Percutaneous transluminal angioplasty of the popliteal artery without the use of stents: A review of 116 consecutive procedures

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PURPOSE: To evaluate the safety and efficacy of percutaneous transluminal angioplasty (PTA), without the use of stents, for the treatment of popliteal artery stenosis.

METHODS: From March 1997 to December 2003, 116 consecutive PTAs of the popliteal artery were performed in 98 patients. All patients underwent preoperative and postoperative colour duplex scans and preoperative angiography. In all cases, the superficial femoral artery was patent and without significant stenosis. Follow-up

patency was assessed by clinical examination and colour duplex scanning in all patients.

RESULTS: There was no perioperative mortality. Primary patency after two years was 86% for intermittent claudication (IC) patients and 54% for critical limb ischemia (CLI) patients. Secondary patency rates were 98% for IC patients versus 92% for CLI patients after one year, 94% for IC patients versus 83% for CLI patients after two years and 69% for IC patients versus 7% for CLI patients after five years ($P<0.001$).

CONCLUSION: Popliteal artery PTA is safe and efficient, especially in IC patients with single lesions.

Key Words: *Critical limb ischemia; Percutaneous transluminal angioplasty; Popliteal artery angioplasty*

Endovascular treatment has been considered the standard option for popliteal steno-occlusive disease (1,2). However, most centres have only studied the results of iliac and superficial femoral artery angioplasty (3-5), and only three studies have focused especially on angioplasty of the popliteal artery (6-8).

In the event of unsuccessful percutaneous transluminal angioplasty (PTA) in the iliac region, stents have proven to be a valuable adjunct, providing a wider initial lumen and a lower restenosis rate than PTA alone (9-11). However, the popliteal artery is smaller than the iliac artery, and stent patency rates decrease with increasing arterial diameter (5). Moreover, the popliteal artery appears ill-suited for stent implantation because its anatomical location (posterior to the knee joint) demands accommodation during limb flexion and extension (8). Therefore, popliteal artery stenting is rarely performed because it is assumed to be associated with a high risk of restenosis and failure (12).

The aim of the present, retrospective, single-institution study was to investigate the safety and efficacy of PTA of the popliteal artery without the use of stents.

METHODS

From March 1997 to December 2003, 116 consecutive PTAs of the popliteal artery were performed in 98 patients. Sixty-eight (58.6%) were symptomatic for intermittent claudication (IC) and the remaining 48 (41.4%) were symptomatic for critical limb ischemia (CLI). Patients with acute limb

ischemia, total occlusion of the popliteal artery, and occlusion of the iliac axis or the superficial femoral artery were excluded from the study. Patient demographics are shown in Table 1.

Procedure

All procedures were performed in the operating room by vascular surgeons using a C-arm portable fluoroscopic device. Eighty-nine procedures were performed by antegrade puncture of the common femoral artery, and 27 were performed by retrograde puncture of the contralateral common femoral artery. Systemic heparinization was performed (70 UI/kg), and 100 mg of acetylsalicylic acid were given daily after the procedure. Short 6 Fr or 7 Fr introducer sheaths (10 cm long) were used. A conventional guidewire was used initially, and a hydrophilic 0.035 in guidewire (Terumo Medical Corporation, Germany) or a V-18 ControlWire (Boston Scientific, USA) was used when necessary. A straight flash 5 Fr catheter or a Berenstein 5 Fr catheter was used. UltraThin SDS 3 mm, 4 mm or 5 mm balloon dilation catheters (Boston Scientific, USA) were used for angioplasty. The removal of the introducer sheath with an activated clotting time of less than 150 s and manual compression followed in all cases.

