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Popliteal Aneurysms: a 10-year Experience

S. T. Duffy, M. P. Colgan[1], S. Sultan[1], D. J. Moore[1] and G. D. Shanik*[1]

School of Medicine, Trinity College Dublin, [1]Department of Vascular Surgery, St. James's Hospital, Dublin, Ireland

Background: *Popliteal aneurysms account for 70% of peripheral arterial aneurysms and, if untreated, pose a serious threat to the affected limb. Debate continues about the best form of treatment especially for asymptomatic lesions.*
Method: *We reviewed the computer records and charts of patients seen at this department with a diagnosis of popliteal aneurysm over the last 10 years. Patients who had not been seen within the last year were followed-up through their G.P.*
Results: *Twenty-four patients (M 23/F 1) presented with 40 popliteal aneurysms. The mean age was 63.5±9 years. Symptoms were present in 23 of the affected limbs while 17 were asymptomatic. Thirty were treated surgically and 10 followed with regular ultrasound. The mean diameter of the repaired aneurysms was 3.3±1 cm. Aneurysms <2 cm were more likely to be asymptomatic. No limbs were lost in patients undergoing elective repair of popliteal aneurysms. The secondary patency and limb salvage rates at 3 years were 84% and 96% respectively. Conservative management of asymptomatic lesions <2 cm was not complicated by the development of symptoms.*
Conclusions: *Elective repair of popliteal aneurysms by exclusion and bypass is a safe, effective and durable technique. Small asymptomatic lesions can be safely managed with close follow-up.*

Key Words: Popliteal artery; Aneurysm; Atherosclerosis; Vascular surgery.

Introduction

Popliteal artery aneurysms, although uncommon, account for 70% of peripheral artery aneurysms. They may be associated with amputation rates of up to 67% (mean 25%) if not treated before the onset of complications.[1] In contrast elective repair has been widely reported to be associated with limb salvage rates of 100%.[2–8]

Many previous series have had the disadvantage of being collected over extended periods of up to 39 years,[2,4,5,9–11] during which the management policy has changed and a wide mix of operative techniques and graft material have been employed. We report the results of a homogenous group (single centre and all treated in a similar manner by one of two surgeons) of patients seen over a 10-year period.

Methods

Between 1987 and 1997 26 patients presented to the department of vascular surgery at St. James's Hospital with a total of 43 popliteal aneurysms. One patient had multiple myeloma and a mycotic aneurysm and is excluded from consideration. The remaining 42 were atherosclerotic in aetiology. Insufficient information was available for a further patient with bilateral popliteal aneurysms and is also excluded from consideration; he is, however, alive and well with both legs intact more than 8 years after his operations. This leaves a total of 24 patients with 40 aneurysms for study.

The clinical diagnosis of a popliteal aneurysm was confirmed with B mode ultrasonography. Screening was carried out for contralateral popliteal aneurysms, abdominal aortic aneurysms and other peripheral aneurysms. Patients were also assessed for the major recognised risk factors for arterial disease (Table 1). Preoperative angiography to assess run-off was only available in 14 cases, due to urgent/emergency surgery

Table 1. Risk factors.

Risk factor	No.	%
Tobacco use	22	92
Cardiac disease	12	50
Hypertension	9	38
COPD	5	21
Diabetes mellitus	2	8
AAA	14	58

* Please address all correspondence to: G. D. Shanik, Department of Vascular Surgery, St. James's Hospital, Dublin 8, Ireland.
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Table 2. Symptoms at presentation by limb.

Symptoms	No.	%
None	17	43
Rest pain	5	13
Intermittent claudication	6	15
Local symptoms	8	20
Acute ischaemia	3	8
Rupture	1	3
Foot drop	1	3
Deep vein thrombosis	1	3

Note: some limbs presented with more than one symptom.

Table 3. Associated major arterial aneurysms.

	Bilateral		Unilateral		Total	
Site	No.	%	No.	%	No.	%
Abdominal aorta	10	63	4	50	14	58
Iliac	6	38	3	38	9	38
Femoral	5	31	2	25	7	29
Any extra popliteal	12	75	4	50	16	67

Note: several patients had more than one aneurysm.

($n=7$) or lost films ($n=3$). Perioperative angiography was performed in all cases.

Twenty-three of the patients (96%) were male with only one female patient. The age at presentation ranged from 48 to 82 years (mean 63.5 ± 9 years). At first presentation 23 (58%) limbs were symptomatic (Table 2) and the remaining 17 (43%) were asymptomatic.

