Egyptian Journal of Surgery Vol. (19), No. (2), April 2000

ANEURYSMS OF THE POPLITEAL ARTERY: MANAGEMENT STRATEGY AND STUDY OF OUTCOME

By
Waleed El Baz, M.D.; Hussein Khairy, M.D., FRCS; Mahmoud Abu Zeid, M.D.;
Sherif Balbaa M.D.; Wafik Massoud MD, FRCSI; Amir Nassef, M.D.
Department of Surgery, Faculty of Medicine, Cairo University

Purpose: *This study summarizes our experience in the management of popliteal aneurysms in 23 limbs (21 patients) during a 3-year period. The aim being to provide what constitutes our strategy of management and to determine the factors that influence the outcome.*

Methods:*The data of 21 patients with 23 aneurysms were reviewed. There were 20 males and only one female, age ranging between 28 and 70 years, 18 aneurysms were atherosclerotic and 5 were arteritic. Patients were classified into group 1, the acutely ischaemic, group II with no evidence of acute ischaemia and group III, the asymptomatic cases. All patients had colour coded duplex assessment, arteriograpgy was done in cases presenting with ischaemia whether acute or chronic. 21 aneurysms were managed by operative repair while only one small asymptomatic aneurysm with no mural thrombus was managed conservatively. Also, one limb was treated by primary amputation because of irreversible ischaemia.*

Results: *The overall limb salvage rate in this series was 82.6%. All lost limbs belonged to group I i.e. those presenting with acute ischaemia. There was no hospital mortality and a follow up period ranging from 6 to 18 months brought forth neither mortality nor complications.*

Conclusion: *Operative repair is the ideal treatment for all popliteal. aneurysms. Exclusion and bypass, is the recommended procedure. Resection being particularly indicated when compression symptoms are conspicuous. There is a place to conserve in small asymptomatic aneurysms with no mural thrombi as well as in symptomatic aneurysms in non-threatened limbs with poor outflow vessels. In the latter situation, ill-advised surgery may end in limb loss. The results of this study also confirm that the outcome is strongly related to the initial presentation, being worse in the acutely ischaemic cases and hence elective repair is recommended.*

Keywords: Popliteal artery, peripheral aneurysms, limb salvage, acute ischemia.

INTRODUCTION

A popliteal artery aneurysm (P.A.A.) has been described as a sinister harbinger (messenger) of sudden catastrophe. [1]

These aneurysms account for 70% of peripheral arterial aneurysms and if untreated pose a serious threat to the affected limb.[2].

Debate continues about the best form of management and newer modalities are being tested. So, popliteal artery aneurysms remain a challenge for the vascular surgeon [3].

This study summarizes our current experience with the management of popliteal artery aneurysms. The aim being to provide what constitutes in our opinion the optimal management and to determine the factors that influence the outcome

MATERIALS AND METHODS

A retrospective review of the data of 22 patients (diagnosed clinically as having popliteal artery aneurysms)

who presented to the authors between 1996 and 1998 at Kasr EI-Aini Hospitals was carried out.

One female patient diagnosed as thrombosed popliteal aneurysm by duplex scanning was excluded as the lesion proved to be adventitial cystic disease intraoperatively.

So we were left with 21 patients with 23 popliteal aneurysms.

Analysis of the clinical data, investigations management, operative details and outcome was carried out.

Patients were classified into 3 groups. Those presenting with acute ischaemia were designated as group I, while patients with symptomatic aneurysms but no evidence of acute ischaemia as group II and asymptomatic patients as group III.

Apart from one limb presenting with irreversible ischaemia. which required primary amputation and a small aneurysm which was managed conservatively all the remaining 21 aneurysms underwent operative repair.

RESULTS

This retrospective study included 21 patients who presented with 23 popliteal aneurysms i.e. 2 patients, had bilateral aneurysms (9.5%).

All were true fusiform aneurysms, 20 (86.9%) were located above or just behind the knee joint and only 3 (13.1%) were located in the lower popliteal artery.

Patient Groups:

Group I included 10 patients with 10 aneurysms (one patient had bilateral aneurysms but one was asymptomatic and hence included in group III). They were all males with mean age of 56.6 years (range 32 - 70), 9 (90%) aneurysms were atherosclerotic and only one was presumed to be arteritic.

