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Popliteal vessel trauma: Surgical approaches and the vessel-first strategy

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ABSTRACT

Background: In this study, we analyzed long-term outcomes following treatment of traumatic popliteal vascular injuries in an urban level I trauma center, using a vessel-first approach in the case of combined vascular and bony/ligamentous injuries and discussing the relative merits of the medial and posterior approach to popliteal vessels.

Methods: Data including patient demographics, mechanism and type of injury, severity of limb ischemia, Injury Severity Score (ISS), limb ischemia time, time to revascularization from admission, treatment strategy, type of vascular reconstruction, limb salvage and mortality were retrospectively collected in patients treated for traumatic popliteal vessel lesions. All patients in this study were operatively treated using medial and posterior approaches. A vessel-first approach was used where possible.

Results: Twenty-four patients (13 male) with a median age of 45 years (range 21–88) and popliteal vessel injury after traumatic knee dislocation (n = 10, 42%), proximal tibia fracture (n = 5, 21%), distal femur fracture (n = 4, 17%), blunt popliteal injury (n = 3, 12%) and penetrating trauma (n = 2, 8%) were identified. Twelve (50%) patients were treated via a medial approach and 12 (50%) via a posterior approach. All had injury of the popliteal artery (15 complete transection, eight local intimal disruption and one pseudoaneurysm) with seven having additional popliteal vein and five with nerve injury. Nineteen patients (88%) presented with limb ischemia Rutherford category ≥II. Vessel reconstruction (four direct sutures, four patch plasties, 16 venous interposition/bypasses) was performed prior to bone/joint stabilization in 22 patients (92%). Thirty-day mortality was zero. Two above-knee amputations were performed within 30 days due to severe infection. During a median follow-up of 59 (range 12–143) months, there were no deaths and no amputations. At the end of follow-up, all patients denied claudication.

Conclusions: The vessel-first strategy promises an excellent outcome, independent of the surgical approach needed to repair traumatic popliteal vessel injuries.

1. Introduction

Popliteal vessel injury in the context of lower extremity trauma is relatively rare (0.2–1%), but associated amputation rates are high (10–16%) [1–5]. The practice of early vascular repair over simple ligation has greatly improved limb salvage rates [6–10]. Successful endovascular repair has been reported in select cases of intimal disruption or rarely for transection of the popliteal

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artery [11–14]. However, endovascular repair is time consuming, technically demanding and is associated with early complications such as local dissection or thrombosis [11–14]. Furthermore, additional open exploration of concomitant injuries is not possible with this approach. Open surgery therefore remains the treatment of choice in traumatic popliteal vessel injury.

Many studies discuss the criteria for treatment strategy selection in this heterogeneous patient cohort, but no clear recommendation yet exists for whether bony fixation or revascularization should take priority in the management of these patients [6, 7, 9, 15, 16]. Some groups advocate skeletal fixation first in order to protect subsequent vascular reconstruction and other favor vessel-first strategy to minimize the limb ischemia [17–21]. Although vessel reconstruction with interposition graft bears twice the risk of secondary amputation compared with direct vessel reconstruction, no consideration has yet been given to the impact of different surgical approaches which may be employed [9]. In this study, we analyzed early and long-term outcomes following treatment of traumatic popliteal vascular injuries using a vessel-first approach in the case of combined vascular and bony injuries and discussing the relative merits of the medial and posterior approach.

2. Material and methods

We performed a nonrandomized retrospective case series for patients undergoing open vascular reconstruction for traumatic popliteal vessel injury via a medial or posterior approach between March 2005 and December 2016 in an urban level I trauma center. Patients treated via a lateral approach as well as patients with traumatic limb amputations were excluded. The following data were collected from hospital records: patient demographics, mechanism and type of injury, severity of limb ischemia, Injury Severity Score (ISS), duration of limb ischemia and time from admission to revascularization, treatment strategy, type of vascular reconstruction, limb salvage and mortality. Subgroup analysis between both approaches was performed. All patients gave informed consent and the local ethics committee waived the need for approval (decision number Req-2017-00023).

2.1. Definitions and treatment strategy

Initial diagnosis of popliteal vessel injury was based on clinical examination (e.g. palpation of pedal pulses or detection of pedal arterial Doppler signals). Vascular lesions as well as concomitant bony injuries were diagnosed using computed tomography angiography and/or duplex ultrasound. Trauma mechanisms were classified as low (e.g. falls from standing height, missteps), medium (e.g. sporting accidents, road accidents as a pedestrian) or high energy trauma (e.g. road traffic accidents) [22]. In case of knee dislocation, reduction was performed as early as practicable. Imaging to diagnose fractures and ligamentous injuries was performed as required.

Limb ischemia was classified according to Rutherford's classification of acute limb ischemia [23]. Duration of limb ischemia was defined as time from injury to revascularization (either definitive or by means of an intravascular shunt). In-hospital delay was defined as time from admission to revascularization. A vessel-first strategy with direct vessel reconstruction or with use of intravascular shunt prior to orthopedic reduction/stabilization was undertaken whenever possible.

2.2. Surgical approach

The medial or posterior approach for popliteal vessel reconstruction was chosen at the discretion of the treating vascular and trauma surgeons based on surgeon preference, as well as the location and extent of the arterial injury, taking into consideration concomitant bony, ligamentous, or venous injuries. The posterior approach was performed in the prone position, and an S-shaped incision in the popliteal fossa was used to gain access to the popliteal vessels proximally and distally to the lesion. For the medial approach, patients were positioned supine and medial access to the popliteal vessels was obtained above and below the knee joint. Heparin (100 IU/kg body weight) was administered intravenously before clamping. Fogarty catheter thrombectomy was performed when required. Temporary intravascular shunting as well as intraoperative angiography was used at the discretion of the surgeon. If tension-free anastomosis was possible, direct vascular reconstruction was performed. For longitudinal arteriotomy closure, a venous or bovine pericardium patch was used. For more extensive lesions, great or small saphenous vein interposition graft was used for revascularization. The vein was harvested ipsi- or contralateral depending on the extent of the lesion, surgical approach, concomitant injuries and its availability. For suspected neural lesions, neural integrity was assessed intraoperatively using a neuro-stimulator.

In case of invasive compartment pressure measurements ≥30 mmHg after restoration of blood flow, four-compartment fasciotomy of the lower leg was performed. Temporary or definitive stabilization of the knee was achieved with a brace or external fixator in supine position. Where definitive knee ligament reconstruction and/or osteosynthesis was necessary, this was performed in a subsequent procedure.

2.3. Follow-up

All patients received either antiplatelet therapy with 100-mg acetylsalicylic acid or anticoagulation with coumarin or rivaroxaban between 30 and 90 days postoperatively. Indications for anticoagulation and the duration of postoperative thrombosis prophylaxis were based on patient factors (e.g. mobility, comorbidities). Measurement of the ankle-brachial index (ABI) as well as

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