All symptomatic aneurysms, bar one, ($n=22$) were repaired surgically as were asymptomatic aneurysms >2 cm ($n=8$). A patient with a 2.8 cm symptomatic aneurysm was treated conservatively due to severe coronary artery disease. Of note he has had a digital amputation and continues to have rest pain. The mean diameter of the reconstructed aneurysms was 3.3 ± 1 cm (range 2.2–6 cm) based on accurate measurements from 21/30 aneurysms. Information on aneurysm length is not available. Three cases were repaired on an emergency basis for acute ischaemia, four on an urgent basis and the remainder were repaired as elective procedures. Asymptomatic aneurysms were followed until they were >2 cm, and were then repaired electively.

Exclusion and vein bypass using a medial incision was the operation of choice. In seven out of 30 operations the artery was transected proximal to the aneurysm and an end-to-end anastomosis was performed. All others were end-to-side. In only one instance where the aneurysm was 4.2 cm was the aneurysm sac opened.

Autogenous saphenous vein was available in 29 cases and in the remaining case a synthetic conduit (polytetrafluorethylene) was employed. Two of the vein grafts were placed *in situ*, while the remaining 27 were reversed. The proximal anastomosis was to the common femoral artery in four cases, the femoral limb of a previous aortobifemoral graft in two, the superficial femoral artery in 23 and the popliteal artery in one instance. The distal anastomosis was to the distal popliteal artery in 16 cases, the tibioperoneal trunk in three, the anterior tibial artery in four, the peroneal artery in six and the posterior tibial artery in one case. Tibial vessels were used as the best run-off vessels where there was extension of thrombus or calcification. The anterial tibial artery was approached by tunnelling through the interosseous membrane.

Patients were followed on an outpatient basis at 3, 6 months, 1 year and annually thereafter. Any patient who had not attended the outpatient clinic within the last year was followed-up through their general practitioner. Mean follow-up was 36.5 months (range 17 days–100 months).

Statistical analysis was performed using Fisher's exact test and the Student's *t*-test where appropriate.

Results

Bilateral popliteal aneurysms were identified in 16 (67%) patients while 14 (58%) had at least one other peripheral aneurysm. On presentation the rate of coexisting abdominal aortic aneurysm was higher in patients with bilateral popliteal aneurysms (Table 3). One-third of patients had more than three aneurysms on presentation while six (25%) had had previous arterial reconstructions (five aortofemoral grafts and two femorodistal bypasses in the contralateral leg).

Operative complications occurred in 10 patients (Table 4) with two deaths. The first (at home) from a stroke at day 17 postop, in a 66-year-old patient with

Table 4. Operative complications according to presentation.

Complication	Symptomatic		Asymptomatic	
	No.	%	No.	%
Death	2	7	0	0
Amputation	1	3	0	0
Graft thrombosis	1	3	1	7
Digital amputation	1	3	0	0
Pyrexia	1	3	0	0
DVT	1	3	0	0
Pulmonary oedema	1	3	0	0
Cellulitis	0	0	1	3

Table 5. Cumulative patency and limb salvage rates.

Time postop	1 month		1 year		3 years	
No. at risk	30		18		14	
	%	95% CI	%	95% CI	%	95% CI
Primary patency	89%	(0.77,1.01)	85%	(0.69,1.01)	71%	(0.47,0.95)
Secondary patency	96%	(0.89,1.03)	92%	(0.77,1.05)	85%	(0.65,1.03)
Limb salvage	96%	(0.89,1.03)	96%	(0.88,1.04)	96%	(0.86,1.06)

atrial fibrillation. The second occurred in a 79-year-old man who had a concomitant 10 cm thrombosed abdominal aortic aneurysm and developed renal and cardiac failure postoperatively. The first patient had general anaesthesia and the second epidural. There were two further deaths during follow-up; one due to stroke at five and a half months and the second from a pulmonary embolus at 42 months. There was no indication of DVT at surgery or at follow-up though the patient has marked primary varicose veins.

There were three cases of early graft failure. Patency was restored in two cases following thrombectomy and patch angioplasty. The third patient, aged 52, who had presented with limb-threatening ischaemia, returned to theatre on the first postoperative day and was found to have a patent graft but obstructed outflow. Thrombectomy and graft extension to the tibioperoneal trunk were performed. Despite a further thrombectomy and streptokinase infusion he proceeded to a below-knee amputation. In hindsight he was possibly a candidate for primary amputation but an aggressive approach was adopted in view of his young age.