Limbs in this group were further classified into viable 2 (20%), threatened 7 (70%) and irreversibly ischemic 1 (10%) according to the recommended standards for reports dealing with lower extremitiy ischaemia [4] (Table 1& 2).

Table(1): ***Aneurysm aetiology in the different groups***

Aetiology	*Group I (10)*	*Group II (11)*	*Group III (2)*
Atherosclerosis	9 (90%)	7 (63.7%)	2(100%)
Arteritis	1 (10%)	4 (36.3%)	-
Total	10	11	2

Table (2): ***Clinical Presentations in the different groups***

Presentation	*Group I*		*Group II*		*Group III*	
	No	%	No	%	No	%
Asymptomatic	0/10	0	0/11	0	2/2	100
Acute Ischemia						
Viable	2/10	20	0/11	0	2/2	100
Threatened	7/10	70				
Irreversible	1/10	10				
Chronic Ischemia	0/10	0	3/11	27.27	0/2	0
Mass	0/10	0	5/11	45.45	0/2	0
Compression	0/10	0	3/11	27.27	0/2	0

Group II included 11 patients with 11 aneurysms (again one patient had bilateral aneurysms but one asymptomatic and hence included in group III), 10 males and only 1 female. The mean age was 47 years (range 26 - 65). Seven (63.63%) aneurysms were atherosclerotic and 4 (36.36%) were presumed to be arteritic. The presentation in this group was chronic ischaemia in 3 patients, compression symptoms in another 3 and a mass in the popliteal fossa in the remaining 5 (Table 1 & 2).

Group III included 2 male patients with 2 asymptomatic atherosclerotic aneurysms.

Preoperative Evaluation:

All 21 patients were submitted to colour coded duplex scanning (Fig. 1) (to confirm the diagnosis, to measure the size of the aneurysm and to detect bilaterality).

In 2/21 (9.5%) patients, there were bilateral aneurysms and in another two (9.5%) multiple successive aneurysms (Fig 2).

Fig.(1): Duplex scan depicting a 42 mm popliteal artery aneurysm

In group III::

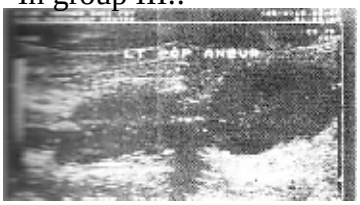

Fig (2.): Duplex scan depicting successive thrombosed popliteal aneurysms.

Duplex scanning missed the diagnosis in 2/23 aneurysms (8.6%). Aneurysm diameter varied from 12 mm to 48 mm.

Abdominal ultrasound was done in all cases and showed an associated abdominal aortic aneurysm in only one case.

In group I:

Urgent angiographic study was done in all patients except the one who presented with irreversible ischaemia. Only 3 aneurysms (33.33%) were visualized angiographically with distal embolization. In the remaining 6 cases, thrombosis of the infrapopliteal arterial tree was demonstrated with non-visualisation of the aneurysms.

In group II:

Angiography was done in the 3 patients presenting with chronic ischaemia as well as in one of the patients presenting with compression symptoms. Only one aneurysm was apparent an angiography in this group (Fig 3).

Fig.(3): Arteriogram showing a popliteal artery aneurysm with normal distal circulation.

In group III:

Duplex scanning clenched the diagnosis in these two asymptomatic aneurysms.

Management:

Twenty symptomatic aneurysms (group I and II) as well as one asymptomatic aneurysm (group III) with a 2.5 cm diameter were managed by operative repair.

The other remaining asymptomatic aneurysm (group III) with a 12 mm diameter and no mural thrombus was managed conservatively.

The medial approach for popliteal exposure was used in all patients.

In group I:

Exclusion and bypass was performed in 8 aneurysms employing autogenous reversed great saphenous vein in 6 cases and expanded polytetrafluoroethylene in 2 cases.

Only one aneurysm was treated by resection and interposition vein graft.

The remaining patient had above knee amputation because of irreversible ischaemia.

All patients received preoperative heparin and clearance of arterial tree both proximal and distal was ensured using ballon catheter prior to definitive reconstruction.

In group II, exclusion and bypass was performed in 8 aneurysms employing autogenous reversed great saphenous vein in 6 cases and expanded polytetrafluoroethylene in 2 cases.

