilities are not readily available in Pakistan at every health facility, we evaluated the efficiency of readily available tools i.e. clinical assessment and colour Doppler ultrasound examination in diagnosing popliteal artery trauma in knee dislocations. A good clinical examination and easily available colour Doppler ultrasound exam in combination may prove invaluable in managing such trauma cases.

#### **Patients and Methods**

The prospective case series study was done at the Liaquat National Hospital, Karachi, and comprised patients with simple knee dislocations or knee fracture dislocations presenting to the emergency department (ED) between February 2013 and April 2014. Patients who had knee arthroplasty or a prior meniscal injury or cruciate tear were excluded.

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Figure: Pre-reduction radiographs of some cases from the series.

After receiving patient in ED and following initial trauma protocols, standard posterior anterior and lateral radiographs of the affected knee were taken (Figure). An initial clinical assessment prior to reduction was carried out including examination of dorsalispedis and posterior tibial artery and comparison with the contralateral limb. Also, hard and soft signs of traumatic vascular injury were actively sought for. In cases with hard signs, the patients were immediately taken to the operating room for the restoration of circulation. The rest of the patients underwent reduction of the knee dislocation in ED under conscious sedation and appropriate analgesia. Following relocation, a repeat clinical assessment was carried out followed by colour Doppler ultrasound examination of the limb and the findings were noted.

In cases of normal clinical examination following relocation and normal flow velocities on ultrasound, the affected knee was immobilised with an above-knee plaster slab and the patients were admitted for observation of any late circulation deficit for at least 72 hours. Conditions requiring urgent orthopaedic surgical procedures such as irreducible dislocations or dislocations associated with fractures or open wounds were addressed immediately. Patients with abnormal clinical examination and ultrasound findings indicating vascular insult were prepared for surgery. After vascular repair, immobilisation was done with external fixator and was continued for 6 weeks. Later, removal was carried out

and range-of-motion exercises and weight-bearing was started gradually.

### Results

There were 9 patients in the study with a mean age of 32.2±10.52 years. Eight (89%) were male and 1(11%) was female. Overall, 8(89%) patients suffered road traffic accident (RTA) injuries, while 1(11%) sustained fall from height. Six (66.7%) had simple dislocations, while 3(33.3%) had fracture dislocations. The mean arrival time to reduction of dislocation was 2.68±1.13 hours. There was 1(11%) exceptional case, a 28-year-old male, who had a spontaneous relocation before arrival to ED.

There were 2 (22.2%) cases in which patients also suffered trauma to the popliteal artery. One (50%) of these patients was the one with spontaneous knee relocation and visible arterial spurting from a wound in the popliteal fossa. Because of such confirming findings, further examination by ultrasound was unjustified and the patient was immediately taken to the operating theatre for the restoration of circulation. He had suffered from complete transaction of both popliteal artery and vein which were successfully repaired with graft and protected with knee spanning external fixator. The other patient (50%) with

**Table:** Clinical and diagnostic characteristics.

Clinical Characteristics	Number of Patients
Gender	
◆ Male	8
◆ Female	1
Mode of Injury	
◆ RTA	8
◆ Fall	1
Initial Pulse	
◆ Absent	3
◆ Decreased	2
◆ Normal	4
Pulses after reduction	
◆ Absent	1
◆ Normal	7
◆ Not Available	1
Time to relocation	
◆ 1 Hour	2
◆ 2 Hours	1
♦ 3 Hours	4
◆ 4 Hours	1
◆ Spontaneous Relocation	1
Doppler Ultrasound	
◆ Normal Flow	7
◆ Decreased Flow	1
◆ Not Done	1
Neurologic Injury Present	1

RTA: Road Traffic Accident.

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vascular trauma had intimal damage and was treated with resection and repair with reverse sephanous vein graft and external fixator. This patient also suffered neurological injury (Table).

Clinical examination effectively screened limbs threatened by vascular insult. Of the 2(22.2%) patients, 1(50%) had reduced peripheral pulses in both prereduction and post-reduction examination, while 1(50%) had absent peripheral pulses and frank arterial bleed from wound. Out of the 7(78%) patients who did not suffer vascular trauma, 2(28.6%) had reduced pulses prior to reduction, but all (100%) had a normal clinical examination after reduction.

