CASE REPORT

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Popliteal artery injury following traumatic knee joint dislocation in a 14-year-old boy: A case report and rewiev of the literature

Povreda poplitealne arterije nakon traumatske dislokacije zgloba kolena kod 14-godišnjeg dečaka: prikaz bolesnika i pregled literature

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Abstract

Introduction. Posterior knee joint dislocation associated with injury of the popliteal artery in children is an extremely rare condition. Rapid diagnosis and treatment are essential for limb salvage and function. **Case report.** We reported a 14-year-old boy who suffered traumatic displacement of the right knee and contusion of the popliteal artery during motorcycle accident. The diagnosis was confirmed using Doppler and duplex ultrasonography and digital substraction transfemoral arteriography. The urgent surgical procedure was performed using posterior approach to the popliteal artery. During the surgical exploration, rupture of the posterior cruciate ligament associated with thrombosed popliteal artery have been found. The damaged popliteal artery was resected and replaced with autologous saphenous vein graft. The last stage of the procedure was a transosseous femoral fixation of posterior circuate ligament. A 3-year-follow-up after the surgery demonstrated intact arterial perfusion and very good function of the knee with a minimal difference as compared with the contralateral knee. **Conclusion.** Combined orthopedic and vascular injuries are very rare in children. They require combined treatment.

Key words:
knee injuries; popliteal artery; blood vessels; wounds and injuries; child; vascular surgical procedures; transplants; recovery of function.

Apstrakt

Uvod. Zadnja dislokacija zgloba kolena praćena povredom poplitealne arterije kod dece veoma je retko stanje. Brza dijagnoza i lečenje ključni su za očuvanje kako samog ekstremiteta tako i njegove funkcije. **Prikaz bolesnika.** Prikazali smo 14-godišnjeg dečaka koji je pretrpeo iščašenje desnog kolena i kontuziju poplitealne arterije u saobraćajnoj nesreći na motociklu. Dijagnoza je potvrđena doplerom i ultrazvučnim dupleks pregledom i digitalnom suptrakcionom transfemoralnom arteriografijom. Urađena je hitna hirurška procedura zadnjim pristupom poplitealnoj arteriji. Tokom hirurške eksploracije pronađena je ruptura zadnjeg ukrštenog ligamenta udružena sa trombozom zatkolene arterije. Oštećena poplitealna arterija resecirana je i zamenjena autolognim safenskim venskim graftom. Poslednji korak hirurške procedure bio je transosealna femoralna fiksacija zadnjeg ukrštenog ligamenta. Trogodišnji postoperativni period praćenja pokazao je intaktnu arterijsku perfuziju i veoma dobru funkciju kolena sa neznatnom razlikom u odnosu na suprotno koleno. **Zaključak.** Komplikovane ortopedske i vaskularne povrede kod dece su veoma retke i zahtevaju multidisciplinaran pristup.

Ključne reči:
koleno, povrede; a. poplitea; krvni sudovi, povrede; deca; hirurgija, vaskularna, procedure; graftovi; funkcija, povratak.

Introduction

Vascular injuries (especially blunt trauma) in infants and children are rare, occurring for less than 1% of pediatric trauma according to literature data [1]. However, the amputation rate associated with vascular injury, do not differ between adults and children. At the same time, pediatric patients showed an improved adjusted mortality when compared to adults [1]. The long term patency after repair of injured vessels, in children is not well documented in the literature. Because of that vascular trauma in infant and children age, is important clinical entity.

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Blunt trauma of the popliteal artery can be caused by many different mechanisms, including a posterior knee joint dislocation. These combined injuries are very rare in children. We presented such a case and reviewed the literature.

Case report

A 14-year-old boy was addmited urgently after motorcycle accident. Physical examination revealed sweeling and hemathoma over the right popliteal fossa associated with minimal knee deformity. The pedal pulses were absent. Ancle brachial indexes at both dorsalis pedis and posterior tibial arteries were less than 0.4. The patient underwent duplex ultrasonography which showed popliteal artery thrombosis, while popliteal vein was patent. The right femoral arteriography revealed occluded popliteal artery at the level of the knee joint (Figure 1).

