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Thromboendarterectomy with Posterior Approach for Local Occlusive Lesion of Popliteal Artery: 4 Case Reports

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Abstract

Purpose: Thromboendarterectomy (TEA) is the standard procedure for atherosclerotic lesions in the common femoral artery, which is considered a non-stent region. Although the popliteal artery is also a non-stent territory, endovascular procedures are commonly performed in this artery as well as in the superficial femoral artery. The usefulness of TEA *via* a posterior approach for localized occlusive lesions in the popliteal artery has been noted. Therefore, we investigated the usefulness of TEA of the popliteal artery by a posterior approach based on cases we have managed at our institution.

Methods: We retrospectively analyzed four patients with peripheral arterial disease in the popliteal artery presenting as intermittent claudication who underwent popliteal TEA by the posterior approach in the prone position at our institution from June 2017 to May 2018.

Results: The mean postoperative observation period was 18.8 ± 5.6 months (range, 14-25 months). The patch material used was the small saphenous vein in two patients and an expanded polytetrafluoroethylene sheet in two patients. In all patients, claudication improved and recovery of the ankle-brachial pressure index was observed postoperatively. Early stenosis occurred one of the four patients. No patients developed serious complications during the observation period.

Conclusion: TEA with a posterior approach for local lesions in the popliteal artery is a useful technique because the great saphenous vein can be preserved using the small saphenous vein or a prosthetic patch. However, if the lesion extends proximally, application of this technique should be carefully considered.

Keywords: Popliteal artery; Peripheral arterial disease; Posterior approach; Thromboendarterectomy

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Introduction

The applications of endovascular treatment for occlusive lesions of the lower extremity have expanded, and previously unsuitable treatments for such lesions have become possible with advancements in surgical devices. However, the arterial regions in which the vessel bends are recognized as "non-stenting zones" based on concerns regarding stent damage, and the results of endovascular therapy in such regions have been unacceptable; therefore, the use of stents at such sites is not recommended [1]. Thromboendarterectomy (TEA) of the common femoral artery has long been carried out by the standard operation for arteriosclerotic lesions [2,3]. Balloon angioplasty is performed for endovascular treatment of the popliteal artery because this artery is also a non-stenting zone. However, treatment is often difficult for coral-like lesions with strong calcification or cases of repeated restenosis [4]. Because most occlusive lesions of the Superficial Femoral Artery (SFA) have been managed by endovascular treatment, hybrid surgery with TEA of the popliteal artery has recently become the procedure of choice. Therefore, the usefulness of TEA for localized occlusive lesions of the popliteal artery with the posterior approach has been reported [5-7]. In the present study, we investigated the utility of popliteal TEA with the posterior approach based on cases managed at our institution as well as previously described cases.

Materials and Methods

We retrospectively analyzed four patients who presented with intermittent claudication and underwent TEA *via* the posterior approach for occlusive lesions of the popliteal artery in our hospital from June 2017 to May 2018.

TEA and patch plasty of the popliteal artery with the posterior approach were performed in the

Table 1: Patients' preoperative characteristics.

Age	n=4
Gender	76.3 ± 7.0 (range: 66-82)
Distance of claudication (m)	Male =4
Preoperative ABPI	238 ± 205 (range: 50-500)
Past history	0.69 ± 0.09 (range: 0.63-0.83)
Hypertension	4
Diabetes mellitus	1
Dyslipidemia	4
Ischemic heart disease	1
Cerebral vessel disease	2
Hemodialysis	0
Smoking	4
COPD	1

ABPI: Ankle-Brachial Pressure Index; COPD: Chronic Obstructive Pulmonary Disease

prone position. A proximal medial-to-distal lateral S-shaped incision was performed. If the Small Saphenous Vein (SSV) was suitable, it was harvested and used as a venous patch (Figure 1). When a suitable vein for the patch was not found, a prosthetic patch made of extended Polytetrafluoroethylene (e-PTFE) was used. The tibial nerve was taped and pulled laterally. If the popliteal vein affected the operative field, it was taped and pulled laterally as well. One or two antiplatelet drugs had been administered to each patient preoperatively, and this treatment was continued postoperatively. Postoperative computed tomography angiography was performed and the Ankle-Brachial Pressure Index (ABPI) was measured during hospitalization.

Results

The patients' mean age was 76.3 ± 7.0 years (range, 66-82 years). All patients were male. The mean preoperative claudication distance was 238 m ± 205 m (range, 50 m-500 m), and the mean preoperative ABPI was 0.69 ± 0.09 (range, 0.63-0.83) (Table 1). The patch material was the SSV in two patients and an e-PTFE sheet in two patients. No patients underwent endovascular treatment of the SFA.

