

Deep Vein Arterialization Case: Critical Limb Ischemia Diabetic Foot Ulcer Healed with Novel Skin Graft

M.Laiq Raja M.D.^{1,1}, Adrienne Valles^{2,2}, Laura Labrado RN
Oscar Hernandez², Alyssa Ponce^{2,2}, Luis Fuentes, Adriana C. Mares².

1: El Paso Cardiology Associates, El Paso TX
2: The Institute of Cardiology at El Paso, El Paso TX

INTRODUCTION

Deep venous arterialization(DVA) is a technique that involves generating an anastomosis between the arterial and venous system to create an “arterialization” of the veins in order to provide sufficient blood flow and reduce rest pain as well as heal a wound.¹ There has been numerous reported data that supports DVA for limb salvage and have shown to improve vascularization in skeletal muscles after DVA, reduce ischemic lesions and improve distal perfusions.^{2,3,4} This procedure has been used as an option for Chronic Limb Ischemic patients with no options except amputations. DVA can be done in three distinct ways, open, hybrid and percutaneous. For the purposes of this case, the latter is further described. The percutaneous approach involves creating a connection between a proximal arterial inflow and a distal venous outflow in conjunction with disruption of the vein valves in the foot.⁵

Critical limb ischemia is a serious chronic disease stemming from peripheral arterial occlusive disease. It occurs after chronic lack of blood supply and is considered the “end stage” of peripheral arterial disease.⁶ It is characterized by at-rest pain, lesions, and gangrene to the affected extremities. Risk factors include older age, smoking and diabetes. The disease is also known to elevate the risk of myocardial infarction, stroke and vascular death.⁷ If left untreated critical limb ischemia can lead to tissue death, amputation, and poor quality of life.

PURPOSE

The rising number of diabetics has increased the demand for more advanced endovascular procedures and wound care modalities. Successful revascularization is the first step to optimal wound healing but unfortunately not always proving sufficient. Patients with multiple comorbidities and end-stage renal diseases often have restricted blood flow below the ankle to the arteries directly supplying blood to each individual ulcer for healing. When no blood flow is supplied to the distal foot and there are no target vessels to perform bypass or endovascular surgery, it is known as a desert foot. This case study exhibits the innovative DVA procedure in a fifty-seven-year-old male with diabetes, end-stage renal disease, and a necrotizing foot ulcer.

FIGURES

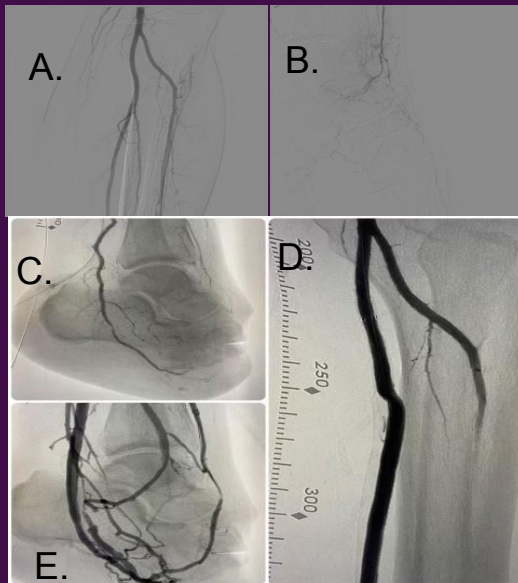


Figure 1: (A-C) Pre-angiography (D) pDVA flow into TPT (E) Completion angiogram of pDVA at the foot level, exhibiting arterialized blood flow into the plantar (pedal) veins.

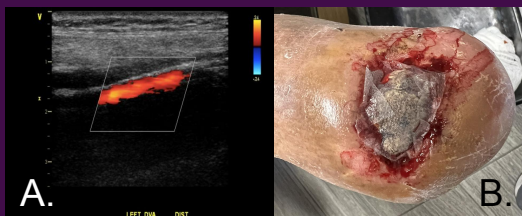


Figure 2: (A) Post-discharge duplex ultrasound (B) Amniotic membrane application to the ulcer with sufficient blood supply to the wound bed.

METHODS

IVUS of the left SFA, popliteal artery, TP trunk and posterior tibial vein. Subsequently, patient also underwent a re-entry to the posterior tibial vein with subsequent PTA to the left tibioperoneal trunk of the arterial system and PTA of the posterior tibial vein going all the way to the plantar vein and pedal venous, pedal loop PTA. PTA to the pedal loop and anterior tibial vein utilizing a Wolverine cutting balloon and followed by PTA using multiple balloons. The first was 2.0 then 3.0 followed by 4.0x 80 and at the end PTA the entire posterior tibial vein going into the TP trunk a 5.0 x 200 balloon. Next placement of a covered stent originating from the posterior tibial vein at the plantar area going all the way into the TP trunk 5.0 x 250 and 150 followed by post-dilatation. (Figure 1: A-E).

RESULTS

DVA was successful and supplied blood flow below the ankle into the pedal loop and the foot ulcer. The standard of care included sharp debridement with adequate blood flow and oxygen delivery to the tissue. Advanced modalities were introduced to aid the healing cascade. The patient's own healthy skin was harvested to create a skin graft promoting new granulation and healing. (Figure 2: A-B).

CONCLUSION

Limb preservation was possible with the DVA technique in endovascular intervention. With the use of MedCU copper dressings the ulcer maintained an infection free environment and began showing signs of angiogenesis. Amniotic membrane was applied to control inflammation and prepare the wound for a graft application. DermiStat is the novel skin matrix graft composed of the patient's own skin cells. This autologous skin graft will remain in place for 21 days closing the wound.

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