Fig. 1 – A right femoral arteriogram demonstrating complete occlusion of the popliteal artery at the level of the knee joint. The crural arteries were patent.

The urgent surgical procedure under general anestesia was performed about four hours after injury. The dorsal approach to the popliteal artery revealed the rupture of the posterior cruciate ligament associated with advential hemorrhage and thrombosis through a 4.5 cm segment of popliteal artery (Figure 2a). A thrombosed segment of the popliteal artery was resected and replaced with a saphenous vein graft (Figures 2b and c). The resected part of the popliteal artery showed complete intimal disruption with secondary thrombosis (Figure 2d).

A transosseus femoral fixation of the posterior cruciate ligament using non-absorable stitch was carried out. Postoperatively, the patient had palpable both pedal pulses, while ancle brachial index was 1.0. Control arteriography demonstrated a patent graft with good distal runoff (Figure 3). There was no clinical signs of compartment syndrome and fasciotomy was unnecessary since there was no prolonged ischemia of lower limb.

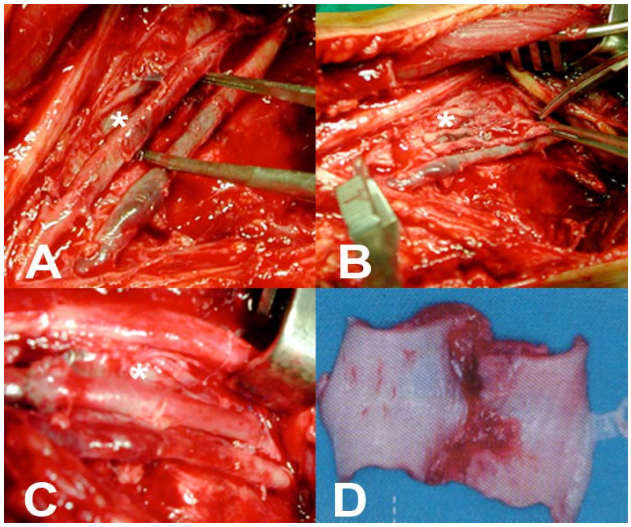

Fig. 2 – A) The adventitial hemorrhage and thrombosis of the popliteal artery (asterix); B) Following opening of the damaged artery the secondary thrombus (asterix) was found; C) The complete replacement with autologous saphenous vein graft (asterix); D) The intimal disruption of the damaged popliteal artery following removal of the secondary thrombus.

Fig. 3 – The white arrows demonstrating patent saphenous vein graft on control angiography.

Physiotherapy started with partial weight-bearing a week postoperatively. Six weeks later the patient started with full weight bearing. After 3 years, a follow up revealed that the patient had vascular graft with palpable pedal pulses and normal ancle brachial indices. No degenerative changes could be observed on radiography at the knee, while MRI confirmed intact both posterior and anterior cruciate ligament. There were no significant differences in functional statements between the left and right knee.

Discussion

Traffic accidents (injuries related to motor vehicle and motorcycle accidents) and sports activities (skiing, football) are the main reasons for knee injuries associated with posterior knee joint dislocation [2–4]. Falls from height are the second most common cause of knee dislocations [5]. Other interesting reported causes of knee dislocations include martial arts injury [6, 7], trampoline injuries [8], and spontaneous knee dislocation in the morbidly obese [9]. Male children have higher injury rates as a result of their more aggressive behavior and exposure to contact sports.

One of the most important causes of the posterior knee dislocation is a rupture of posterior cruciate ligament with or without proximal avulsion fracture [2, 10–15]. The posterior cruciate ligament is approximately twice as strong as that anterior cruciate one. Because of that, posterior cruciate ligament plays an important role in stabilizing the knee joint [16]. Injuries of the knee ligaments in children are rare [17, 18].