Follow-up

Patients underwent a colour duplex scan to determine patency at three months, six months, 12 months and annually thereafter. The mean follow-up was 65 months (range 24 to

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TABLE 1
Patient characteristics

Characteristics	Patients, n (%) [*]
Age, years	71 (range 56–90)
Male sex	79 (68)
Smoking history	48 (41)
Coronary artery disease	31 (27)
Hypertension	54 (46)
Dyslipidemia	41 (35)
Diabetes mellitus	44 (38)
Intermittent claudication	68 (59)
Critical limb ischemia	48 (41)
Single popliteal stenosis	95 (82)
Multiple popliteal stenosis	21 (18)

^{*}Data presented as n (%) unless otherwise stated

Figure 1) Cumulative secondary patency rate with the Kaplan-Meier method. The black line represents patients with intermittent claudication and the grey line represents patients with critical limb ischemia (CLI) ($P<0.001$, Mantel-Cox test)

105 months). Persistence or recurrence of significant popliteal stenosis in the duplex scan was the definition of angioplasty failure (primary patency). These patients underwent a second PTA procedure, and then followed the same protocol of duplex scans at three, six and 12 months (secondary patency).

Statistics

Data were analyzed using the SPSS software package, version 13.0 (SPSS Inc, USA). The Kaplan-Meier method was used to calculate the cumulative patency rates of the patients and the subgroups. The long rank test (Mantel-Cox) was used to compare the curves. The hazard function estimated the risk of failure as a function of time.

RESULTS

No major hematomas or arteriovenous fistulas were observed at the puncture site. In 22 cases (18.9%), multiple stenoses of the popliteal artery were treated. Three major amputations were performed in the first year in the CLI group. Nine

Figure 2) Cumulative secondary risk of percutaneous transluminal angioplasty failure with the hazard function. The black line represents patients with intermittent claudication and the grey line represents patients with critical limb ischemia (CLI)

Figure 3) Cumulative secondary patency rate with the Kaplan-Meier method. The black line represents patients with single stenosis of the popliteal artery and the grey line represents patients with multiple stenosis of the popliteal artery ($P=0.029$, Mantel-Cox test)

(7.8%) femoropopliteal and tibial bypasses were performed in the first year.

Primary patency after two years was 86% for IC patients and 54% for CLI patients. Secondary patency rates were 98% for IC patients versus 92% for CLI patients after one year, 94% for IC patients versus 83% for CLI patients after two years, and 69% for IC patients versus 7% for CLI patients after five years ($P<0.001$) (Figure 1). The risk of popliteal artery PTA failure is shown in Figure 2. Patients with multiple popliteal lesions were more likely to have early PTA failure ($P=0.029$) (Figure 3).

Ten patients needed PTA of the iliac axis, five patients needed thromboendarterectomy of the common and/or profunda femoral artery, and two patients needed an aortobifemoral bypass. Twenty-one patients died during the follow-up period.

DISCUSSION

Patients with peripheral artery disease usually have multiple lesions in the aortoiliac-femoral-popliteal-tibial axis. There are multiple alternative methods of treatment, such as medical therapy, balloon angioplasty, primary stenting and surgical revascularization. In the present study, we evaluated PTA as a single treatment option without the use of stents, in the treatment of the popliteal artery region.

There is some confusion in the literature about the choice of simple PTA as the first choice in popliteal artery treatment (13). Strecker et al (8) showed encouraging results with the use of tantalum stents in the popliteal artery in recurrent stenosis only, while Steinkamp et al (7) found some benefit of laser angioplasty over balloon dilation, but only in the immediate outcome. In fact, they concluded that laser angioplasty did not have any long-term benefit over balloon dilation. In a study conducted by Abdul Raouf et al (6), stents were used in restenosis and dissection of the popliteal artery only. In the present study, restenosis was treated with simple balloon dilation, and no cases of dissection were observed. This may be explained by the fact that Abdul Raouf et al included recanalizations of totally occluded

popliteal arteries that may have had a greater risk of dissection, while recanalizations were not included in the present study.

In accordance with other investigators (6), we observed a significantly higher benefit of PTA in the IC patients over those with CLI. Our data suggest that PTA could be an alternative to surgical revascularization for the IC patients. Perkins et al (14) showed that there was no benefit of angioplasty over exercise, and consequently they recommended exercise as the first approach treatment to this pathology. However, not all patients conform to these instructions.

Interestingly, procedures performed for single stenosis of the popliteal artery had significantly better results between the short and long term, compared with procedures that included multiple popliteal stenoses.

CONCLUSION

PTA of the popliteal artery is safe and effective, even between the short and long term. The major benefit of this treatment can be achieved in IC patients with a single popliteal stenosis. Patients suffering from CLI benefit significantly less from the procedure.

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