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Case Report

Bilateral popliteal artery injury: Lessons learned

Tashinga Musonza[a,*], Ahmed Khouqeer[b], Ramyar Gilani[b]

[a] Michael E. DeBakey Department of Surgery, Baylor College of Medicine, Houston, TX, United States of America
[b] Division of Vascular Surgery and Endovascular Therapy, Michael E. DeBakey Department of Surgery, Baylor College of Medicine, Houston, TX, United States of America

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ABSTRACT

Popliteal artery trauma is reported to have the highest rates of limb loss in peripheral vascular injuries. It can be inferred that morbidity associated with bilateral popliteal artery trauma is worse. However, bilateral popliteal artery injuries are sparsely reported in literature and as such management options are not well defined. Despite the paucity of reported cases, a systematic and deliberate approach to these devastating injuries may result in reproducible limb salvage. We hereby use our case report as a provocateur to this conundrum.

Consideration should be given to the utilization of surgical shunts or a two-surgical team and limb salvage attempted till proving the neurovascular bundle irreparable. Arterial grafts should be part of the surgeon's armamentarium. In massive hard to control hemorrhage, tourniquets or resuscitative endovascular occlusion devices (REBOA) may prove lifesaving. Larger studies are needed to define contemporary management and derive management guidelines.

Introduction

Bilateral popliteal artery injuries are sparsely reported in literature. Consequently, diagnostic and management options are not well defined. Despite the paucity of reported cases, a systematic and deliberate approach to these devastating injuries may result in reproducible limb salvage [1].

Case report

A 16-year-old female presented to our Level One Trauma Center after being wedged between two cars upon low velocity impact. She had a normal mental status, was tachycardic (heart rate 134) and normotensive (systolic blood pressure 114). Her left knee had an open fracture (Fig. 1). Dorsalis pedis (DP) and posterior tibial (PT) pulses and signals were absent. The extremity was cool, discolored, had delayed capillary refill, motor and sensory deficits. The right leg had open tibia and fibular fractures with diminished sensation and weak motor function. The right DP and PT signals were discernable by a hand-held doppler.

The initial management was done by the trauma surgeon on call. Computed Tomography (CTA) revealed no intraabdominal or pelvic injuries. The left popliteal artery (PA) was completely occluded but had normal distal runoff. The patello-tibial articulations were disrupted due to severely comminuted distal femur, patellar and proximal tibial fractures (Fig. 2). The right PA had a 1 cm segment of occlusion with distal reconstitution. The posterior tibial artery was diminutive, and the ipsilateral peroneal and anterior

* Corresponding author at: Michael E. DeBakey Department of Surgery, Baylor College of Medicine, BCM One Baylor Plaza, Suite 404D, Houston, TX 77030, United States of America.
E-mail address: tashinga.musonza@bcm.edu (T. Musonza).

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Fig. 1. Open left knee fracture (s).

Fig. 2. Disrupted left patello-tibial articulation.

tibial arteries were not visualized. In the interim, a vascular surgeon was consulted.

The presence of an unstable left knee joint mandated orthopedic stabilization prior to vascular repair. The left leg had severely comminuted fracture dislocation with complete disruption of the distal femur, proximal fibula, proximal tibia and patella. The proximal right tibia had severe extra-articular comminuted fractures. The left neurovascular bundle was explored and found to be intact. External fixation and antibiotic beads were placed. (Fig. 3). The orthopedic surgeon then handed over the case to the vascular surgeon and the time he made initial incision, 5 h had passed since the inciting event.

Systemic heparin was administered and both injuries were sequentially approached via medial incisions.

Left PA thrombectomy was done via a transverse arteriotomy with minimal back flow. The vessel was further debrided proximally and distally revealing an intimal flap. The artery was spatulated at both ends and primarily repaired with 6.0 prolene in a running fashion posteriorly and interrupted anteriorly. DP and PT signals were confirmed.

By the time of intervening on the right, the extremity had become ischemic: cold and inaudible signals. An angiogram was done, and this showed behind the knee PA occlusion. An above to below the knee contralateral reversed great saphenous vein graft in an end to side fashion was utilized. DP and PT signals were confirmed. A lateral transection in the popliteal vein was primarily repaired with a single 6.0 prolene stitch. Completion angiography showed good distal flow. Bilateral fasciotomies were done. It took 2 h

Fig. 3. Fracture fixation and antibiotic bead placement.