Fractures around the knee result in vascular injuries in about 3% of cases. However, the incidence or vascular events is about 16%, when the posterior knee dislocation is present [2–4, 13, 19]. The mean reason, regardless of the mechanism of injury or direction of dislocation, lies in the neurovascular anatomy of the knee. The popliteal vessels, run posteriorly within the popliteal fossa. The popliteal artery is fixed proximally at the adductor magnus hiatus, and distally at the fibrous arch of the soleus and interosseus membrane. Because of its "fixed" anatomical position, popliteal artery is predisposed to injury with posterior knee dislocation [4]. When posterior knee dislocation occurs, the popliteal artery can be stretched, lacerated, kinked, contused (followed by secondary arterial thrombosis) [2, 4, 14, 20], and even, transsected [14, 19, 21].

Injury to the popliteal artery predisposes to limb-threatening ischemia, although up to one third of patients may present with intact distal pulses [22]. The problem is how to recognize and avoid missing a popliteal artery injury in such cases. Is arteriography neccessary in all patients with posterior knee dislocation? Some authors recommend arteriography, only when physical signs (absent pedal pulses) or/and diminished ancle brachial indices, show arterial flow disturbance [19, 21, 23].

Pediatric vascular injury is uncommon during childhood and adolescence. Because of that, its surgical management is traditionally based on adult trauma experience. The first question is surgical approach. The popliteal artery reconstruction can be approached medially or posteriorly. The medial approach is preferable if distal thrombectomy is necessary, while the posterior approach may be helpful when treating short popliteal artery injuries. The stretch injury of the popliteal artery associated with intimal separation requires an abundant arterial resection before reconstruction [4, 20, 21]. Inadequate debridement of contused popliteal artery is always results in arterial thrombosis in the early postoperative period [24]. Vascular repair includes primary end-to-end anastomosis, vein graft interposition, or bypass grafting [4]. The majority of popliteal artery injuries (always when the length of damaged segment is more than 1.5 to 2 cm) secondary to knee dislocation, require an interposition vein graft secondary to the extent of arterial injury. End-to-end repair may require extensive popliteal artery mobilization with sacrifice of collateral vessels to ensure a tension-free repair [25].

However, in the pediatric population, there are same specific factors that should be respected when vascular traumatic lesions are treated. They are small vessel size, vessel spasm, tendency for restenosis, and rapid body growth. Most authors recommend to avoid the use of continuous sutures, because of possible narrowing along the suture with growth [26, 27]. Next, what happens with saphenous vein in arterial position several years after the reconstruction? On the basis of previous reports [28, 29], the risk of significant aneurismal dilation or occlusion of saphenous vein grafts is acceptable in children, even with long-term follow-up. So, autlogous saphenous vein is the material of choice for arterial reconstruction in children (Table 1).

Table 1

Early results and types of surgical procedures by various authors

The authors and the year	Sex (M/F)	Age (years)	Vascular procedure	Early result
Kirby et al, 1999 [4]	M	9	Reverse saphenous vein graft	Good
Dalsing et al, 2005 [29]	M	9	Reverse saphenous vein graft	Good
Angiletta et al, 2006 [31]	M	13	Stenting	Good
Lineena et al, 2008 [30]	M	11	Reverse saphenous vein graft	Good
	M	11	End-to-end	Good

M – male; F – female.

Few years ago stenting was described as a treatment of femoro-popliteal arterial trauma [30]. According to the author opinion the rationale for choosing stenting *vs* direct vascular reconstruction was based on the arterial caliber (approximately 4 mm) and the size of the great saphenous vein (approximately 2 mm), which led to the decision to defer further surgery until the child was older and the arteries and veins for reconstruction grew larger [28]. In our opinion this kind of injured popliteal artery treatment has some major disadvantages. There are stent fracture and migration as a result of biomechanical forces, as well as in-stent restenosis due to the healing process that induces neointimal hyperplasia. Because of that stenting could be eventually considered to be the bridge procedure to delay open surgery in smaller children.

Conclusion

Traumatic posterior knee dislocation is very often followed by popliteal artery damage. The standard Doppler ultrasound or multislice computed tomography angiography (DSA or MSCTA) are neccessary when pedal pulses are absent or/and ancle brachial indices significantly diminished. Such injuries should be treated interdisciplinary by the well-trained vascular surgeon and pediatric orthopedic surgeon.

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