Case Report

Pedal Bypass with Deep Venous Arterialization for Acute Ischemia in Unreconstructable Distal Arteries Patient: A Case Report

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Background: Through acute limb ischemia from thrombosis of angioplasty is low incidence. The result may cause major limb loss, especially in unreconstructable artery. The authors report successful deep venous arterialization bypass in a case of acute limb ischemia from thrombosis of a severe atherosclerotic artery after angioplasty.

Case Report: A 67-year-old male suffering from acute left limb ischemia from thrombosis of anterior tibial artery after angioplasty with stent was treated at the Division of Vascular Surgery, Department of Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand. He underwent pedal bypass with deep venous arterialization bypass (DVA bypass) from left superficial femoral artery to left posterior tibial artery. The primary patency was 35 days, and the secondary patency was 6 months. The secondary intention healing of the transmetatarsal amputation wound was 11 months, and the patient was found to be in good condition at 36 months after the operation.

Conclusion: DVA bypass in this patient with acute limb ischemia caused by calf vessel thrombosis had low patency. However, this procedure when combined with an endovascular intervention to achieve prolonged patency was shown to be an alternative revascularization treatment for limb salvage in patients with acute limb ischemia in an unreconstructable distal artery.

Keywords: Deep venous arterialization bypass, Acute limb ischemia, Unreconstructable distal arteries

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Acute thrombosis is a serious complication of endovascular interventions, and this complication may cause limb loss from acute limb ischemia. The incidence of acute thrombosis at the angioplasty site ranges from 2.9% to 3.2%[1,2]. Deep venous arterialization (DVA) is a new concept to apply the disease-free venous bed as an alternative conduit for perfusion of peripheral tissue with arterial blood. Many studies reported that deep venous arterialization (DVA) bypass can enhance healing in patients with critical limb ischemia and unreconstructable distal artery[3-10]. The authors herein report the use of DVA bypass in a patient with acute thrombosis after angioplasty stent placement for a severe diffuse lesion of the crural artery.

Case Report

A 67-year-old Thai man had a 3-month history of dry gangrene in all of his left toes. His comorbidities were diabetes mellitus, hypertension, current smoker, cerebrovascular disease, and a right above the knee amputation due to an unhealed ulcer 7 years previously. He had a full pulse in his left popliteal artery and absent pulses at his left ankle. His ankle-brachial index was 0.32. The patient's definitive diagnosis was left tibioperoneal occlusion with dry gangrene of the forefoot. Preoperative magnetic resonance angiography (MRA) demonstrated diffuse long occlusions of all arteries below the knee (Figure 1). He underwent angioplasty along the anterior tibial artery using a 2.5 mm x 60 mm balloon angioplasty catheter. However, acute thrombosis of the left anterior tibial artery occurred immediately after stent deployment for treatment of vessel recoil after angioplasty (available stents were 4 mm x 80 mm and 4 mm x 200 mm self-expandable stents). The patient had pain and numbness of the left foot. Physical examination revealed no pulse in the left dorsalis pedis artery and the posterior tibial artery, and poikilothermia of the left foot. Catheter-directed thrombolysis of the thrombosed anterior tibial artery could not be performed because the patient refused the procedure. Exploration of the left dorsalis pedis artery and posterior tibial artery at the ankle level revealed long total occlusion and severe calcification of both vessels. However, the left posterior tibial vein at the ankle level was patent and had a diameter of 3 mm. Therefore, the authors

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performed a bypass from the left distal superficial femoral artery to the left posterior tibial vein. The authors used a composite graft comprising a PTFE ring graft of 7 mm x 70 cm and 10 to 15 cm of contralateral great saphenous vein from the right thigh as a long tube conduit due to the lack of an adequately long vein graft. The ipsilateral greater saphenous vein was preserved for distal runoff for the bypass. Eradication of the posterior tibial vein valve distal to the anastomosis was performed using a vascular dilator via longitudinal venotomy incision, after which distal anastomosis was performed between the venous end of the composite graft and the longitudinal venotomy incision of the posterior tibial vein in an end-to-side fashion. Upon completion of the distal anastomosis, intraoperative angiography was performed to ensure that the bypass circulation was adequate for distal tissue perfusion. After the operation, a continuous thrill was palpable in the natural vein graft and the distal vein below the paramalleolar area. Doppler ultrasonography of the left ankle changed from a monophasic waveform to a biphasic waveform with diastolic velocity. Postoperatively, aspirin and systemic heparinization were continuously administered.

During the early postoperative period, the entire left leg swelled to the same degree as in DVA bypass for critical limb ischemia, and the area of gangrene in the left foot extended from the toes to the forefoot. Transcutaneous oxygen manometry of the left foot 10 days postoperatively revealed a pressure of 53 mmHg. Transmetatarsal amputation was performed when the line of demarcation was clear. The blood supply to the foot at the transmetatarsal amputation stump was good (Figure 2). The primary graft patency was 35 days. The patient then developed pain of the left foot. Physical examination revealed poikilothermia of the left foot, no pulse along the bypass graft, and no palpable thrill at the

Figure 1. Preoperative magnetic resonance angiogram (A). Postoperative computed tomography angiogram (B). The direction of blood supply is from bypass graft to posterior tibial vein, and the left anterior tibial artery had thrombosed stent.

