Semiclosed and Remote Endarterectomy of the Superficial Femoral Artery

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ABSTRACT

Objective: To evaluate the feasibility of semiclosed and remote endarterectomy for the treatment of occlusive superficial femoral artery disease.

Methods: During 2005 and 2006, 31 patients (aged 25-81) with critical lower limb ischemia and disabling claudication whom underwent endarterectomy of the superficial femoral artery using ring stripper in the vascular surgery department at Queen Alia hospital in Amman, were reviewed. Semiclosed endarterectomy technique was performed in 21 patients and remote endarterectomy in 10 patients. The procedure with its suspected outcome and complications was discussed with the patients including other treatment options. Written Ethical Approval was obtained from all the study patients.

Results: In 29 patients clinical success in the form of restoration of blood supply with limb salvage and alleviation of rest pain and disabling claudication was achieved which was the main goal. Clinical success rate was 94%. Two patients ended up with below knee amputation with a failure rate of 6%. One patient died postoperatively with a mortality rate of 3%. During the two years follow-up period, another three patients died, which was not related to surgery.

Conclusion: Semiclosed and remote endarterectomy using ring stripper is a useful technique in the treatment of occlusive arterial lesions of the superficial femoral artery and should be considered as one of the treatment options among selected cases.

Key words: Superficial femoral artery (SFA), semiclosed endarterectomy, remote endarterectomy, ring stripper.

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Introduction

The beginnings of femoral artery revascularization can be traced back to the early postwar years in 1947, in a paper by Joao Cid Dos Santos, who named the procedure “superficial femoral artery thromboendarterectomy.”(1) With gradual introduction of femoropopliteal bypassing by Kunlin in 1949, the bypass technique has gained predominance.(2) As early as 1967, Jorg Vollmar preferred semi-closed endarterectomy as a...
minimally invasive surgical procedure using a ring stripper. Also, mention should be made of the use of Dotter and Judkin’s coaxial catheter and Grünzig’s procedure of percutaneous transluminal angioplasty from 1974, as considerable advancements in the field of endovascular technique. Remote endarterectomy, a procedure introduced by Ho and Moll in 1995, is a minimally invasive procedure that is performed through a small inguinal incision, which allows complete debulking of the arterial plaque and placement of a distal stent, as indicated. Semiclosed and remote SFA endarterectomy is an operation which can be performed through two or a single incision sparing the long saphenous vein and avoiding the use of prosthetic material.

This study was conducted to evaluate the feasibility of semiclosed and remote endarterectomy for the treatment of occlusive superficial femoral artery disease.

**Methods**

Thirty-one patients underwent semiclosed and remote endarterectomy in the Vascular Surgery Department in Queen Alia Hospital during 2005 and 2006. The indications for operation were Critical Limb Ischemia (CLI) in the form of tissue loss in 10 patients, CLI in the form of rest pain in 8 patients and disabling claudication in 13 patients, (Table I).

Duplex ultrasound, conventional angiography or Computerized Tomographic Angiography (CTA) were the diagnostic tools to delineate the extension of the disease. At the beginning we started to perform this type of surgery in patients with tissue loss and unsuitable veins for bypass surgery. Later, patients with rest pain or disabling claudication were treated using this technique, selecting patients for this method was intraoperative, excluding those patients with diffuse atherosclerosis and in cases of acute ischemia we didn’t apply this method.

