

Vascular Injury in Obese Patients after Ultra-Low-Velocity Trauma

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Abstract

Background: Traumatic Knee Dislocation (KD) is a serious and potentially limb threatening injury, albeit a relatively rare condition. Knee dislocation, defined as a complete disruption of the integrity of the tibia-femoral articulation, is uncommon, representing 0.001% to 0.013% of orthopedic injuries. Male:Female ratio is 4:1, and nearly 10% are caused by ultra-low-velocity dislocations. These injuries have historically been attributed to High Velocity Impacts (HVKD) however more recently they are being noted in Low Velocity Incidents (LVKD), particularly involving morbidly obese people. An increase in LVKD in the morbidly obese from 17%, between 1995-2000 to 53% in 2007-2012 was reported in the literature.

Methods: In our case series of two female patients vascular injury occurred after an ultra low velocity trauma in the domestic environment. Case 1 was a 72-year old female, BMI 28 kg/m², with diabetes mellitus Type II, arterial hypertension, and obesity. Case 2 was a 57-year old female, BMI 44 kg/m², with diabetes mellitus Type II, psychosis, and obesity. Vascular surgery was performed to maintain blood supply for the injured limb.

Results: In one case full weight-bearing was achieved and the other case resulted in an above the knee amputation, due to severe soft tissue damage.

Conclusion: Knee dislocation is a rare albeit a serious and potentially limb threatening condition. Expediency in reducing the acutely dislocated knee is vital to prevent neurovascular damage and potential for compartment syndrome and limb amputation. Based on our observation, the knowledge of potentially serious adverse outcomes in obese patients with ultra-low-velocity trauma and vascular injury should increase our awareness in these patients with knee pain even after marginal trauma. X-rays, and if suspicion is raised, a CT-scan usually leads to a detailed and profound diagnosis, enabling immediate surgical intervention to save the affected limb.

Keywords: Knee dislocation; Vascular injury; Ultra-low-velocity trauma

Introduction

Traumatic knee dislocation (KD) is a serious and potentially limb threatening injury, albeit a relatively rare condition [1-6]. Knee dislocation, defined as a complete disruption of the integrity of the tibia-femoral articulation [7], is uncommon, representing 0.001% to 0.013% of orthopedic injuries [8]. Male:Female ratio is 4:1, and nearly 10% are caused by ultra-low-velocity dislocations [9,10].

These injuries have historically been attributed to High Velocity Impacts (HVKD) however more recently they are being noted in low velocity incidents (LVKD), particularly involving morbidly obese people [6,11-15]. Incidence of associated vascular lesions is reported in the actual literature with 7.5 up to 14% [16-18]. Natsuhara et al. reported an increased risk for males of vascular injury compared to females (OR 2.59, p<0.001) [19]. Knee dislocation often reduces spontaneously, potentially leading to a high rate of delayed presentation or missed diagnosis [6,20,21]. Knee dislocations are traditionally divided epidemiologically into those caused by high velocity trauma such as an MVA (motor vehicle accident) or low velocity trauma such as those sustained in sporting injuries [6,7]. More recently there has been an increasing number of reports of knee dislocations involving morbidly obese patients [6,22-25]. An increase in LVKD in the morbidly obese from 17% between 1995-2000 to 53% in 2007-2012 was reported by Georgiadis [24]. Obese patients with LVKD were more likely to have neurovascular injuries requiring surgical intervention compared to HVKD [24]. With increase of the obese population, those kinds of injuries will be seen more frequently.

Case Report

In our case report we want to present two patients treated at the LKH Bruck/Mur with closed knee dislocation after ultra-low-velocity trauma.

Case 1

A 72-year old female, BMI 28 kg/m², with diabetes mellitus Type II, arterial hypertension, and obesity was admitted on an outpatient basis due to acute ischemia of the lower limb following ultra-low-velocity trauma after knee dislocation. At the time of admission the patient was suffering from acute ischemia of the lower right limb, without palpable peripheral pulses. Due to the symptoms, the patient underwent immediate X-ray of the knee and CTA-scan (Computerized tomography angiography), to verify the exact dimension of injury. The CTA-scan showed a missing contrast at the segment II of the popliteal

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artery over distance of 3 cm, a reconstitution of segment III, and a wall hematoma in segment II and III (Figure 1). The X-ray images revealed a dislocated knee joint associated with a fracture of the proximal tibia.

Emergency surgery to preserve the limb was performed within three hours after CTA-scan diagnosis. Intraoperative finding was a stenosis between Superficial Femoral Artery (SFA) and popliteal artery due to an arteriosclerotic plaque. The SFA was dissected under conservation of two main collateral vessels. The major saphenus vein was harvested contra lateral and implemented in end-to-end technique, and fixed with a running polypropylene 6/0 suture (Prolene, Ethicon Inc.). Immediate after flushing the graft, palpable pulses of the dorsalis pedis artery were observed. Intraoperative performed angiography revealed an unobtrusive graft and a good revascularization of the fibular and tibial artery. Subsequent to vascular grafting a knee joint bridging external fixator was implemented to stabilize the fracture and knee joint. After four hours of surgery, peripheral vascularization was normal, with tissue perfusion comparable to the uninjured contra lateral limb. Because there was no evidence of a compartment syndrome, no fasciotomy was performed.

