Late Recognized Vascular Injury after High-energy Fracture of the Proximal Tibia: a Pitfall to Know in Current Practice

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Abstract
Failure to recognize associated soft-tissue injuries after high-energy proximal tibia fractures is not uncommon. Despite the progress in managing these complex injuries, a prompt diagnosis of associated arterial injuries still remains difficult. A high index of suspicion for arterial damages is nevertheless mandatory in these severe fractures. Treatment protocols have been developed to reduce the previously reported high rates of amputation and permit an optimal management of soft-tissue and an acceptable functional outcome. We report here a well-documented case of a severely displaced proximal tibia fracture that illustrates the problem of diagnosing and managing the associated vascular injuries.

Key Words
Proximal tibia fracture · Vascular injuries · Management

Eur J Trauma Emerg Surg 2008;34:91–4
DOI 10.1007/s00068-007-7099-0

Case Report

A 26-year male was admitted to our emergency room following a road traffic accident. He rode his motorbike and collided with a car at a speed of about 80 km/h. He sustained a right apical pneumothorax which did not require any drainage and a severely displaced fracture of the proximal right leg. The patient was alert, fully orientated and hemodynamically stable. The local exam yielded a pre-tibial skin contusion with a star-shaped pre-patellar wound, preserved pedal pulses with normal skin capillary refill time, but with a global hypoesthesia and tenderness of the leg making a compartment syndrome very plausible. Motor tests were not reliable due to the intensity of pain. A prophylactic antibiotic treatment (penicillin) has been immediately begun. X-ray films showed a bicondylar fracture of the tibia (type 41-C2 according to the AO-classification), severely displaced at the transition of the proximal and medial third, with collapse of the lateral plateau and involvement of the fibula (Figure 1).

The patient was operated on emergency. The operation was carried out without tourniquet. First the pre-patellar wound was debrided, the bursa removed and the skin sutured. Then we proceeded to fasciotomies of the antero-lateral compartment, exposed the fracture of the fibula and tried to reduce it unsuccessfully. We changed, therefore, to the medial side where we carried out fasciotomies of the posterior compartment, exposed the fracture of the tibia which was severely displaced. Under traction and with forceps we obtained an acceptable reduction. There was no evidence of active arterial bleeding during exploration. In order to reduce the injury to the periosteum and soft tissues we chose to fix the fibula and the tibia by means of reconstruction plates. The external tibial plateau was fixed with a cannulated screw 7.3. We completed the montage by a hybrid external fixator (Figure 2). Medially we only closed the skin without tension. Laterally we let the wound open and covered the musculature by an artificial membrane (Epigard®). Postoperatively the pedal pulses were present. The

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Received: July 5, 2007; revision accepted: September 25, 2007;
Published Online: November 14, 2007

Figure 1. High-energy proximal tibia fracture (initially described as Gustilo IIIA/Tscherne FxOII).

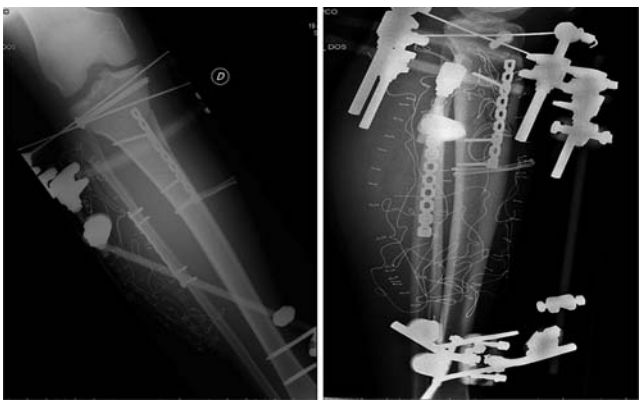

Figure 2. Postoperative X-ray control.

patient presented a hypoesthesia on the dorsal foot, an anesthesia on the plantar sole and could extend his toes weakly but not flex them.

