

CASE REPORT

Pedal bypass as urgent surgical revascularisation

Kriz Z, Vlachovsky R

*2nd Department of Surgery, St. Anne's University Hospital, Brno,
Czech Republic. zdenek.kriz@fnusa.cz***Abstract**

Pedal bypass (arterial reconstruction with distal anastomosis on the dorsal pedal artery (DPA) or in the submalleolar portion of the posterior tibial artery) is now considered as a standard method of revascularisation in critically ischaemic limb with obliteration of the crural arterial system. While a number of studies in large cohorts have proved the success of this method in saving limbs with chronic critical ischaemia, only few papers report the pedal bypass as an urgent intervention. In this study, the authors describe 3 cases where urgent pedal bypass saved the limb threatened by an acute ischaemia (Fig. 3, Ref. 12).

Key words: pedal bypass, angioplasty, angiography, critical limb ischaemia, acute ischaemia, emergency treatment.

In 1988, Ascer first reported the possibility to save a limb using a bypass with distal anastomosis placed on pedal artery (1). His work was based on knowledge, now well known, that pedal arteries are markedly less affected by atherosclerosis than crural arteries, and due to collateral circulation they often remain permeable even in total occlusion of crural arteries. A rapid development of so called extremely distal bypasses is present and a number of long-term studies both in U.S. and Europe demonstrate, on large cohort, up to 80 % success rate in saving limbs with chronic critical ischaemia including diabetic gangrene (2, 3, 4). Our institution has performed pedal bypasses since 2000 and we demonstrate good results in saving limbs in patients previously threatened by major amputation (5). In our group of patient, diabetic patients with gangrene and chronic critical limb ischaemia are dominant. So mostly we perform planned interventions. In three cases, urgent interventions were performed with the aim to save the limb threatened by acute ischaemia using a pedal bypass. The revascularisation was successful in all three patients and as there are not many studies describing pedal bypass as an urgent surgery (6), we are presenting these case reports.

Case 1

This case presents a 66-year old female with a non-healing defect following amputation of the 2nd right toe due to diabetic gangrene. Digital subtraction angiography (DSA) confirmed multiple occlusions of crural arteries. The only artery pervious to the

periphery was the posterior tibial artery, however, with a haemodynamically significant stenosis in the proximal portion. Although also stenotic in its further course, the posterior tibial artery was pervious. The stenosis in the proximal portion was treated by percutaneous transluminal angioplasty (PTA) using a stent. A weakly palpable pulsation appeared behind the ankle and the periphery of the limb was well supplied with blood. After two days a sudden loss of pulsation occurs and an acute ischaemia of the limb developed. The extremity was cool from the middle of shank distally. An angiography confirmed the closure of posterior tibial artery at the site of the stent. From possible solutions (thrombolysis, thrombectomy, revascularisation) we decided to perform an urgent pedal bypass. We implanted an autologous reversed venous graft with a proximal anastomosis on the popliteal artery (PA) under the knee and a distal anastomosis on the posterior tibial artery at the ankle level. Following implantation, revascularisation of the limb appears, and the diabetic defect has healed within 3 weeks. Fifty-six months after the intervention is the patient is good condition, without claudications, without defects on the limb.

2nd Department of Surgery, St. Anne's University Hospital, Brno, Czech Republic

Address for correspondence: Z. Kriz, MD, 2nd Department of Surgery, St. Anne's University Hospital, Pekarska 53, CZ-656 91 Brno, Czech Republic.

Phone: +420.543.182431

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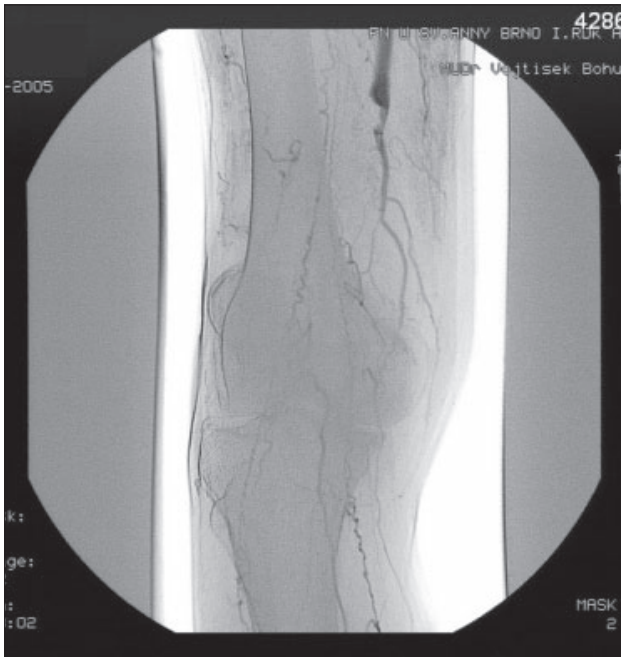