Figure 2. Sequences of left foot gangrene treatment. The level of forefoot gangrene at 1 week after pedal bypass with deep venous arterialization (A). The gangrene extended to nearly midfoot level by 1 month after bypass (B). Improved blood supply at forefoot stump (C). Images of the healing process at the forefoot stump after transmetatarsal amputation (D, E, and F).

distal vein below the left ankle. Open thrombectomy of the bypass graft with focal intraoperative thrombolysis was performed. Intraoperative angiography demonstrated short-segment stenosis at the posterior tibial vein. After balloon angioplasty of the posterior tibial vein, intraoperative angiography showed good bypass circulation (Figure 3). The secondary graft patency was 6 months. Although the bypass graft thrombosed, the patient had no clinical signs of acute limb ischemia, and the open transmetatarsal amputation wound bed filled with granulation tissue. With appropriate wound care, second-intention healing of the open transmetatarsal amputation wound bed was complete in 11 months. The patient was able to walk again in 12 months. Transcutaneous oxygen manometry of the left foot 2 years postoperatively revealed a pressure of 40 mmHg. The patient was found to be clinically well at the 3-year follow-up.

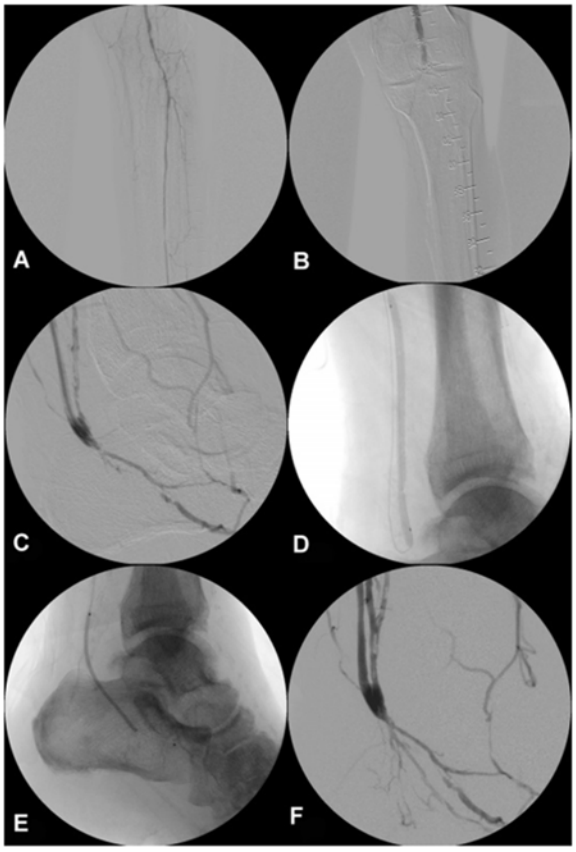

Figure 3. Summaries of angiograms. Angiogram after angioplasty of anterior tibial artery (A). Thrombosis of anterior tibial artery after deployment of stent (B). Intraoperative angiogram at distal anastomosis of venous arterialization bypass after thrombectomy of bypass graft demonstrated stenosis of posterior tibial vein (C). Angioplasty of posterior tibial vein (D and E). Angiogram after angioplasty of posterior tibial vein (F).

Discussion

In addition to the use of DVA bypass as an alternative treatment for critical limb ischemia with nonreconstructable distal arteries, this case report describes the successful use of DVA bypass in a patient with acute limb ischemia. This patient had previously lost his right leg secondary to peripheral arterial occlusion. A review by Taylor, et al[11] reported that bilateral amputation and an age of ≥60 years were both significant risk factors for postamputation ambulatory failure and postoperative death. Moreover, Inderbitzi, et al[12] reported the average survival time to be only 2 years in diabetic patients who had undergone bilateral amputation. The operative findings in the present case revealed the dorsalis pedis artery and the posterior tibial artery at the ankle level to be calcified and diffusely occluded, making pedal arterial bypass as an unsuitable procedure. In emergency cases of limb loss, DVA bypass can be performed as an alternative revascularization treatment. During the postoperative period, the circulation from the DVA bypass to the disease-free venous bed of the foot provided a blood supply that relieved our patient's acute ischemic limb symptoms and promoted wound healing.

Review of the literature revealed that all published studies in DVA bypass in critical limb ischemic patients used any appropriate arterial inflow from the ipsilateral leg. Outflows to disease-free venous system of the ischemic foot can be categorized as direct anastomosis to deep vein[3-5], indirect perfusion from in situ great saphenous vein conduit to dorsal superficial venous arch[6], or both by adding an anastomosis between a large tributary of the great saphenous vein to deep vein[7,8,12]. The endovascular intervention uses the proximal posterior tibial vein as outflow of DVA revascularization[9-12]. The 1-year primary patency of DVA bypass ranges from 59 to 71%[3-12]. A 2006 review by Lu XW, et al reported a secondary patency of DVA bypass rate of 46%[9]. The 1-year limb salvage rate after DVA bypass ranges from 53 to 73%[3-12].