Under spinal or epidural anesthesia the Common Femoral Artery (CFA), Superficial Femoral Artery (SFA), Deep Femoral Artery (DFA) and Popliteal Artery were exposed through longitudinal inguinal and distal thigh incisions. The adductor canal was opened. After systemic heparinization two arteriotomies were made; a longitudinal arteriotomy at the origin of the SFA and another longitudinal or transverse arteriotomy at the Popliteal Artery at the distal end of the lesion (Semiclosed Endarterectomy). The cleavage plane between the plaque and the deep media/adventitia layer usually
became prominent after performing the arteriotomy. Patients with diffuse arteriosclerosis will not show this cleavage plane and they are not suitable for this technique. Endarterectomy was commenced in the standard cleavage plane between the inner and outer media. The intimal core was transversely cut at the SFA origin and threaded into the loop of a conventional Vollmar ring stripper (Fig. 1). Traction is applied at the intimal core and the ring stripper is advanced distally down the SFA beyond the occluded segment using rotation and thrusting motion for spiral dissection (Fig. 2). The atheromatous core along the entire column of plaque was removed, in 4 patients of those the plaque was removed retrograde through the popliteal arteriotomy. The length of the endarterectomized SFAs ranged from 16-32 cm (Fig. 3) and the endarterectomized segment was irrigated with heparinized saline followed by primary closure of the transverse arteriotomies and by using vein patches for closure of the longitudinal arteriotomies. Successful recanalization was confirmed using flowmeter, palpation of distal pulses and detection of distal Doppler signals.

In 9 patients, the SFA endarterectomy was performed through a single incision, then the procedure preceded as mentioned above, and distal incision was not needed, because distal end of the plaque was tapered indicated it was completely removed (remote endarterectomy). Regarding postoperative, result was evaluated as mentioned above. In 5 patients the lesion was limited to the upper 2/3 of the SFA. The endarterectomy was performed antegrade through the proximal arteriotomy at the origin of the SFA.

In 6 patients a longitudinal arteriotomy at the common femoral artery was made for CFA endarterectomy to provide adequate inflow. In one patient, SFA remote endarterectomy was performed in association with an Aortobifemoral bypass. During the postoperative period in the hospital (average 3-4 days), the patients received prophylactic low molecular weight heparin and 100mg aspirin. Aspirin treatment was continued after discharge. The patients were followed by regular visits to the clinic with an ankle brachial pressure index (ABPI) and Colour Flow Duplex.

**Results**

In 29 patients restoration of blood supply with limb salvage was achieved which was the main goal. Clinical success rate regarding limb salvage and alleviation of rest pain was 94%. Out of those 29 patients, toe amputation was required in 5 patients and forefoot amputation in another three after restoration of arterial blood supply making limb salvage possible with minor amputations.

Below knee amputation was performed in two patients during the postoperative period, one for 40 years old male patient who was having multilevel arterial occlusive disease including distal crural arteries, the second patient was an 81 year old male patient with extensive foot infection who died within the same hospitalization from sepsis. Failure rate was 6% and postoperative mortality was 3%.

Over the follow-up period of 2 years, one patient died 4 months after surgery and another patient died one year after surgery, both deaths were due to myocardial infarction. One patient died 18 months after surgery due to unrelated cause. This procedure was compared to surgical femoropopliteal bypass procedures and percutaneous stenting in our hospital over the same study period regarding the following end points: perioperative death, unrelated death, myocardial infarction (MI), limb loss and repeat procedures. (Table II).

**Discussion**

Atherosclerotic arterial disease of the lower extremities is a common event especially after the age of 55. The prevalence of intermittent claudication as one of its major manifestations varied widely in population studies.[2] The most