Case 2

A 57-year old female, BMI 44 kg/m², with diabetes mellitus Type II, psychosis, and obesity was admitted on an outpatient basis due to acute ischemia of the lower limb following ultra-low-velocity trauma after knee dislocation. At the time of admittance the patient was suffering from acute ischemia of the lower left limb, without palpable peripheral pulses and compartment syndrome and paresis of the lower limb. CTA-scan revealed a vascular stenosis between segments I and II of the popliteal artery, occlusion of all distal vessels, accompanied with a huge intramuscular hematoma at the calf (Figure 2). No associated fracture was observed.

Emergency surgery to preserve the limb was performed immediately after CTA-scan diagnosis. During a total time of seven hours of surgery the following procedures were performed. Primary dissecting the femoral fascia reflected blood coagulums. Dissecting the tibial fascia lead to a muscular spill, interspersed with hematoma. During debridement of the lateral part of the gastrocnemius muscle, necrotic tissue was removed. The superficial branch of the peroneal nerve was intact, but the main branch of the tibial nerve was torn apart due to the trauma. The major saphenus vein was harvested contra lateral in a distance of 40 cm and implemented in end-to-end technique, and fixed with a running polypropylene 6/0 suture (Prolene, Ethicon Inc.). Proximal docking site of the graft was the SFA, the distal anastomosis was connected at the III segment of the popliteal artery at the outlet of the anterior tibial artery, showing dry anastomosis and a palpable dorsalis pedis artery after flushing. Subsequent to vascular grafting a knee joint bridging external fixator was implemented to stabilize the knee joint. Primary wound closure was not possible and therefore an under-pressure wound system was implemented.

Post-operative Results

Case 1

After a total inpatient stay of 17 days the patient was able to leave the hospital with full weight bearing and two crutches. During follow up visits no complications occurred and the external fixator was removed, leaving a knee joint with ROM 0-0-90, capable of full weight bearing without pain.

Case 2

Second look surgery was performed 24 h after initial surgery, showing vital soft tissue and muscles and an intact bypass. Due to the swelling, primary wound closure was not performed. During the following 11 days, the patient developed deep broad muscle necrosis, an expanded dermal necrosis and septic wound healing problems at the lower limb with a CRP rise from initially 1.19 up to 24.30 mg/dL. After consent of the patient, an AKA (above the knee amputation) was performed. Eight days after amputation, definite wound closure was performed, and the patient was able to leave the hospital 37 days after initial trauma with a healed femoral stump, ready for remobilization and prosthesis provision.

Discussion

Knee dislocation is a complex trauma often characterized by association of vascular injuries [1-6]. In the last decades knee dislocation was considered a seldom diagnosis, a fact now changing attributed to a growing number of obese patients, even in young adults.

Gender distribution was contrary to findings in the literature [9,10], but due to the fact that our case series involved only two patients, no reasonable statement can be given.

The most common artery injured in knee trauma, according to the literature, is the popliteal artery (33.3%) followed by femoral artery (24.4%), consisting with the findings in our case series [26-29]. In our two cases, injury to the popliteal artery was predominant. The incidence of popliteal artery injury in KD patients can be as high as 32% [29-32].

Diagnostic accuracy of CTA-scan, as used in our patients, is well established in the literature [29]. CTA-scan or angiogram can be seen as a standard procedure to detect vascular injuries and should be performed prior to surgical intervention [29].

The ischemic time, from injury to first presentation at clinics, in our two cases was case 1 <2h and for case 2 <4h. If including the duration of diagnostic procedures and surgery, both cases were beyond the "golden period" of 6 hours warm ischemic time, proposed by many authors to maximize limb salvage [29].

The severe vascular and soft tissue damage at presentation in case#2 was obviously crucial influencing the outcome, ending in an AKA.



Figure 1: CT-scan images case 1: Showing the stenosis of the right popliteal artery on the CTA scan



Figure 2: CT-scan images case 2: showing the perfusion stop at the left popliteal artery

Similar characteristics have been reported in the literature, concluding the imminent danger of underestimating soft tissue damage leading to compartment syndrome [33-35].

Despite the fact of the “golden period”, Huynh et al. concluded that even though prolonged ischemia has been a well recognized predictor for cell death, the tolerance period varies from person to person, depending on severity of ischemia and collateral flow [36]. This can be confirmed comparing the vascular and soft tissue situation in our two cases. We also have to comment on the possible influence of the surgery time of seven hours. Due to the short time between diagnosis and initial surgery in both patients but different durations of surgery, four hours case 1 versus seven hours case 2, duration of surgery may had an influencing role in overall outcome. The intraoperative procedures were performed by two experienced vascular surgeons. Time interval of 4 hours from injury to first presentation, was leading to a disastrous clinical finding related to the soft tissue situation and can be identified as the main reason for the unpleasant outcome of an AKA.

In our two cases the trauma occurred in the domestic environment. Both patients had similar pre-operative medical conditions, obesity and diabetes mellitus Type II. Gender distribution is contrary to what has been reported in the literature, because in an observation period of seven years, both patients admitted for vascular injury after ultra-low-velocity trauma was female.

Conclusion

Knee dislocation is a rare albeit a serious and potentially limb threatening condition. Expediency in reducing the acutely dislocated knee is vital to prevent neurovascular damage and potential for compartment syndrome and limb amputation.

Based on our observation, knowledge of potentially serious adverse outcomes in obese patients with ultra-low-velocity trauma and vascular injury should increase our awareness in these patients with knee pain even after marginal trauma. X-rays, and if suspicion is raised, a CT-scan usually leads to a detailed and profound diagnosis, enabling immediate surgical intervention to save the affected limb.

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