The mean postoperative observation period was 18.8 ± 5.6 months (range, 14-25 months). Postoperative improvement in the ABPI and disappearance of claudication were observed in all patients (Figure 1). One of the four patients developed restenosis 8 months after surgery. Endovascular treatment was performed for that lesion (Figure 2), and no further restenosis occurred. Postoperatively, one patient developed numbness in the ipsilateral lower extremity, which resolved quickly during hospitalization. No major amputations or perioperative deaths occurred (Table 2).

Discussion

Autogenous vein bypass surgery to the below-knee popliteal artery is the standard method for revascularization of below-knee arteries in patients with occlusive lesions from the SFA to mid-popliteal artery. However, recent advances in endovascular treatment devices have improved the treatment outcomes for SFA lesions and the utility of hybrid surgery that combines endovascular treatment of the SFA and TEA of the popliteal artery, which is less invasive than bypass surgery, has attracted attention [5-7]. Imperato et al. [8] compared the results of the three treatments (segmental TEA, full-length TEA, and vein bypass) for femoropopliteal lesions and found no significant difference between them. Inahara et al. [7] found that the patency rate for popliteal TEA was 75.6% at 3 years and 58.5% at 5 years. In a recent report, Kumar et al. [9] reported a 3-year patency rate of 89.4%, and Iscan et al. [6] and Nasr et al. [5] showed good initial results in a short observation period after popliteal TEA (Table 3). By contrast, Soga et al. [4] reported that the patency rate of endovascular treatment of the popliteal artery was 75.5% at 1 year and 56.2% at 5 years. These outcomes indicate that TEA is superior to endovascular therapy and non-inferior to bypass surgery.

Among the four patients who underwent popliteal TEA at our hospital, the SSV was used in two and an e-PTFE patch was used in two. Restenosis of the operative site was seen in one of the patients in whom an e-PTFE patch was used. In TEA of the common femoral artery, which is more commonly performed than TEA of the popliteal artery, the differences in patency rates between use of an autogenous vein patch and use of a prosthetic patch have not been determined. Iscan et al. [6] used an e-PTFE patch when suitable venous material was not available, and no restenosis or occlusion occurred in all nine patients treated with an e-PTFE patch. The difference in the occurrence of restenosis depending on the patch material used may be revealed as the number of cases increases. At the least, TEA with a posterior approach is considered a useful operative method because the great saphenous vein can be preserved, which is important because

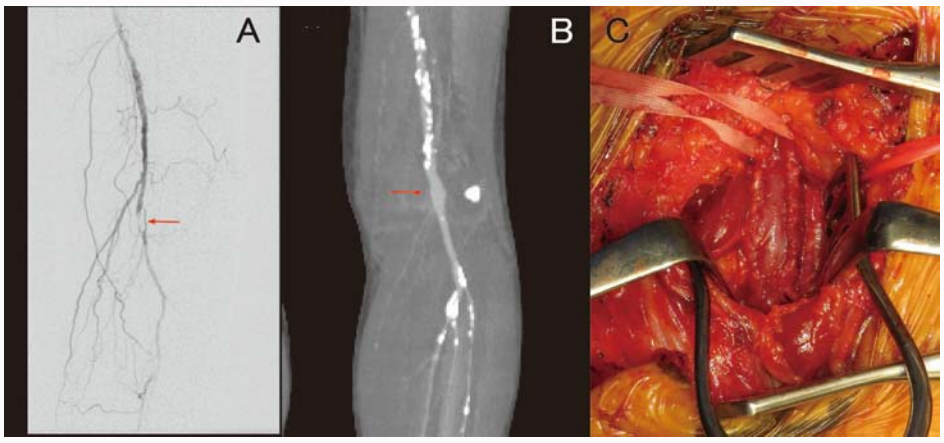

Figure 1: Patient 3. (A) Preoperative angiography. Arrow: severe stenosis was seen in the left popliteal artery. (B) Computed tomography angiography 6 days after the operation. The operated site was patent and not stenotic. Arrow: the part of the patch plasty. (C) Intraoperative photograph of the patch plasty with the small saphenous vein.

Table 2: Outcomes of thromboendarterectomy.

Case	Age	Laterality	Preoperative claudication	Postoperative claudication	Patch materials	Follow-up (mo)	Preoperative ABPI	Postoperative ABPI	
1	79	Rt	100 m	None	SSV	25	0.63	0.91	patent
2	66	Rt	300 m	None	e-PTFE	25	0.65	0.93	Restenosis after 8 mo →PTA
3	78	Lt	50 m	None	SSV	14	0.66	0.78	Patent Untreated SFA lesion. occlusion of the retinal artery
4	82	Rt	500 m	None	e-PTFE	14	0.83	1.2	patent Short term paresthesia

mo: months; Rt: Right; Lt: Left; SSV: Small Saphenous Vein; e-PTFE: Expanded Polytetrafluoroethylene; PTA: Percutaneous Transluminal Angioplasty; SFA: Superficial Femoral Artery; ABPI: Ankle-Brachial Pressure Index

Table 3: Reports of popliteal thromboendarterectomy.