We proceeded on day 9 to a skin graft over the lateral wound. To complete the clinical neurological status we performed an electromyography that confirmed a partial injury of the common peroneal nerve and a severe injury of the tibial nerve. On day 24 the patient complained of reappearing pain in his right leg. Clinically he presented a hematoma under tension on the dorso-medial face of the proximal leg. An ultrasound (Figure 3) showed a false aneurysma at the expense of a deep artery of the calf with a voluminous organized intramuscular hematoma. An arteriography (Figure 4) confirmed the diagnosis of a false aneurysma with an aperture at the level of the peroneo-tibial trunk and an occlusion of the posterior tibial artery at its proximal part with a recapture distally. The anterior tibial and peroneal arteries were patent. On day 25 a voluminous (about 1 l) hematoma was evacuated surgically, the lacerated peroneo-tibial trunk

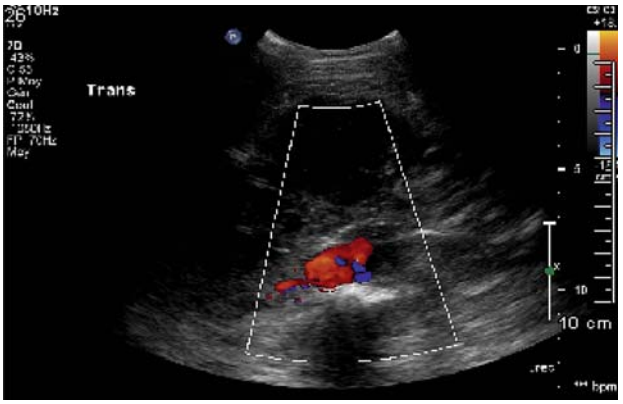

Figure 3. Ultrasound (mode Doppler color). Transverse view on the right calf. Note the arterial flow (in *red*) of the collection which is connected to a small arterial vessel.

sutured, the distal stump of the posterior tibial artery ligated and the posterior tibial nerve partially released (Figure 5). Postoperatively we obtained an excellent Doppler signal on the dorsal pedal artery and a satisfying signal on the posterior tibial artery. On day 55 the patient was discharged from hospital.

The patient was followed ambulatory at regular intervals. The external fixator was removed ambulatory at 3 months. A cruro-pedal cast was applied for 2 weeks. At 4.5 months the stability of the knee was good, the mobility complete. At 6 months the patient was able walk almost without any limp and without any pain. The neurological exam and electromyography showed a virtually complete recovery of the strength of the flexors of the foot. Radiologically the fibula was healed, the tibia showed signs of consolidation (Figure 6). At 8 months the vascular control showed patent anterior tibial and peroneal arteries, a posterior tibial artery occluded on its two proximal thirds with a distal revascularization by collaterals. The velocimetric curves were triphasic including the right posterior tibial artery!

Discussion

Tibial fractures with an associated vascular injury are a challenging management problem for the orthopedic and the vascular surgeon. More specifically, tibial fractures with associated infrapopliteal arterial injuries (IPAIs) are uncommon [1]. In the literature, these are still inadequately documented. In fact most studies concerning tibial fractures with IPAIs are either case reports like ours or present data in such a way that the reader is not able to differentiate between popliteal and infra-popliteal arterial injuries [2–6].

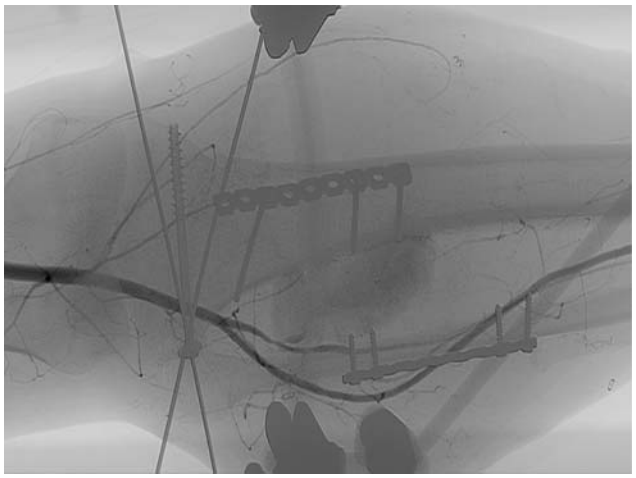

Figure 4. Arteriography of the right lower leg. Note the false aneurysma spreading along the proximal calf with an opening at the level of the tibio-peroneal truncus.

Figure 5. Operative site showing the distal stump of the posterior tibial artery which was ligatured.