### Table II: Comparison of end results between endovascular stenting, surgical bypass and SFA endarterectomy

<table>
<thead>
<tr>
<th>End result</th>
<th>Percutaneous stenting</th>
<th>SFA endarterectomy</th>
<th>Surgical femoropopliteal bypass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perioperative death</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Unrelated death</td>
<td>7/113</td>
<td>1/31</td>
<td>5/88</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>9/113</td>
<td>2/31</td>
<td>7/88</td>
</tr>
<tr>
<td>Limb loss</td>
<td>11/113</td>
<td>2/31</td>
<td>7/88</td>
</tr>
<tr>
<td>Repeat procedures</td>
<td>14/113</td>
<td>0</td>
<td>2/88</td>
</tr>
</tbody>
</table>
commonly affected artery is the SFA. SFA is affected in 70% of all patients with intermittent claudication. The management of patients with SFA disease includes a wide array of different specialties such as angiology, interventional radiology and vascular surgery. Thromboendarterectomy was the procedure of choice for patients with peripheral vascular occlusive disease. With gradual introduction of femoropopliteal bypass, the bypass technique has gained predominance. The advent of and the development of prosthetic grafts led to a marked decline in the number of surgeons performing the thromboendarterectomy technique. In 1963, Jorg Vollmar introduced the semi-closed endarterectomy as a minimally invasive surgical procedure using a ring stripper. With the more recent development of endovascular stenting and atherectomy, endarterectomy as a primary procedure in the treatment of lower extremity ischemic disease has been indicated less frequently. The critical features that make endarterectomy feasible are the characteristic localization of atherosclerotic plaques to the intima and subjacent media of the diseased artery. The outer media and adventitia are spared by atherosclerosis; therefore, a cleavage plane can be developed between the diseased and nondiseased zones of the arterial wall. This cleavage plane is characterized by easy separation between the two zones. The inner thrombogenic layer is removed and the outer layer of the media (external elastic membrane) and adventitia are spared. The residual outer media and adventitia left after endarterectomy have sufficient tensile strength to support the vessel wall. The presence of aneurysmal disease is the major specific and absolute contraindication to endarterectomy for the management of occlusive arterial disease. Recently there has been a reappraisal of endarterectomy. Several reports have shown it to have long-term patency comparable to femoropopliteal bypass surgery. Endarterectomy has a better patency than angioplasty in long segmental occlusive lesions and proves to be more cost effective. Semiclosed and remote endarterectomy offers an autogenous revascularization technique that removes essentially all of the atherosclerotic material in the affected vessel. As opposed to atherectomy, which removes less amounts of the plaque, this technique removes virtually all the disease. As a result of the dilatation that vessels undergo in response to the initial stages of atherosclerotic occlusion (i.e. adaptation), the lumen after remote endarterectomy is generally in the range of 130% to 150% of the lumen size of the original vessel, providing for a large margin of safety and redundancy in the face of Rest-enosis. Moreover, endarterectomy spares the saphenous vein and avoids the use of synthetic material. In case of femoral artery reocclusion, it leaves the possibility to perform at a later time the bypass technique. Our own experience, despite the low number of cases and limited follow-up time, confirms that the procedure of ring stripper endarterectomy (semiclosed and remote endarterectomy) is an alternative procedure in revascularization of the obliterated SFA. A modification of the ring stripper is the Mollring cutter introduced by Ho and Moll in 1995 (Fig. 4). This device enables the surgeon to perform the endarterectomy through a small inguinal incision (remote endarterectomy RE) (Fig 2). This is a minimally invasive procedure which allows complete debulking and sharp cutting of the arterial plaque distally followed by endoluminal stent positioning at the distal intimal flap. The intimal core is transversely cut at the SFA origin and threaded into the loop of a conventional (Vollmar) ring stripper. The ring stripper is advanced distally down the SFA beyond the occluded segment, the location of which has been determined with intraoperative arteriography and “road mapping.” The ring stripper is exchanged for the Mollring Cutter device, which transsects the distal atheromatous core under fluoroscopic guidance. The entire core is removed, and arteriography is performed to confirm a patent distal artery. Our clinical success rate was comparable to the results obtained at Department of Vascular Surgery and Interventional Radiology, St. Antonius Hospital, Nieuwegein, Netherlands which achieved a 96% clinical success rate in 26 patients over 6 months. Conclusion Semiclosed and remote endarterectomy using ring stripper is a useful technique in the treatment of occlusive arterial lesions of the superficial femoral artery. In our department it has an outcome comparable to international centers and should be
considered as one of the armamentarium used to treat patients with arterial occlusive disease.

References
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