Late graft thrombosis occurred in three cases, two of which were in grafts to below the tibioperoneal trunk. Successful thrombectomy was performed in one and the remaining two were asymptomatic. There was no resulting limb loss. Primary and secondary patency rates and cumulative limb salvage rates are reported in Table 5.

Seven of the 17 aneurysms which were asymptomatic at presentation were operated on based on an initial size >2 cm. One further aneurysm was repaired 33 months after diagnosis as it had expanded from 1.7 cm to 3.1 cm. Of the remaining nine patients one died 5.5 months after his first repair while another patient was referred to the palliative care services with metastatic prostate cancer. The remaining seven patients have small asymptomatic aneurysms (mean diameter 1.86 cm) and are under continuing observation (mean follow-up 34 months) and have suffered no complications.

With the exception of two patients who have persistence of presenting symptoms, all surgically repaired limbs were asymptomatic at last follow-up. One patient has a persisting foot drop and a second who has generalised atherosclerosis has persistent rest pain.

Discussion

The high proportion of males in our series is in keeping with that in all other series, with Dawson *et al.* reporting a range from 90 to 100% in a recent meta analysis.[1] Similarly many previous authors have reported a mean age in the seventh decade.[2–7,9–16]

Rates of tobacco use in patients with popliteal aneurysms have been reported at between 67 and 81%[2,12] and these figures are somewhat lower than in our series (92%). Rates of heart disease and hypertension are within reported ranges. While Wychulis *et al.*[17] reported a 34% rate of diabetes, most authors report rates below 15%[2,4,11,13–16] and it does not appear to be an important risk factor for popliteal aneurysm formation. Asymptomatic popliteal aneurysms are common, accounting for 43% in this series and on average 37.5% of other reported series.[1]

Several other authors have reported higher rates of coexisting aneurysms in patients with bilateral popliteal lesions.[2,4,8] Farina *et al.*[12] reported a significantly higher rate ($p<0.003$) in a series of 36 patients while in this series the difference was not significant, 50% vs. 63% ($p>0.2$), CI (−0.53, 0.29). However, the undoubtedly high rate of abdominal and peripheral aneurysms in patients with popliteal lesions makes careful examination for additional aneurysms mandatory.

In 1991 Shortell *et al.*[3] reported their experience in a series of 39 patients with similar make-up and risk factors to ours. They reported a much lower level of bilaterality; however, this may relate to the unavailability of B mode ultrasonography in the early years of their study. They reported an operative mortality of 6%. Several groups have reported no operative deaths[2,10,12,13,18] while others have reported rates below 3%.[4,16,19] Despite the high rates of operative complications reported in this and other studies[6,12] these complications are generally minor and transient.

Farina *et al.*[12] reported significantly higher long-term patency rates with vein grafts over synthetic grafts ($p<0.002$) in their series of 45 reconstructions, with a patency rate in vein grafts of 100%. A similar finding was reported by Roggo *et al.*[10] and this is consistent with the experience of many others.[2,5,14] Our 1-month patency and limb salvage rates are very close to the 94% rate reported by Shortell *et al.* The reported 5–6-year patency rates for autogenous vein grafts are

between 81 and 100%.[2,10,12] In the same series[2,10,12] figures for overall patency ranged from 61 to 69%. We were fortunate in having to use synthetic material in only one instance and feel that this contributed to our high long-term patency rates. As in Shortell *et al.* the late fall in patency rates was not matched by a corresponding decline in limb salvage.

Hand and Collin[20] reported significant complications in three of 11 surgically repaired asymptomatic lesions, including one amputation, while the eight treated conservatively remained asymptomatic. Data on aneurysm size was not reported. In contrast the absence of limb loss in the eight asymptomatic limbs repaired electively in our series is not unique, with other groups reporting the same finding in a total of more than 101 limbs[2–8,19] and the excellent outcome from conservative management of small aneurysms with careful follow-up has also been reported previously.[2,5]