Resection and interposition vein graft was performed in the 3 cases presenting with compression symptoms.

In group III, exclusion and bypass was performed in one large aneurysm and the other was managed conservatively.

The lower popliteal artery was the site of the distal anastomosis in all except for one limb in which the anterior tibial artery was the site of the distal anastomosis due to diseased tibioperonal trunk.

No inframalleolar bypass was resorted to in this study.

Also intraarterial thrombolysis and percutaneous stented grafts were not used.

In group I, early graft failure occurred in 4 patients, two ending with above knee amputation without an attempt of graft thrombectomy and in the other two, thrombectomy failed in one instance and succeeded with limb salvage in the other. Of the 3 patients who ended up with above knee amputation (AKA), 2 had threatened limbs and 1 had a viable one, the latter had poor outflow vessels; also the acute isehaemic episode was embolic in one patient and thrombotic in 2.

In group II, early graft failure occurred in 3 patients. In all three, limb salvage was possible following graft thrombectomy.

Outcome:

The overall limb salvage rate in this series was 82.6%.

In group I, the salvage rate was 60% (6/10). Of the four amputations done, one was a primary amputation for irreversible isehaemia.

In groups II and III, there were no instances of limb loss. There was no hospital mortality and a follow up period ranging from 6 to 18 months brought-forth no mortality or complications.

Management and outcome are shown in (Table 3.)

Table (3): ***Management and outcome in 23 popliteal artery aneurysms***

	Primary Management					*Outcome*	*Further Management*	*Overall limb salvage*
	Conservative	Exclusion		Resection	1ry Amputation			
		Vein	Synth-etic					
Group I	-	6/10	2/10	1/10	1/10	EGF* 4/9	2/9 amputation without thrombectomy 2/9 graft thromb-ectomy 1/9 lost 1/9 saved	6/10
Group II	-	6/11	2/11	3/11	-	EGF 3/11	3/11 graft thrombectomy	11/11
Group III	1/2	1/2	-	-	-	EGF 0/2	-	-

* EGF = Early Graft Failure

DISCUSSION

Apart from the abdominal aorta the popliteal artery is the most common site of aneurysm formation, accounting for more than 70% of all peripheral aneurysms [4 - 5];

These aneurysms have the second highest priority for treatment, again after the abdominal aorta because of their potential to threaten the viability of the limb [1].

The disease is generally perceived to be a problem of men in the sixth and seventh decades of life [1].

Our series of popliteal aneurysms comprised only one female comparing well with a female incidence of 0 - 5% in the literature [1].

As arteritis accounted for more than one fifth of our cases (21 .7%) we dealt with a slightly younger age group down to the fourth and fifth decades.

In 1996 Abd-El Azeim and Co-workers [6] reviewed a series of 26 aneurysms, 4 of which were arteritic.

In another setting, Dawson and co-workers in 1997 [1] reviewed 1673 patients with 9445 popliteal aneurysms, all of which were atherosclerotic.

Also fibromuscular dysplasia has been reported as a rare cause of popliteal aneurysm in females.[7] Although popliteal artery aneurysms have been referred to as "an index of generalized vascular disease" [8], pointing towards the high incidence of bilaterality [9,10] and extrapopliteal aneurysmal involvement, the incidence of bilaterality in this study was only 9.5%.

Also there was only one abdominal aortic aneurysm in this series and no other extrapopliteaI aneurysms again unlike an incidence of 36.5% (9%-62%) in other studies [9-11].

This may be due to the younger age of patients in this study and the anecdotal data regarding a lower incidence of aortic aneurysms in the Egyptian population.

Also because aortic aneurysms occur more commonly with bilateral popliteal invovlement[6], the incidence was low in this study because of a low incidence of bilaterality.

In the literature, between 15% and 30% of popliteal aneurysms are asymptomatic at the time of presentation, while approximately 20% present with acute ischaemia requiring emergency treatment [16,12].

Results obtained from this current study confirm that our aneurysms generally present late as only 8.6% were asymptomatic and 43.4% presented with acute ischaemia implying a worse prognosis as a result of late presentation and demanding more awareness to diagnose these aneurysms in the presymptomatic phase.

Apart from clinical vigilance duplex examination of the contralateral limb in patients with symptomatic aneurysms seems to be the usual method of diagnosing asymptornatic aneurysms.

