A Review of Surgically Treated Patients with Obstruction after Stenting in the Femoropopliteal Artery Region

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In this study, we retrospectively reviewed 36 cases that required surgical treatment in the femoropopliteal regions (46 regions) because of the development of obstructions after stent placement in these patients. Of the 46, stents were placed in 37 involved regions (80.4%) that included the common femoral and popliteal arteries; such as the common femoral, entire length of superficial femoral, or popliteal arteries, and the anastomosis site created during femoropopliteal (prosthetic graft) bypass surgeries (Group A). In contrast, 9 involved regions (19.6%) did not include the common femoral or popliteal arteries; the stents were primarily localized in the superficial femoral artery (Group B). Symptoms of stent occlusion were more severe in the former group of patients, who subsequently required peripheral artery bypass surgery. These results indicate that placement of stents in the common femoral artery and popliteal arteries should be avoided. (*English translation of J Jpn Coll Angiol 2012; 52: 19-23)

Keywords: peripheral arterial disease, stent occlusion, stent fracture, endovascular treatment, femoropopliteal artery

INTRODUCTION

Endovascular treatment (EVT) has markedly advanced, and indications for stenting have also widened in the femoropopliteal region. As a result, stent occlusion after placement is emerging as a problem.1,2 In this study, patients who presented with difficulties in revascularization after stent occlusion were reviewed to improve the results of EVT in the femoropopliteal region.

SUBJECTS AND METHODS

Thirty-six patients who underwent surgical revascularization for ischemia caused by stent occlusion after placement for peripheral arterial disease (PAD) of the femoropopliteal region during the 5 years from August 2005 and July 2010 were retrospectively evaluated. Surgical revascularization was indicated for Fontaine stage IIb or severer PAD not responding to medication. The site of occlusion was determined by computed tomographic angiography (CTA), and symptoms after occlusion and surgical revascularization procedures were compared between patients in whom stents had been placed in the common femoral or popliteal artery (Group A) and those in whom they had been placed outside the femoropopliteal region (Group B). Moreover, Group A was divided into 4 subgroups according to the site of stent placement, and the relationship between the stent placement site and occlusion was evaluated. Comparisons between groups was made by the χ²-test at the p < 0.05 level of significance. Statistical analysis was performed using JMP (Ver.8.0.2, SAS Institute, Cary, North Carolina, USA).

RESULTS

The annual number of patients who required surgery for revascularization increased from 3 (6.4%) to 15 (27.3%)
during the 5 years (Fig. 1). Stenting was performed for 46 lesions in the 36 patients (Fig. 2): 37 lesions in 27 patients in Group A and 9 lesions in 9 patients in Group B. Group A was divided further into 4 subgroups according to the site of stent placement. Stenting involved the entire length of the SFA in 16 lesions (Group A1, Fig. 3a), the common femoral artery in 9 lesions (Group A2, Fig. 3b), the popliteal artery in 7 lesions (Group A3, Fig. 4), and the distal anastomosis of femoropopliteal (prosthetic graft) bypass in 5 lesions (Group A4, Fig. 3c).

Table 1 shows the symptoms after stent occlusion and revascularization procedures. The symptoms after stent occlusion were Fontaine IIb in 7 patients (25.9%) and III in 20 patients (74.1%) in Group A but 7 (77.8%) and 2 (22.3%) patients, respectively, in Group B; the percentage of patients with severer symptoms was significantly higher in Group A (p < 0.006). Also, surgical revascularization was performed due to the appearance of symptoms after stent occlusion. While above-knee bypass surgery with endarterectomy/angioplasty of the deep femoral artery was conducted in 3 (11.1%), and bypass surgery to a below-knee or more distal part of the popliteal artery was performed in 24 (88.9%) in Group A, these procedures were carried out in 6 (66.7%) and 3 (33.3%), respectively, in Group B; bypasses were grafted to distal parts of the popliteal artery significantly more frequently in Group A (p < 0.002). After revascularization, none of the patients showed early occlusion or the
Unsuitable Stent Placement in Femoropopliteal Artery

Fig. 3  (a) Stent covering the entire length of the superficial femoral artery. (b) Stent covering the common femoral artery and profunda femoris artery. (c) Stent placed at the distal anastomotic site created during an above knee femoropopliteal bypass graft.

Fig. 4  Popliteal artery stent fracture in the region of knee joint flexion (arrows).

