Management of chronic critical lower limb ischemia with no distal run off

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Abstract

Despite advances in vascular and endovascular techniques, 14-20% of patients with chronic lower limb ischemia are not suitable for distal arterial reconstruction due to occlusion of crural and pedal arteries. The aim of this study was to evaluate the outcome of distal venous arterialization (DVA) in treatment of those patients in whom major amputations were decided. This study was conducted in Tanta University Hospital; in the period from April], 2008 to March 31, 2010 on 27 patients with chronic critical/ower limb ischemia with no distal run off. Arteriogram and coloured Duplex were mandatory investigations. Great saphenous vein (GSV) was anastomosed to the superficial femoral artery in 15 patients (55.5%), to the popliteal artery in 9 patients (33.3%) and to the common femoral artery in three patients (11.1%). All DVA procedures were peiformed in situ with destruction of the valves of the GSV using Mills valvulotome. After the first year, limb salvage was achieved in 17 patients (65.4%) with healing of wounds, marked improvement of the rest pain and increased pain free walking distance. Nine patients (346%) ended with major amputation. As a conclusion, DVA could be considered as a promising method in treatment of chronic critically ischemic limb with no distal run off before jumping to major amputation.

Key words: Distal venous arterialization, critical ischemia, non reconstructable lower limb ischemia.

Introduction:

Despite advances in vascular and endovascular techniques, 14-20 % of patients with chronic lower limb ischemia will not be suitable for distal arterial reconstruction due to occlusion of crural and pedal vessels. ▮ Major amputation is linked with substantial morbidity and mortality, with a particularly high prevalence of comorbid diseases.2 About half of patients who undergo above-knee amputation will die within one year after the procedure, and a high percentage of patients are considered unfit for prosthetic rehabilitation. After two years, only 40% of those fitted with prosthesis are mobile, and even fewer are independent outside the home. Because of this generally poor outcome, there is a strong need for attempting any procedure to save the affected limb.3

There are multiple treatment options for patients with chronic critical limb ischemia showing poor distal run off in their arteriogram, prostaglandin infusion or spinal cord stimulation, but with limited clinical effectiveness and applicability.4 Lumbar sympathectomy continues to be a thoroughly viable option as an indirect attempt for vasodilatation. It is known that there are precise prerequisites restricting its indication, such as mainly distal involvement, the existence of arterial obstruction with no distal run off but with adequate collateral circulation, and finally presence of severe ischemic pain.5 Injection ofbone marrow mononuclear cells (BMMNCs) in the calf muscles of patients with non-reconstructable lower limb ischemia can relieve ischemic symptoms.6

Another possible option to relieve critical lower limb ischemia is venous arterialization of the lower leg that uses the venous bed as an alternative conduit for perfusion of the peripheral tissues with arterial blood. Distal venous arterialization is an old procedure but started to be on the surface again in the recent

research trials as an alternative option.4,7

Limb salvage by distal venous arterialization is achieved by multiple mechanisms. Reversal of flow through the capillaries improves tissue nutrition.[8] Increase collateral vessel formation by arterialized venules. Direct stimulation of angiogenesis is considered as the main explanation of the long term perfusion.4 Expression of Tenascin-C (TN-C), which is an extracellular protein in the arterialized vein, increases vascular growth factors causing angiogenesis.9

The aim of this study was to evaluate the outcome of distal venous arterialization in treatment of patients with chronic critical lower limb ischemia with no distal run off who could not be treated by any conventional therapeutic procedure and required major amputation.

Patients and methods:

This study was conducted in Tanta University Hospitals, Surgery Department, Vascular Surgery Unit in the period from April 1, 2008 to March 31,2010. All patients with chronic critical lower limb ischemia with no distal run off and Duplex showed patent great saphenous vein (GSV; 2.5 mm or more in diam.) were included in this study. Patients with acute ischemia or nonsuitable GSV (sclerosed or small diameter< 2.5mm) were excluded from this study. Informed consent after detailed explanation from each patient was taken. Conventional arteriography was done for every patient and all staff members of the vascular unit agreed that there was no distal run off **Figure(l).** No solution by conventional therapy and major amputation was the decision. Ankle brachial pressure index was measured for each patient.