Currently, the absolute indication for repair of a traumatic IPAI is disruption of both anterior and posterior tibial arteries. In cases of injury to only one of these vessels, like in our case, the indications for vascular repair have not been clearly defined. Segal et al. reported in a series of 18 patients with tibial fractures with 27 IPAIs that the limb can survive with patency of only the anterior tibial or posterior tibial artery [7]. Horton emphasized on the contrary the prompt surgical repair in tears of the posterior tibial artery with tibial fracture [8]. Brinker et al. showed an increased risk of both delayed union and non union of tibial shaft fractures in a retrospective series of 46 patients with tibial fractures with an associated vascular injury [9]. In fact the posterior tibial artery gives off the principle nutrient artery of the tibia which supplies the marrow cavity and at least the inner two-thirds of the diaphyseal cortex [10, 11]. Winter et al. reported a retrospective review of 18 arterial reconstructions after trauma in the region of the knee joint. Among these arterial injuries 14 (77.8%) were intimal lesion after blunt trauma with subsequent thrombosis. To note that two thirds of these arterial lesions were not or too late recognized. Complete restitution to normal was achieved in only two cases, while in the remaining 12

Figure 6. X-ray control at 6 months postoperatively. The fibula is healed, the tibia shows signs of consolidation.

there were defects of motor and sensory function as seen in the post-ischemia syndrome. In four cases above-knee amputation was necessary despite successful reconstruction of the artery because there was irreversible ischemic damage with tissue necrosis. In our case we didn't reconstruct the posterior tibial artery because the other two infrapopliteal arteries were patent.

In the absence of penetrating wounds, arterial injury is more likely to be overlooked. This may result in delayed thrombosis, false aneurysm like in our case or arteriovenous fistula. To avoid these complications, a high index of suspicion for arterial injuries is mandatory. Arteriography or computed tomography angiography (CTA) can be requested. Käch et al. reported management errors in ten patients (27%) in a retrospective study of 37 patients with popliteal vascular injury after blunt trauma [12]. Among these, 7 delays in diagnosis of the vascular injury were found. A postoperatively occurred ischemic process was mistaken for a compartment syndrome in three patients. An intimal lesion was not recognized in three other patients. An underestimated crush injury led to arterial insufficiency in the seventh case.

Conclusion

Severe traumatic forces are required to produce a concomitant major arterial and skeletal injury in a lower extremity. Early recognition of the arterial injury is mandatory. Although an isolated IPAI seems to have no repercussion on the viability of the injured leg as demonstrated in our case, such a lesion may have a great influence on the functional outcome. Consequently we advocate, as far as possible, a vascular repair aiming at anatomic vessel reconstruction in cases of an isolated IPAI especially in young trauma patients.

References

1. Sher M. Principles in the management of arterial injuries associated with fracture/dislocations. Ann Surg 1975;182:630–4.
2. Lange RH, Bach AW, Hansen ST Jr. Open tibial fractures with associated vascular injuries: prognosis for limb salvage. J Trauma 1985;25:203–8.
3. O'Donnell TF Jr, Brewster DC, Darling RC, Veen H, Waltman AA. Arterial injuries associated with fractures and/or dislocations of the knee. J Trauma 1977;17:775–84.
4. Ottolenghi CE. Vascular complications in injuries about the knee joint. Clin Orthop 1982;165:148–56.
5. Tinley NL, McLamb JR. Leg trauma with posterior tibial artery tear. J Trauma 1967;1967:807–10.
6. Waddell JP, Lenczner EM. Arterial injury associated with skeletal trauma. Injury 1974;6:28–32.
7. Segal D, Brenner M, Gorczyca J. Tibial fractures with infrapopliteal arterial injuries. J Orthop Trauma 1987;1:160–69.
8. Horton RE. Injury to the posterior tibial artery complicating fracture of the tibia. Br J Surg 1968;55:93–5.
9. Brinker MR, Caines MA, Kerstein MD, Elliott MN. Tibial shaft fractures with an associated infrapopliteal arterial injury. J Orthop Trauma 2000;14:194–8.
10. Trias A, Fery A. Cortical circulation of long bones. J Bone Joint Surg Am 1979;61:1052–9.
11. Trueta J, Caladias AX. A study of the blood supply of the long bones. Surg Gynecol Obstet 1964;118:485–98.
12. Kach K, Kunzi W, von Wartburg U, Largiader J. Injuries of the lower extremity with vascular lesions of the popliteal area. Management errors. Helv Chir Acta 1991;57:753–7.

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