Ramesh *et al.*[18] recently reported a significantly higher risk of thrombosis in aneurysms larger than 3 cm with associated distortion on angiography. In the absence of results from large controlled trials to assess the association between asymptomatic aneurysm size and the development of complications we used an arbitrary cut-off of 2 cm.[7] It is interesting to note that none of the symptomatic aneurysms in this series was smaller than 2 cm. We found that asymptomatic aneurysms were smaller, mean 2.24 cm vs. 3.42 cm ($p<0.001$), 95% CI (0.61, 1.75) and that aneurysms >2 cm were more likely to be symptomatic ($p<0.0076$). Whitehouse *et al.*[4] have reported the same observation from their series of 88 aneurysms. Reviewing a total of 208 aneurysms Vermilion *et al.*[5] and Lowell *et al.*[21] reported similar results, while Dawson *et al.*[9] report an increased risk of complications with increased aneurysm size. Since the commencement of our study Varga *et al.*[19] have published the results of their multicentre trial in which they prospectively studied 200 popliteal aneurysms from 19 surgeons. They too employed the 2 cm arbitrary cut-off and reported that asymptomatic aneurysms were significantly smaller than those which caused ischaemia ($p=0.0004$). Carpenter *et al.*[22] noted a trend towards thrombosis for larger popliteal lesions ($p<0.068$) in the 54 aneurysms in their series. This contrasts with the finding of Inahara and Toledo[13] that smaller aneurysms (mean 1.8 cm) were more likely to thrombose. Roggo *et al.*[10] reported progression to ischaemic complications in all 45 patients who were asymptomatic at presentation (mean follow-up 4.2 years); however, all lesions were >2 cm in diameter.

The finding in this and other series[2,5,7,8,10,12,13,17] that asymptomatic patients do better after reconstruction than those patients with symptomatic or complicated aneurysms is felt to be related to the quality of run-off. Shortell *et al.*[3] reported significantly better outcome at 3 ($p<0.05$) and 10 years ($p<0.001$) in patients with good run-off, while Carpenter *et al.*[22] noted that both graft patency and limb salvage were significantly favoured by good run-off ($p<0.025$) and ($p<0.003$) respectively. In a review of 89 reconstructions Bouhoutsos *et al.*[16] reported an amputation rate of 69% at 3 years in patients presenting with obliterated tibial arteries. This compares with a rate of 6% in those with patent tibial vessels. Raptis *et al.*[15] and Halliday *et al.*[6] have also reported better outcome in the presence of good run-off. It is this widely reported observation along with the high rates of ischaemic complications in untreated asymptomatic lesions[1,4,5,7,9,10,17,23,24] that lead some authors to recommend elective repair of all popliteal aneurysms.[11,13,25,26]

The introduction of thrombolysis provides the possibility of improving distal run-off in patients presenting with complications. Hoetling *et al.*[27] report a better outcome, with no limb loss, in the nine of 24 patients, presenting with acutely thrombosed popliteal aneurysms, who were treated preoperatively with thrombolysis. Six of the seven patients treated preoperatively with thrombolysis in Carpenter *et al.*'s[22] study had complete clearing of thrombus and significantly better patency ($p<0.005$) and limb salvage ($p<0.01$) than in comparable patients in the same study who went directly to operation. Bowyer *et al.*[28] advise that, given the availability of thrombolysis, surgical repair of asymptomatic lesions is no longer required and this is a view shared by others.[20,29] In their series of eight patients receiving thrombolysis only five had successful lysis of clot.[28] Varga *et al.*[19] report lasting success for thrombolysis in 16 of the 23 cases of recent onset acute ischaemia in which it was employed in their series but conclude that the results do not justify an expectant policy for asymptomatic aneurysms. In a multicentre study of 886 treatments Galland *et al.*[30] report distal embolisation as complications in 12% of cases and acute deterioration of the limb in 2.3% with this complication being particularly associated with thrombosed popliteal aneurysms ($p<0.001$) and an increased amputation rate. Thrombolysis is also associated with a 1% risk of stroke and a 5% risk of major haemorrhage[26] and cannot clear atheromatous emboli from distal vessels.

While the development of newer treatment modalities such as endoluminal graft covered stents[31,32] offers great potential for the future treatment of popliteal aneurysm they are neither widely available nor of proven durability.

In the absence of long-term follow-up results from a multicentre control trial of conservative treatment of asymptomatic popliteal aneurysms and given the excellent results reported from elective repair, and the propensity for serious limb-threatening ischaemia in untreated lesions, we continue to recommend a policy of surgical repair for all symptomatic aneurysms and all asymptomatic lesions larger than 2 cm, unless the patient's general medical condition is prohibitive. A high index of suspicion with early referral to a specialist centre for assessment will undoubtedly save many limbs.

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