Similarly, colour Doppler ultrasound of the 8(89%) affected limbs clearly revealed normal vasculature of 7(78%) examinations, while 1(11%) with vascular insult had severely reduced flow velocities. This patient was further examined with computed angiography scanning which supported the ultrasound findings and revealed intimal thrombosis.

All patients had a mean hospital stay of  $4.28\pm1.7$  days during which no differences were observed on clinical examination and management plan in the context of vascular status.

#### Discussion

Knee dislocation is a devastating injury and represents a true orthopaedic emergency. Schenck reported incidence of knee dislocation of 0.001-0.013% of all urgent traumatological lesions.<sup>6</sup> However, with the rising incidence of trauma caused by motor vehicle accidents, this incidence might be on the rise as well. RTAs and sports injuries are the major causes of knee dislocations, followed by fall from height as the second most common cause.<sup>7</sup>

Major concern for a knee surgeon might be the ligamentous damage and instability in such a traumatic injury, but the immediate and foremost important realisation is the possibility of vascular compromise. The popliteal artery is found in an anchored position in the popliteal fossa emerging from the adductor hiatus and ending underneath the fibrous arch of the soleus muscle. Such an anatomical position of the popliteal artery makes it vulnerable to trauma. The incidence of vascular injury associated with knee dislocation has been reported by many authors with wide variation. Hoover reported it to be 64% in 1961,¹ whereas Green and Allen published an incidence of 32% vascular lesions in total 245 knee dislocations in 1977.8 McCoy observed that out of 4 cases with low-velocity knee dislocations, three had vascular

injuries.<sup>5</sup> Recent authors also show discrepancies in reported incidence of vascular trauma following knee dislocation ranging from 1.6%<sup>2</sup> to 18%.<sup>3</sup>

Kennedy pointed out in his experiments on cadavers that a hyperextension of about 50% can produce significant damage to popliteal vessels. Below that degree, a knee may only suffer damage to the posterior capsule and posterior cruciate ligament (PCL). He also revealed that anterior knee dislocations mostly lead to intimal thrombosis while posterior dislocations are more frequently the cause of lacerations and transections of the popliteal artery.

Regardless of the variable incidence or patho-mechanism of popliteal artery injury, the general consensus regarding the management of such an injury is rapid diagnosis and urgent treatment. Green and Allen found that vascular repairs must be performed within 6-8 hours of injury. In their study, patients treated after the above-mentioned time period had an amputation rate of 86%.8

Arteriography is the gold standard when it comes to evaluating popliteal artery injury with dislocation.<sup>8,10</sup> But due to its associated complications, time consumption, invasiveness and cost effects, it has been turned down by most of the authors as the first choice of imaging.<sup>11</sup> Clinical examination is mandatory in every case prior to reduction and also in the postreduction period in order to screen cases with vascular compromise. Stannard strongly advocated serial clinical examination in cases of knee dislocation.<sup>12</sup> Similarly, Miranda also recommended selective arteriography only in cases with clinical examination positive for vascular insult.13 But there are other cases where researchers like Gable have found vascular insults after trauma presenting with completely normal clinical examination and later requiring surgery.<sup>10</sup> Barnes also in his meta-analyses described that abnormal pedal pulses on examination have a sensitivity of 79% and specificity of 91%.14

Ankle-brachial index (ABI) is also a valuable screening tool for assessing vascular injury. Mills published data stating that ABI<0.9 can diagnose vascular injury with 100% sensitivity and specificity. Similarly, colour Doppler ultrasound is also 95% sensitive and 99% specific in diagnosing vascular trauma with the added advantage of being non-invasive and readily available. Schwartz also pointed out that colour Doppler is well able to detect major injuries requiring immediate intervention. The only drawback with colour Doppler ultrasound is that it is operator-dependent.

MRA is associated with less complications compared to

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standard arteriography and provides simultaneous diagnosis of ligament injuries of the knee as well,<sup>18</sup> but it is not easily available in emergency settings. Other limitations with MRA are that it may also consume critical time and is not cost-effective as a screening tool.

### Conclusion

The findings support the idea that clinical examination supplemented with other non-invasive tests such as colour Doppler ultrasound is a safe approach to knee dislocations. Arteriography is not mandatory in every case and should only be undertaken when one is sure to gain critical information from it without affecting treatment duration.

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