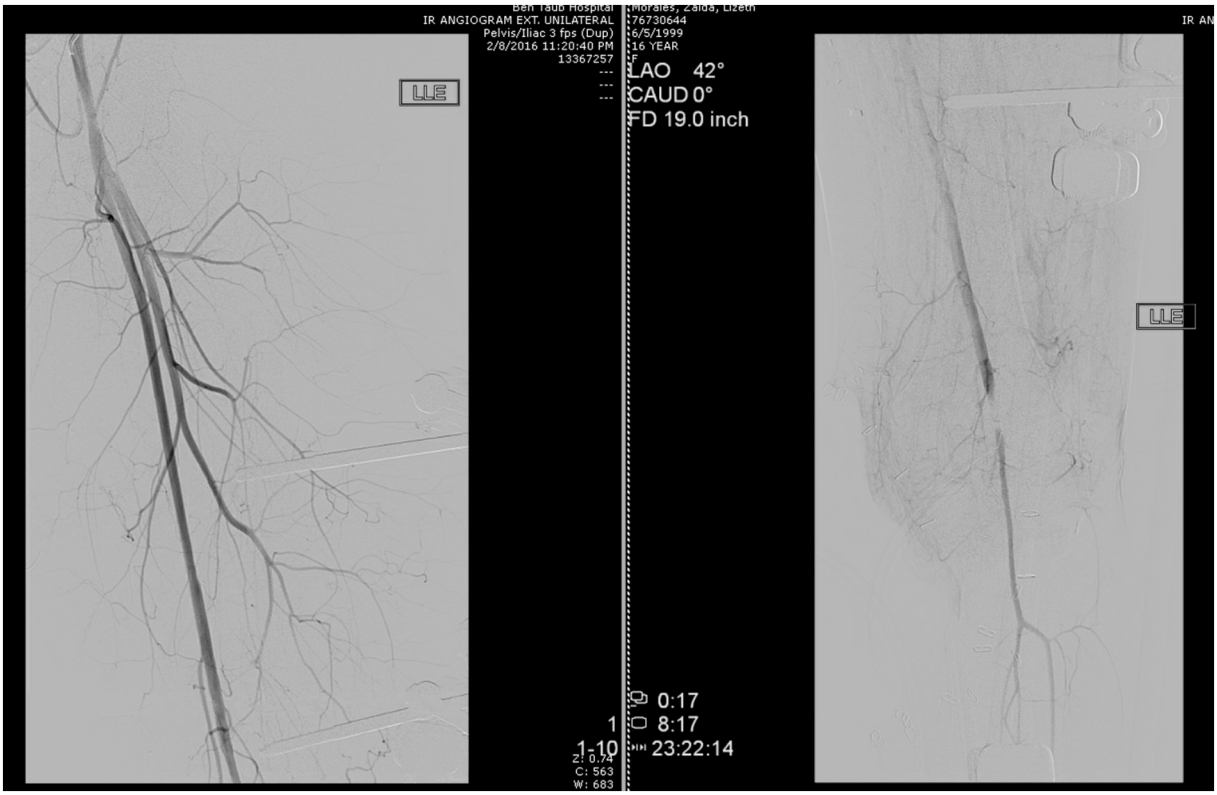

Fig. 4. Diagnostic angiogram showing an occluded left behind the knee popliteal artery on POD 9. The suprageniculate vessels were patent as shown on the left-hand image.

18 min to establish flow in the left popliteal artery. The cumulative operative time was 5 h. The patient received.

She lost the left PT signals on POD 9 and a diagnostic angiogram showed behind the knee PA occlusion (Fig. 4). We surmise this was due to missed intimal flap extension during the index operation. The occlusion was managed with a contralateral reversed saphenous femoral to below the knee popliteal artery bypass graft. The patient underwent multiple wound debridements,

xenografting and later skin grafting, free muscle flap coverage, in addition to orthopedic repair of her injuries. The left extremity wound was later covered with a free right latissimus dorsi flap and the right extremity covered with a free right rectus abdominis flap. Her hospital stay was 2 months. The patient later developed left tibial osteomyelitis which was managed by suppressive antibiotic therapy in the outpatient setting. She has had recurrent superficial infections on the left lateral knee, and these have been managed with antibiotics. Twenty-four months later, she still ambulates with a steady gait but has chronic bilateral knee pain. She has diminished sensation in the right lower extremity. Her range of motion is preserved though she minimal difficult with extension of the left knee.

Discussion

Diagnosis

PA trauma is reported even with palpable pulses in more than 10% of cases [2]. A focused exam is diagnostic in patients with hard signs of vascular injury such as signs of ischemia (pain, pallor, paralysis), absent distal pulses, active hemorrhage, bruit or thrill over the wound, an expanding or pulsatile hematoma. In the setting of hemodynamic stability, diagnostic uncertainty (soft signs of vascular injury) or suspicion of concomitant injuries, imaging should be liberal. Contrast enhanced computed tomography (CTA) with runoff is preferable.

