Multiple Atherectomy and Patch Plasty in Diffuse Atherosclerotic Peripheral Vascular Disease: Our Experience

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Abstract

Background: Peripheral vascular disease of lower limbs is a debilitating condition with a significant proportion of patients having diffuse, long segment atherosclerosis. This study emphasizes the role of surgery in this group of patients.

Materials and Methods: Eighty patients (95 legs) met the inclusion criteria for this study and were followed prospectively. Patients with Rutherford Class IV–VI were taken. Operative findings (type of operation, number of patches, total length of patches, etc.) were recorded. Subsequently, in postoperative period, they were evaluated for improvement in clinical (Rutherford) class, appearance of distal pulsations, ulcer healing, primary patency rates, freedom from amputation, and associated complications at 1, 3, 6, 12, 18, and 24 months.

Results: Sustained clinical treatment efficacy according to Rutherford was 82% at 12 months and 59% at 24 months. Amputation-free survival rate was 86% at 12 months and 74% at 24 months. Until 24 months, 17 legs were amputated (18%) and 10 (10.5%) target limbs were revascularized through femoral embolectomy. At 2 years, cumulative femoral artery patency was 88%, whereas cumulative popliteal artery patency was 71%.

Conclusion: The present series evaluated patients with the most advanced form of critical leg ischemia with a high rate of leg salvage with this procedure. Multiple atherectomy with patch plasty does offers hope to such patients and can become part of armamentarium of a vascular surgeon.

Key Words: Critical leg ischemia, patch plasty, peripheral vascular disease

Introduction

Atherosclerotic disease is generally diffuse in nature. There is considerable overlap between cerebral, coronary, and peripheral atherosclerotic disease.¹,² Up to 40% of patients of coronary artery disease may have peripheral vascular disease.³ Atherosclerosis of peripheral arterial system contributes to significant morbidity and mortality in our patients. Total disease prevalence based on objective testing varies from 3% to 10%, increasing from 15% to 20% in persons over 70 years.⁴,⁵ Patients with ankle brachial pressure index <0.4 are said to have critically ischemic limb (CLI).⁶ Some have defined CLI as when there is intolerable rest pain for more than 2 weeks or ankle pressure <50 mm Hg.⁷ Observational studies of patients with CLI, who are not candidates for revascularization suggest that a year after the onset of CLI, only about half the patients will be alive without a major amputation although some of these may still have rest pain, gangrene, or ulcers.⁸ Their prognosis is in many ways similar to that of some malignancies. The diagnosis of CLI thus predicts a poor prognosis for life and limb. These patients require aggressive management for improving quality of life and limb salvage. In advanced cases of CLI, there may be extensive atherosclerosis in single region (e.g., involving whole of femoral artery) or multiple regions (e.g., iliac, femoral, and popliteal) of blood vessels. These cases are usually labeled inoperable and dealt medically. However, these patients have persisting rest pain, chronic nonhealing ulcers, and/or progressive gangrene of digits with very poor quality of life.

In 1947, Dos Santos first reported his experience with thromboendarterectomy of a major artery. The success of this operation depends upon the fact that a line of cleavage is present between the viable portion of the
blood vessel wall and the atheromatous plaque with the thrombus. Arnulf used the term “sequestrum” to denote this obstructing material. After securing adequate control of the component arteries, the main vessel can be opened, the obstruction removed, and the artery sutured. Role of endarterectomy at single site (profundoplasty) has been well-described in literature. However, role of multiple endarterectomies is still unclear. We here shall evaluate the role of multiple atherectomies with patch plasty as a new approach in treating this subgroup of patients. The result of over 12 months follow-up has been described.

Materials and Methods

Eighty patients (95 legs) were operated between August 2009 and December 2014 at S.M.S. Medical College, Jaipur, Rajasthan, met the inclusion criteria (mentioned below) for this study and were followed prospectively. All patients were thoroughly examined preoperatively, and vessels were assessed with computed tomography (CT) angiography. Eleven patients had bilateral aortoiliac-femoral disease, and four patients had bilateral femoropopliteal disease.

Inclusion criteria

- Symptoms of limb ischemia for more than 2 weeks
- Patients only in Rutherford classification IV, V, or VI
- No distal pulsations (dorsalis pedis and posttibial artery)
- Only advanced atherosclerotic lesions as seen in CT angiography - The TransAtlantic Inter-Society Consensus (TASC) lesions D.