Fig. 1. Preoperative DSA: occlusion of the SFA at the level of the Hunter's canal and absence of popliteal runoff. The ATA is closed at the proximal section; the fibular artery is poorly filled by collateral circulation as well as the proximal section of the posterior tibial artery, however, it is not reaching the periphery.

Case 2

A 33-year old man with no remarkable history suffered a severe injury of the left shank. He presented with an open splintered fracture of both crural bones and a severe devastation of soft tissues including the crural arterial bed. The periphery of the limb was ischaemic, the foot and toes were cool. After an urgent stabilisation of the skeleton with an external fixing device we proceeded to a revision of crural arteries. The devastation was so extensive that we could only ligate bleeding vessels. An amputation of the ischaemic limb under the knee was considered. Finally we decided to try revascularisation using a pedal bypass. We implanted a reversed autologous venous graft conducted through a subcutaneous tunnel on the dorsal side of the calf. The proximal anastomosis was made on the PA under the knee, the distal one on the posterior tibial artery on the ankle level. A good revascularisation of the limb appeared; the patient underwent also other interventions, but not on arterial system. Two months after the operation, patient started walking on crutches, 6 months after he was walking, now the extremity is well supplied with blood, pulsation behind the ankle is well palpable.

Case 3

An 80-year old male was admitted to the hospital with a thrombosis of popliteal aneurysm and an acute ischaemia of right lower limb. 2 weeks before he underwent an osteosynthesis of the pertrochanteric femur fracture on the left side. Upon admis-

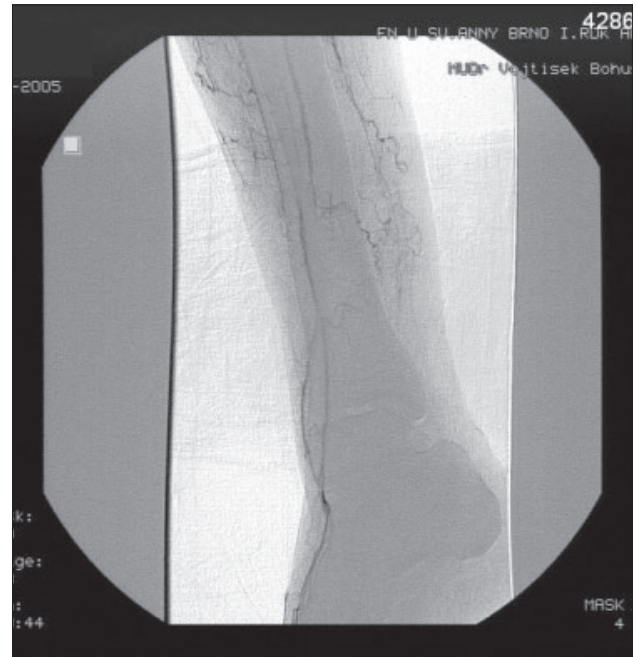


Fig. 2. Preoperative DSA: from lower half of the shank a poor additional circulation serves to fill the ATA, which is the only one to reach the periphery, although marked stenotic at the ankle level. At the dorsum of the foot the DPA is poorly filled.

sion, the right lower limb was cool from the knee downwards, the motility and sensation in the toes were markedly restricted. Doppler examination confirmed a thrombosed aneurysm of the popliteal artery, 3.5 cm in diameter. Preoperative DSA confirmed closure of the superficial femoral artery (SFA) at the level of the Hunter's canal and the absence of runoff under the knee (Fig. 1). Despite a very poor collateral circulation, the anterior tibial artery (ATA) was filling lower half of the shank, and as the only one reached the periphery, although significantly stenotic at the ankle level. The DPA was poorly filling at the dorsum of the foot (Fig. 2). Regarding the progress of ischaemia and contraindication of thrombolysis, we decided to perform an arterial reconstruction. Using epidural anaesthesia, we firstly prepared the SFA in the middle of the thigh where good pulsation was present. Then we prepared the PA under the knee by medial access. We found a thrombosed aneurysm, trifurcation, and proximal parts of crural arteries markedly affected by atherosclerosis. We made an unsuccessful thrombectomy of crural arteries using a Fogarty catheter. Arterial reconstruction under the knee was impossible so pedal bypass appeared as the only choice for arterial reconstruction. After a surgical inspection of the DPA at the foot's dorsum, an implantation of a reversed venous graft with a proximal anastomosis on the SFA and a distal anastomosis on the DPA followed. An intraoperative post-reconstruction angiography showed a distal portion of bypass with free anastomosis and runoff into the DPA (Fig. 3). After the surgery, revascularisation of the limb appeared. Six months after the arterial reconstruction is the patient in good condition, without claudications. The pulsations on the bypass and DPA are well palpable.