Table 1  Symptoms after stent occlusion and bypass surgery in the two groups

<table>
<thead>
<tr>
<th>symptom after stent occlusion</th>
<th>Group A (n = 27)</th>
<th>Group B (n = 9)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fontaine IIb</td>
<td>7 (25.9%)</td>
<td>7 (77.8%)</td>
<td>p &lt;0.006</td>
</tr>
<tr>
<td>Fontaine III/IV</td>
<td>20 (74.1%)</td>
<td>2 (22.3%)</td>
<td></td>
</tr>
<tr>
<td>Surgical procedure after stent occlusion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Above knee reconstruction</td>
<td>3 (11.1%)</td>
<td>6 (66.7%)</td>
<td>p &lt;0.002</td>
</tr>
<tr>
<td>Distal bypass</td>
<td>24 (88.9%)</td>
<td>3 (33.3%)</td>
<td></td>
</tr>
</tbody>
</table>

Group A had a significantly higher rate (%) of critical limb ischemia compared to that in Group B (p <0.006). A significantly higher number (%) of patients in Group A required a distal bypass surgery when compared to that of patients in Group B (p <0.002).
exacerbation of symptoms or required limb amputation.

**DISCUSSION**

Occlusion after EVT is known to often cause severe symptoms.\(^1\) In this study, of the lesions that required surgical revascularization after stent occlusion, the primary stenting involved the common femoral or popliteal artery in 80.4% (Group A). These lesions more often showed severer symptoms and more often required below-knee bypasses than the lesions in which primary stenting did not involve the common femoral or popliteal artery (Group B). Stent placement in parts with collaterals or flexed parts of arteries is considered to have been the cause of the less favorable outcome in Group A. Therefore, stenting in these areas appears to be undesirable.

From this viewpoint, Group A could be divided into 4 subgroups:

1) Occlusion occurred frequently in patients in whom stenting involved the entire superficial femoral artery, probably as a result of aggressive treatment for TASC C or D lesions (TASC: Trans-Atlantic Inter-Society Consensus) or additional EVT for TASC A or B lesions. Stents were often placed proximally in the common femoral artery (CFA) and distally in the popliteal artery above the knee,\(^3\)–\(^6\) and bypassing to the popliteal artery below the knee was frequently needed in patients requiring surgical revascularization, because distal anastomosis of the popliteal artery was difficult above the knee.

2) When stenting for a lesion at the origin of the superficial femoral artery involves the common femoral artery and origin of the deep femoral artery, stent occlusion also induces occlusion of the deep femoral artery. Since the deep femoral artery is an important relay site of collaterals from the pelvic to femoral region and from the femoral to infrapopliteal and lower leg regions, its occlusion is expected to cause severe leg ischemia.

3) In knee flexion, the length of the popliteal artery is adjusted near the upper and lower margins of the patella, which are sites of physiologic flexion of the popliteal artery. For this reason, stents placed at these sites are prone to occlusion due to deformation and fracture.\(^2\)–\(^9\) Also, as these sites are origins of the collateral network around the knee, there is concern over collateral occlusion.

4) In patients who undergo stenting for stenosis at the distal anastomosis persisting after thrombectomy as a measure against occlusion of AKF-P (prosthetic graft) (AKFP: above-knee femoropopliteal) bypass grafting performed for superficial femoral artery lesions, occlusion early after stenting is frequently observed. There have also been reports of poor stent patency in such patients.\(^10\),\(^11\) Since occlusion often leads to obstruction of the origins of above-knee collaterals and causes severe lower leg ischemia, stenting should not be the first choice to relieve AKF-P (prosthetic graft) bypass occlusion.

Stent occlusion occurred more frequently, and severe leg ischemia was caused more often, in patients who underwent stenting of the common femoral and popliteal arteries, probably because the present stent material is not appropriate for the dynamic characteristics of the popliteal region,\(^12\),\(^13\) and because collaterals consisting of a network of the deep femoral artery and vessels around the knee are obstructed.

Modifications of the surgical procedure are more frequently required in 1) and 2) above, and a high skill level is needed to remove stents placed in the common femoral artery and create an anastomosis that can be used as an inflow channel in the common femoral artery for the creation of anastomosis angioplasty of the deep femoral artery. Also, vascular damage is likely to occur in stent removal. Distal anastomosis is more likely to be adversely affected in 1), 3), and 4), in which anastomosis is often created in a distal part, since greater skill of anastomosis is required as it is created more distally.

**CONCLUSION**

EVT is a mildly invasive and very effective treatment. However, outcomes such as those presented above have been reported as its indications have widened. The femoropopliteal region is unique due to the presence of the hip and knee joints and collaterals consisting of the internal iliac and deep femoral arteries and vessels around the knee. Therefore, knowledge of sites inappropriate for stenting is necessary. This effective procedure must be applied with sufficient understanding of the hemodynamics of the leg and advantages and disadvantages of other treatments, including bypass grafting and surgical angioplasty (endarterectomy).

**DISCLOSURE STATEMENT**

The authors have no conflict of interest to declare.

**REFERENCES**