Figure (1): Preoperative arteriogram with no distal runoff.

Operative technique:

The initial step was to expose the GSV medial to the medial malleolus by longitudinal incision about 5 em. According to angiogram the lowermost patent part of the femoral or popliteal artery was exposed. The upper part of the GSV was exposed through the same incision for the artery. The proximal part of the great saphenous vein was anastomosed end to side to the nearby patent artery **Figure(2).** The valves of the great saphenous vein were destroyed using Mills valvulotome, which was introduced through a side tributary of great saphenous vein just above the ankle **Figure(3).** Distally, a Fogarty catheter (3F) was passed to the dorsal venous arch to destruct its valves and ensure adequate patency and caliber.

All patients were followed up for improvement of pain, ulcer healing and development of oedema postoperatively. Duplex was used in follow up for the patency of the arterialized venous system. Postoperative arteriogram was done in 7 cases **Figure(4).**

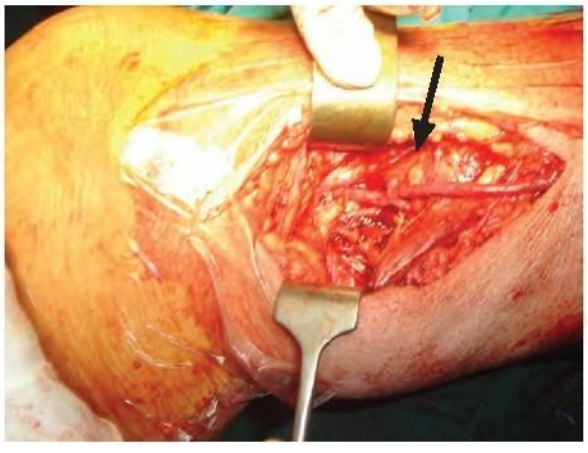

Figure (2): GSV anastomosed to the popliteal artery below knee.

Figure (3): Pulsatile flow from the side branch after withdrawal of the valvulotome.

Figure (4): Postoperative arteriogram with venous arterialization.

Results:

During the period of study, 27 patients with chronic critical lower limb ischemia were included. They had different co-morbid conditions Table(l).They had different clinical presentations Figure(S), Table(l). The mean age of the patients was 64.6 ± 5 years, 15 were males and 12 were females. Ankle brachial pressure index pre-operatively ranged from 0 to 0.35. Epidural anaethesia was used to 22 patients (81.4%), spinal anaethesia to three (11.1%) and general anaethesia to two (7.4%).

The inflow arteJ.y was the superficial femoral artery in 15 patients (55.5%), the popliteal artery in 9 patients (33.3%) and the common femoral artery in three patients (11.1%). All the patients had a palpable thrill over the great saphenous vein and dorsal venous arch at the end of the procedure. Patients were followed up for a mean of 15 months (range 5- 23). All patients who underwent DVA developed postoperative oedema. It was self limited oedema which disappeared after the 2nd or 3rd week completely.

There was marked improvement in rest pain, temperature of the limb, healing of the ulcer and wound after debridement or toe amputation Figure(6). The total number of saved limbs without major amputation after the:first year was 17 (65.4%).Major amputation was done for nine patients (34.6%) during the :first year, 6 of them were done during the first two months due to early thrombosis of GSV. The remaining three major amputations were performed after 6, 8 and 11 months postoperatively due extensive infection, and persistent rest pain. Minor local procedures (toe amputation or debridement) were required in 11 patients.

Table (1): The co-morbid conditions encountered in our patients.

Disease	Number	%
Diabetes mellitus	12	44.4
Hypertension	10	37
Ischemic heart disease	9	33.3
Chronic chest disease	3	11.1
Liver disease	2	7.4
Cerebrovascular disease	5	18.5

Table (2): Clinical presentlltion 1111d grtule of ischemia according to Fontflin classification.