Exclusion criteria

- The patient with only aortoiliac disease as they could be treated more easily by bypass grafting
- Lesions that could be easily bypassed or stented (TASC A, B, D)
- Intermittent claudication.

All patients were evaluated for their cardiac status with two-dimensional echocardiography. Coronary angiography was done with patient’s age >45 years. Five patients with significant coronary block (>70%) were treated by coronary artery bypass surgery first with a successful outcome.

Preoperative status of patients was recorded. Ankle brachial pressure index was not used as index for evaluation as most patients had completely occluded, calcified dorsalis pedis artery or posterior tibial artery which frequently gave erroneously high values. Operative findings were also recorded as per combined length of incisions in the skin, number of arteriotomies done or number of patches applied, length of atheroma removed, combined length of patches, and preoperative level of appearance of pulse.

All patients were individualized for the treatment they received. In 42 patients of aortoiliac disease, abdomen was opened from midline. Infra renal aorta was clamped, aortotomy done, plaque removed, and good flow reensured. Aortotomy was closed with polytetrafluoroethylene (PTFE) patch or graft. In 19 legs, multiple atherectomies with patch plasty was done of external iliac artery. For clearing of femoral artery, multiple incisions were usually required. For atherectomy of common femoral and upper part of superficial femoral artery (SFA), an infragenual incision of length 5–8 cm was used. For middle part of SFA, mid-thigh incision and for lower SFA, lower medial thigh oblique incision was used. At the site of hardening of artery, artery was opened. Adventitia of artery was preserved to maintain strength of wall. With fine mosquito forceps, plane between wall and plaque was made and plaque extracted. Combination of fogarty catheter, plaque extraction catheter, and Hegar’s dilator was used to disect plaque lower down and upward. Patency of vessel was checked by passage of fogarty catheter. PTFE patch was cut from PTFE sheet as per size required. Patch was sutured with wall with PTFE sutures. Popliteal artery was usually exposed in prone position after doing atherectomy of femoral artery. Popliteal fossa was opened, adhesions due to periarteritis removed as much less as possible. However, in patients, whose abdomen was opened, popliteal fossa was explored through medial incision in supine position only. In five patients, we applied patch in posttibial artery also. Subsequently, in postoperative period, all were evaluated for appearance of distal pulsations, primary patency, warmness of foot, symptom relief, wound infection, healing of ulcer, and complications.

Major amputation was defined as an amputation above the ankle. Sustained clinical treatment efficacy was defined as an upward shift of one or more on the Rutherford scale without repeat target limb revascularization (TLR) or amputation. Mortality, need of amputation, or repeat TLR were solitary study endpoints. About 14 patients presented in follow-up with nonpalpable popliteal artery pulsations, which were present before discharge. Out of them, 10 patients experienced deterioration of symptoms, and femoral embolectomy was offered to them. Amputation-free survival (AFS) was defined as the period from the date of surgery to the date of the first major amputation of the leg. Evaluation of each patient was done and recorded just before discharge, at 1, 3, 6, 12, 18, and 24 months, respectively.

Kaplan–Meier survival analysis was used to estimate the rates of cumulative freedom from surgical reintervention (AFS rates), sustained clinical treatment efficacy, and primary patency rates of femoral and popliteal arteries.

Results

Three patients (4%) died in the postoperative period, reducing the number of patients available for follow-up to 77.
**Preoperative findings**
Age, sex, cardiovascular risk factors, renal insufficiency (serum creatinine >140 mg/ml), clinical presentation according to Rutherford’s classification, level of palpable pulse, and lesion morphology as seen on CT angiography are tabulated in Table 2. In only 30% legs pulses were palpable.

**Postoperative findings**
There was single mortality within 30 days in the Rutherford Class IV group, one in the Rutherford Class V, and one in Rutherford Class VI. About one patient died of acute myocardial infarction and two died of septicemia with multiple organ dysfunction syndrome. Perioperative complications are seen in Table 3.

**Follow-up results**
Sustained clinical treatment efficacy according to Rutherford was 82% at 12 months and 59% at 24 months. AFS rate was 86% at 12 months and 74% at 24 months. Healing of ischemic lesions was seen in 70% of the legs. Until 24 months, 17 legs were amputated (18%) and 10 (10.5%) target limbs were revascularized through femoral embolectomy. There were 3 (4%) mortalities in perioperative period. Cumulative femoral artery patency was 97% at 1 year and 88% at 2 years.