Primary graft patency in the present case was 35 days, which is identical to the duration reported by Schreve, et al[6] who also found a 15% rate of early DVA bypass occlusion. The endovascular intervention was an important procedure to prolong the patency of the bypass graft. The post-thrombectomy angiogram revealed stenosis of the posterior tibial vein near the anastomosis site. The circulation of the distal runoff improved after balloon angioplasty of the posterior tibial vein both proximal and distal to the anastomosis site.

Another issue is the relationship between clinical signs of limb ischemia and the duration of bypass patency. After the 6-month period of secondary graft patency, the patient had no clinical signs of limb ischemia, and the open transmetatarsal amputation wound bed still contained healthy granulation tissue. Similarly, Mutirangura, et al[3] reported a 76.02% rate of stable limb salvage at 6 months; however, the

primary graft patency rate decreased to 49.17% at 24 months. Alexandrescu, et al[4] reported a 73% rate of stable limb salvage at 1 year. The 6-month patency of the DVA bypass in this case might suggest that the developed collateral circulation was able to adequately perfuse the distal tissue.

Conclusion

Pedal bypass with DVA in our patient with acute limb ischemia caused by calf vessel thrombosis had low patency. However, this procedure combined with an endovascular intervention to achieve prolonged patency was shown to be an alternative revascularization treatment for limb salvage in patients with acute limb ischemia and an unreconstructable distal artery.

What is already known on this topic?

DVA bypass is the new concept of bypass to disease free distal vascular bed. The DVA bypass is well known as the last option for the unreconstructable distal arteries of critical limb ischemia patient.

What this study adds?

The article presents three information about DVA bypass. The first issue is the confirmation that DVA bypass may be an effective (of) revascularization procedure with long term limb salvage for all types of ischemic limb, not only in critical limb ischemia patients. Second is that the endovascular intervention of distal venous vascular bed may improve the secondary patency of DVA bypass. Finally, the duration of 6-month patency of the DVA bypass may suggest that the developed collateral circulation was able to adequately perfuse the distal tissue.

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Potential conflicts of interest

The authors declare no conflicts of interest.

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ความสำเร็จในการผ่าตัดรักษา pedal bypass with deep venous arterialization ในผู้ป่วยที่มีภาวะขาขาดเลือดแบบเฉียบพลัน

สุธีคณิต หัถพรสวรรค์, ณัฐวุฒ พ่วงพันธุ์งาม, ทศพล ประภัสโร, เกียรติศักดิ์ หงคู, คามิน ชินศักดิ์ชัย, ชุมพล ว่องวานิช, เฉนียน เรืองเศรษฐกิจ, ประมุข มุทิรางกูร

ภูมิหลัง: การผ่าตัดรักษา pedal bypass with deep venous arterialization เป็นที่ยอมรับในปัจจุบันว่าเป็นวิธีการรักษาที่มีประสิทธิภาพในการรักษาผู้ป่วยที่มีภาวะขาขาดเลือดแบบเรื้อรังที่ไม่สามารถรักษาโดยการผ่าตัด pedal arterial bypass ได้ เนื่องจากมีพยาธิสภาพของหลอดเลือดแดงที่เท้าที่ไม่เหมาะสมในการผ่าตัด

รายงานผู้ป่วย: รายงานผู้ป่วยชายไทย 1 ราย อายุ 67 ปี มีภาวะขาดเลือดเฉียบพลัน เกิดขึ้นหลังจากได้รับการรักษา ด้วยการขยายหลอดเลือดที่เท้าเพื่อรักษาภาวะเนื้อตายที่นิ้วเท้าจากภาวะขาขาดเลือดแบบเรื้อรัง จากการตรวจทางรังสีพบว่าเส้นเลือดแดงที่เท้าของผู้ป่วยไม่เหมาะสมในการทำผ่าตัด pedal arterial bypass แต่มีเส้นเลือดดำที่เหมาะสมในการผ่าตัด ผู้ป่วยรายนี้ได้รับการผ่าตัด pedal bypass with deep venous arterialization หลังผ่าตัดพบว่า primary patency ของ bypass เท่ากับ 35 วัน และ secondary patency ของ bypass เท่ากับ 6 เดือน แผลที่เท้าของผู้ป่วยหายเองและสามารถเดินได้อีกครั้งในเวลา 11 เดือน และไม่พบอาการขาขาดเลือดอีกในช่วงเวลา 3 ปีหลังจากผ่าตัด

สรุป: รายงานผู้ป่วยรายนี้เป็นข้อมูลสนับสนุนถึงการผ่าตัด pedal bypass with deep venous arterialization เป็นวิธีการผ่าตัดเพิ่มเลือดสำหรับภาวะขาขาดเลือดที่มีประสิทธิภาพทั้งในภาวะขาขาดเลือดเรื้อรังและขาขาดเลือดเฉียบพลันในผู้ป่วยที่มีพยาธิสภาพของหลอดเลือดแดงที่เท้าที่ไม่เหมาะสมในการผ่าตัด pedal arterial bypass