Grade and ischaemia form	Number	%
(III) Rest pain	12	44.4%
(IV) Toe gangrene	7	25.9%
(IV) Forefoot gangrene	5	18.5%
(IV) Ischemic ulcer	3	11.1%

Figure (5): Preoperative gangrene ofbigtoe.

Figure (6): Postoperative complete healing.

Discussion:

Amputation of an extremity not only worsens the quality of life of a patient but is also associated with high postoperative mortality)O Therefore, a trial was done in the present study to assess the outcome of distal venous arterialization in trea1ment of patients with chronic critical lower limb ischemia with no distal run off as an alternative procedure when revascularization with the conventional methods could not be done and major amputation was required.

Distal venous arterialization for limb salvage in patients with non reconstructable critical limb ischemia was first published by Halstead and Vm1ghan.lO Unfortunately,technical failure associated with persistent distal venous valve function after creation of proximal arteriovenous fistulas in the groin made the operation unpopular.tt Similarly, distal anastomosis of the great saphenous vein to the dorsal venous arch resulted in failure if venous valves were left intact.12

Subsequent destruction of venous valves and distal graft anastomosis resulted in a 50o/o-80% success rate.l3 In the largest of the

relevant published series, Pokrovskii et ai.14 used mechanical valve destruction without direct visualization.

Ozbek et al.l5 used a novel approach for this purpose by performing ascending venous arterialization using reversed great saphenous vein graft between the nearest suitable inflow artery to be anastomosed distally to the great saphenous vein at the level of the medial malleolus. A meta-analysis done by Lu et al.4 included 56 studies about the distal venous arterialization for limb salvage in non-reconstructable lower limb ischemia from different vascular centers all over the world. He found that the overall 1-year foot preservation was 71% with successful wound healing and disappearance of claudication and rest pain. Another recent study done by Gavrilenko and Skrylev16 analyzed the long-term results of venous blood flow arterializations of the leg and foot, performed in 67 patients with critical lower limb ischemia. They found that major amputation of the involved limbs was avoided in 64% of cases and ensured the high level of physical and social adaptation of the patient for 3 years after the procedure. The results of our study are in agreement with most of the recent mentioned studies as it saves the limbs from major amputation in 65.4% in the ftrst postoperative year.

In the present study, postoperative oedema was reported in all patients and was self-limited and disappeared within 2-3 weeks. Similary, Lu et al.4 reported that postoperative oedema was a common complication in nearly all patients, but this generally disappeared after 5-30 days and persisted in a few patients only. In one study, one patient suffered from cardiac insufficiency and the sapheno-femoral shunt had to be ligated and the affected limb was amputated.l7 This may be explained by high shunting and heart failure due to more proximal anastomosis. In the study of Pokrovsky et aJ.14 four patients with Buerger's disease suffered from venous gangrene and the affected limb had to be amputated.18 This may be due to damaged venous system as a result of migrating thrombophlebitis.

Destruction of the valves has been described by different techniques. Pokrovskii et ai.14 described direct valvulectomy at the site of the distal anastomosis in the opened venous arch and passage of metallic olives into the distal part of the arch to destroy the valves. Taylor et al.l9 suggested destroying the valves by retrograde balloon disruption and passage of so called 'Parronnet' probes. When difficulties arise with the retrograde passage of a Fogarty catheter, Rowe et al.ls Found that the passage of a guide wire (0.018 or 0.035mm) was helpful. In our study we used passage of Fogarty catheter (3 F) in the dorsal venous arch distal to the site of entry of valvulotome with marked success.

It is reported that the highly pulsatile pressure generated by means of primary or staged venous arterialization can destroy distal venous valves and improve perfusion of critically ischemic tissues.20 This aspect is supported by a recent article,15 but whether or not highly pulsatile pressure can destroy distal venous valves remains controversial.

Although the international literature shows an increase in publications using this method, the absence of Egyptian studies on the arterialization of the venous arch of the foot shows that surgery is not practiced by Egyptian surgeons. In conclusion to this study, DVA could be considered as a promising method in treatment of chronic critically ischemic limb with no distal run off before jumping to amputation. Further clinical trials of this technique are necessary to convince the vascular specialist of its benefits.

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