Popliteal artery could be made patent in 66 legs (69%) only. Out of them, 14 patients presented with reocclusion of popliteal artery, four patients who maintained their improved clinical class were left as such. Rest 10 (10.5%) patients showed clinical deterioration and femoral embolectomy (TLR) was done. After embolectomy, five patients reported improvement in their symptoms but rest five did not as they developed reocclusion after some time. Two out of five needed to be amputated, whereas three continued in follow-up without more deterioration. Overall cumulative primary popliteal artery patency was 84% at 1 year declining to 71% by 2 years in those where vessel could be made patent at initial operation [Figure 3].

**Discussion**
Revascularization to reestablish continuous in-line flow to the pedal arch represents the preferred treatment for patients with limb-threatening ischemia. The investment of time and resources to restore CLI patients to their morbid state is immense. The unfortunate reality is that many patients with CLI will spend a significant portion of their remaining life tending to the needs of their ischemic limb. Despite the limited number of CLI patients who experience an ideal outcome, successful revascularization leads to a sense of improved quality of life.

Since the introduction of distal surgical revascularization, surgical patch plasty is not commonly performed anymore. There is little literature and no science to provide clear recommendations for atherectomy and PTFE patch plasty. Indeed, The TASC has nothing much to say on the subject. Does it have any role at all in vascular surgery, or should it simply become part of medical history? The aim of our study was to clarify the outcome following multiple atherectomy and PTFE patch plasty in modern practice.

In this study, the outcome following multiple atherectomy and PTFE patch plasty for CLI was successfully measured...

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**Figure 1:** Patch plasty over common femoral artery

**Figure 2:** Patch plasty over superficial femoral artery (in adductor canal)

**Figure 3:** Kaplan–Meier analysis of outcome follows operation over 24 months
in terms of sustained clinical efficacy, primary vessel patency, and AFS. The AFS in this study was 86% at 1 year and 74% at 2 years. Söderström et al. in his study of infrainguinal bypass for Fontaine Class IV patients reported AFS of 55% at 1 year, 40% at 3 years, and 30% at 5 years. Savolainen et al. performed profundoplasty in 106 legs for claudication or CLI. He found AFS of 84% at 3 years.

Therefore, AFS rate of multiple patch plasty is comparable to other methods.

This study revealed that several comorbidities of patients with CLI are risk factors for decreased AFS. Univariate analysis revealed that advanced age (≥70 years), development of gangrene in leg, aorto-ilio-femoro-popliteal lesion and no distal runoff as significant factors leading to amputation. However, only aorto-ilio-femoro-popliteal lesion was significantly associated with death.

Cumulative primary patency rate of femoral pulses was 97% at 1 year and 88% at 2 years of follow-up, while that of popliteal was 84% at 12 months which declined to 71% at 2 years. Overall TLR rate was 10.5% at 24 months. According to Söderström et al., primary graft patency rates for above knee bypass at 1, 3, and 5 years were 63%, 50%, and 49%, respectively. Pereira et al. found that for patients of CLI, primary patency rates at 1 year for above knee vein bypass was 83.4%, 84.3% for below knee vein bypass and 76.3% for above knee prosthetic. Thus, patency rate of patch plasty is comparable to other methods. Secondary patency rate in these patients has no meaning as usually this is the last option that can be exercised to save the limb.

Despite the poor long-term AFS, surgery may be justified in this high-risk patient population, since most of the patients have no other alternatives for immediate major amputation. The risk of limb loss within 1 year has been estimated to be as high as 95% in patients with tissue loss if treated conservatively. A successful intervention offers an opportunity to relieve suffering and preserve mobility. However, active revascularization policy is associated with a decrease in major amputation rates. It is naturally of paramount importance to pay attention to the management of systemic risk factors in this fragile patient population.

**Conclusion**

The present series evaluated patients with the most advanced form of critical leg ischemia. Multiple
atherectomy and patch plasty have resulted in high rate of leg salvage with comparable results to other methods. It appears to be promising in treating patients who were considered inoperable previously.

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**Conflicts of interest**

There are no conflicts of interest.

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