Formal pre- or intra-operative angiography is also diagnostic if there is diagnostic uncertainty. However, completing angiography in the radiology suite may delay intervention and prolong ischemia thus negatively impact limb salvage [3]. If the injury is obvious, heading to the operating room and then doing completion angiography is encouraged.

In our case, on-table catheter angiogram prior to repairing the right extremity did not add value to our management since the diagnosis had been made with CTA and we had signs of injury (absent pulses). In fact, the angiogram probably delayed our intervention. In addition, we could have immediately transported the patient to the operating room and forego the CTA since we had hard signs of vascular injury and concomitant trauma seemed unlikely based on the localized nature of injuries on primary and secondary survey.

Anticoagulation and hemorrhage control

Systemic heparinization should be employed once hemorrhage has been controlled. In massive hemorrhage, a tourniquet can be employed. In addition, deploying an endovascular resuscitation device (REBOA) in zone 3 of the aorta may be of utility in hard to control bilateral hard to control popliteal artery hemorrhage. This has not been reported.

Limb salvage

The possibility of limb salvage is inferred upon initial evaluation, but management decisions should be deliberate. In our case, the possibility of limb salvage became apparent after exploring the neurovascular bundle. An ongoing dialogue between the orthopedic and the trauma surgeon facilitated limb preservation. Limb salvage should be attempted until proving the neurovascular bundle irreparable. In addition, revascularization should be expeditious. Prolonged ischemia and prioritization of concomitant injuries have been reported to negatively impact limb salvage outcomes [4]. Simultaneous management of PA and torso injuries may reduce limb loss.

Operative management

Shunting is preferred if definitive repair is not feasible. Routine shunting in blunt PA trauma with complete lower extremity ischemia was shown to reduce ischemia times, rates of limb loss and postoperative limb complications [5]. The surgeon may utilize any shunt suitable to the vessel caliber. Commercially available shunts or small caliber feeding tubes, oxygen tubing or even dialysis catheters can be used as shunting devices. We did not utilize a shunt and by the time we repaired the right extremity, it had become progressively ischemic. We could have placed a damage control shunt on right extremity during the 2 h we spent repairing the right popliteal artery. Trauma patients are often young and as such do not have well developed collaterals. This makes them prone to ischemia-reperfusion injuries. Shunting is favorable and allows resuscitation to proceed in the intensive care unit when physiologic boundaries have been breached (acidosis, hypothermia, hypotension).

Ligation is appropriate when limb salvage is unattainable, or hemorrhage control has failed.

Success with a two-surgical team simultaneously repairing both injuries has been documented [6]. However, this required a posterior approach in prone position. Anterior torso injuries may preclude this position. The caveat with a medial approach is the difficulty in having two-teams working simultaneously. The feasibility of a two-surgical team depends on institutional resources.

Short segment injuries are amenable to primary repair whereas long segment injuries require grafting. An autologous or synthetic graft may be chosen. The accompanying wounds are often grossly contaminated therefore unsuitable for synthetic grafts. We chose autologous grafts since these were contaminated wounds. Our patient later developed left tibial osteomyelitis, a synthetic graft might have become infected and subsequently failed. Extensive bilateral injuries may preclude saphenous vein harvesting, an arterial graft may be elected. In military conflict, an autologous internal iliac artery graft was successfully utilized after a blast PA injury [7]. Attempts should be made to repair concomitant popliteal vein injuries. Vein repair in addition to intra-luminal shunts was associated

with favorable limb outcomes [8].

Major soft tissue and orthopedic injuries in blunt injuries are thought to complicate traditional repair and some have proposed endovascular techniques [9]. This is not the standard of care and only a few case reports have documented this approach. Placing stents at the knee joint is problematic due to repeated flexion and extension.

Fasciotomies

Ischemia times greater than 6 h, significant crush injuries and concomitant lower extremity venous injuries are indications for prophylactic fasciotomies.

Conclusion

The management of bilateral PA injuries is challenging and needs to be systematic. Limb salvage should be attempted until proving the neurovascular bundle irreparable. Consideration should be given to utilizing surgical shunts or a two-surgical team. Arterial grafts should be part of the surgeon's armamentarium. In massive hard to control bilateral popliteal artery hemorrhage, the use of tourniquets or zone 3 endovascular balloon occlusion devices (REBOA) may be lifesaving. Larger studies are needed to define contemporary management and guide future directions.

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