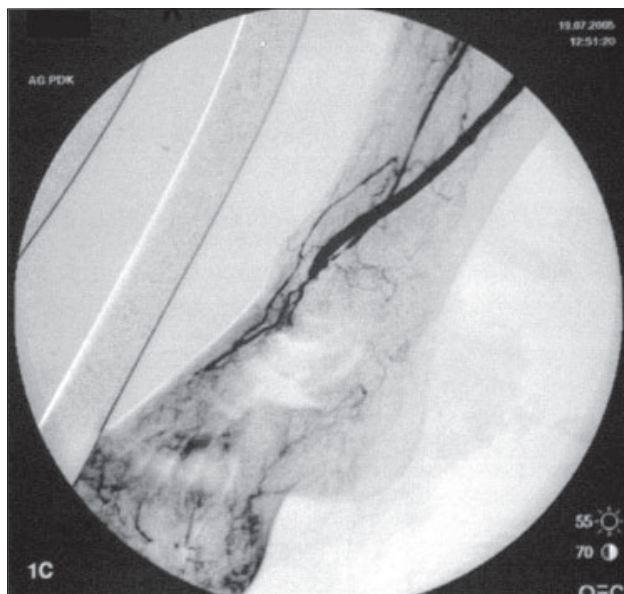


Fig. 3. Intraoperative post-reconstruction arteriography: the distal part of the pedal bypass is shown with a free anastomosis and a runoff into the DPA. There is an obvious stenosis on the ATA over the anastomosis, which is visible on preoperative DSA.

Discussion

In the first case we have preferred pedal bypass to thrombolysis or thrombectomy using a Fogarty catheter, because even in permeable posterior tibial artery would the risk of a recurrent thrombosis at the stent site remain quite high due to poor runoff. When discussing the affection of crural arteries, whether either PTA or pedal bypass is more suitable, a consensus was reached (7). If a so-called short stenosis is involved, it is appropriate to attempt PTA. The result may have a very good effect and, moreover, it is a careful, not too strenuous method for the patient. However, the risk of recurrent stenosis is relatively high. Nevertheless, some studies have shown that as long as the recurrent stenosis takes place, no critical ischaemia of the limb might develop (8). In case of longer or multiple stenotic portions of crural arteries, a bypass bridging is more suitable. The percentage rate of long-term permeability of pedal bypasses and saving the limb is higher for pedal bypasses than for the PTA in crural arteries (9).

In the second case only bridging of the devastated part of shank using a bypass offered a chance to save the limb. A pedal bypass led through the unaffected part of the limb appeared to be the best alternative, because an attempt to reconstruct crural arteries directly at the site of devastation would be associated not only with higher blood losses but also with a risk of infection during tissue healing.

As far as the third patient is concerned, it should be noted that the classical solution for a PA aneurysm is a supra-infrapopliteal bypass, rarely a femorocrural bypass (10). An elective surgical approach is always recommended. A situation, when no good runoff is present, may be a problem. If it is caused by a thrombosis, it is possible to perform a thrombectomy followed

by an arterial reconstruction. However, as the thrombectomy often fails to produce a good-quality runoff, the method of choice is recanalisation of the peripheral arteries by intra-arterial thrombolysis and subsequent arterial reconstruction (11, 12). If, however, thrombolysis is contraindicated and thrombectomy is unsuccessful, and, the situation is urgent, a pedal bypass appears to be the only alternative for saving the threatened limb.

Conclusion

Pedal bypass grafting – as urgent intervention – is indicated in cases where an acute lower limb ischaemia is caused by the occlusion of the crural arteries intractable other way, or where injury of crural arteries is so extensive that the only chance of save the limb is a bypass of the whole part of the shank.

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