Author	Publish	No. of cases	Material of the patch	Follow -up	Primary PATENCY	Complications
Iscan et al. [6]	2015	14	Prosthesis =9, SSV=5	6 mo	100%	paresthesia = 1
Nasr et al. [5]	2015	7	GSV=7	9.9 mo	85.70%	
Kumar et al. [9]	2013	47	SSV=41, Prosthesis =6	3y	93.6%/ 1y, 89.4%/3y	major amputation=1, infection=1
Inahara & Toledo [7]	1978	76	GSV=76	10 y	75.6%/5y, 58.5%/10y	major amputation=1, infection=1, hematoma=1

SSV: Small Saphenous Vein; GSV: Great Saphenous Vein; mo: months; y: years

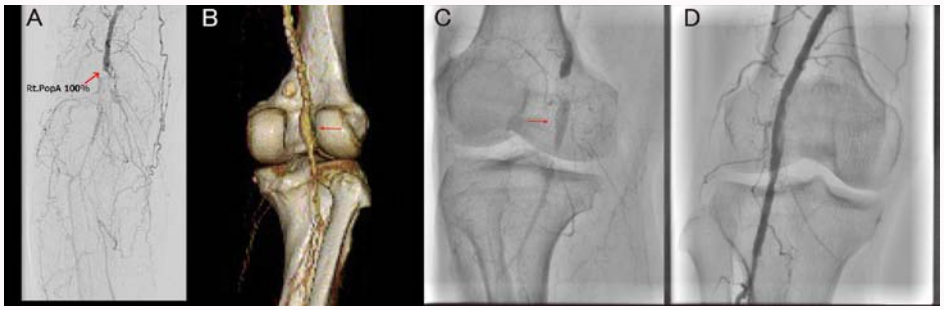

Figure 2: Patient 2. (A) Preoperative angiography. Arrow: the stenotic lesion. (B) Computed tomography angiography 5 days after the operation. Arrow: the site of the patchplasty. (C) Angiography 8 months after the operation. Restenosis was present in the popliteal artery. Arrow: the site of the patch plasty. (D) Angiography after endovascular treatment for the restenotic lesion. The ankle-brachial pressure index had improved from 0.53 to 0.98.

this patient group has a high risk of ischemic heart disease. In the patient who developed restenosis in the present study, endovascular treatment for the restenotic lesion was performed, resulting in improvement.

However, performing TEA in the prone position *via* a posterior approach is also associated with two problems: The narrow surgical field and the possibility of tibial nerve injury. With respect to the narrow operative field, calcified lesions are often contiguous from the femoral artery to the popliteal artery, making it difficult to detect the responsible lesion. In addition, if the lesion is longer than expected (in contrast to the preoperative assessment) or if the calcification makes it difficult to block blood flow, the arterial anatomy extends deeply into the muscles, making it difficult to obtain a sufficient field of view and working space. When planning a hybrid operation that combines endovascular treatment for the SFA and TEA for the popliteal artery, the treatment strategy should be carefully considered, especially when continuous and long calcified lesions are present in the proximal region. If endovascular treatment is not effective, the hybrid revascularization procedure may not yield good results, potentially resulting in early occlusion of the surgical site. Currently, TEA *via* the posterior approach seems to be the most appropriate technique for local lesions of the popliteal artery classified as Trans-Atlantic Inter-Society Consensus (TASC) B lesions, when restenosis or occlusion occurs after endovascular treatment or in non-stented areas. The posterior approach requires passive displacement of the tibial nerve before reaching the popliteal vein and artery [10]. Intraoperative traction for displacement can cause tibial nerve injury postoperatively. In the literature, neuropathy has been observed in 1 of 144 cases, but the incidence does not appear to be high if knowledge of anatomy and protective maneuvers are kept in mind. In the present study, plantar numbness appeared in the four fifth postoperative cases, but it quickly improved and there were no sequelae.

Conclusion

TEA with a posterior approach for localized lesions in the popliteal artery is a useful technique because it allows preservation of the great saphenous vein with the SSV or a prosthetic patch. However, its application should be carefully considered when calcified lesions extend into the proximal region. Accurate preoperative imaging and hemodynamic evaluation and postoperative follow-up contribute to good surgical outcomes.

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