Although rupture is a serious complication, which threatens limb and occasionally life, it is a rare complication, which presents with a massively swollen leg with anemia [13] None of our patients presented with a ruptured aneurysm. A unique presentation found in approximately 20% of our aneurysms was a mass in the popliteal fossa with intact pedal pulses.

Colour duplex scanning has been used to confirm the diagnosis in all 23 aneurysms. The diagnosis was missed in 2 cases and one adventitial cyst was misdiagnosed for an aneurysm giving a sensitivity of 93,1% and a specificity of 95.2%.

Duplex scanning is also ideal for assessment of size, detection of mural thrombus and follow up in the non-operated cases [1,14].

Arteriography on the other hand does not help determining the presence and size of the aneurysm but does provide good quality information about the arterial segments proximal and distal to the dilatation so that appropriate surgery be planned [1,14]. It is thus indicated in all patients presenting with ischaemic manifestation whether acute or chronic. In the acute ischaemic situation, it might help differentiate between thrombotic and embolic occlusions, the latter implying a better prognosis.

The results of the current study confirm the usefulness and limitations of these imaging techniques.

Computed tomography and magnetic resonance imaging were not used in this study, as these diagnostic modalities are expensive and should not be used routinely for diagnosis [15].

Patients with symptomatic popliteal aneurysm should undergo operative repair because the incidence of limb loss increases with the onset of symptomatic disease [12,16].

In contrast the treatment of asymptomatic aneurysms continues to be a controversial issue.

On the one hand, many small symptomless aneurysms remain so for years and prophylactic repair carries a risk of limb loss [1,17].

On the other hand, aggressive repair of all popliteal aneurysms of whatever size is associated with a low operative risk [10].

One study performed in the UK [9] concluded that an expectant policy for asymptomatic aneurysm is not justified.

Still, it seems reasonable to conserve in very small aneurysms <2 cm with no mural thrombus which if present is an important predictor of complications [18] and non threatened limbs with a bad distal arterial tree.

The surgical treatment of popliteal artery aneurysms has evolved considerably over the centuries, from various ligation procedures, endoaneurysmorrhaphy, intraluminal wiring, sympathectomy and excision to present-day vascular [1] reconstruction grafting. Although resection seems the more sound option anatomically exclusion and saphenous vein bypass through the medial approach, first introduced by Edwards in 1969, has become the most acceptable form of operative repair owing to its simplicity [11,19].

Advocates of resection argue that although it requires meticulous dissection to avoid injury to the nearby structures especially the popliteal vein, resection removes a bulky swelling in the popliteal fossa, obviating its compression effects and avoiding kinking of the graft [6].

Moreover, it eliminates the risk of infection, subsequent enlargement, and rupture [20].

However, no controlled trials exist regarding the management of PAAs.[1].

We have performed exclusion and bypass 17 times and resection in only 4 aneurysms. We have reserved the latter for large aneurysms presenting compression symptoms and we have not resected arteritic aneurysms because of the added difficulty of dense adhesions.

Although, the use of synthetic grafts avoids tedious vein harvesting resulting in a significantly reduced operation time and length of stay [21], we have employed the great saphenous vein in the vast majority of cases.

Apart from the superiority of vein grafts, advantages included easy harvest through the same medial exposure wound as well as reduced operation cost.

In the literature, overall 5-year graft patency rates range from 29 to 100 percent [14,12,16], with 5 year limb salvage rates from 75 to 98 percent [11, 12, 16], approximately to the overall limb salvage rate in our patients (82.6%) over a follow up period of up to 18 months.

Results are closely related to the presence of symptoms, the status of the arterial tree and the type of conduit employed [12].

We have shown that all lost limbs were among group I (acutely ischaemic) and that the presence of a bad outflow favors limb loss even if the limb is viable.

Two techniques used to overcome the problem of unusable tibial vessels and hence improve limb salvage include inframalleolar bypass and intraoperative thrombolysis [22].

In contrast percutaneous intraarterial thrombolysis may be associated with rapid deterioration in the clinical condition of the limb particularly during the treatment of thrombosed aneurysms. The amputation rate associated with this complication is high and operative intervention provides better results than continuation of lysis [23].

We have not used any of these techniques in this study.

Finally, experimental trials with transfemoral endoluminal graft stenting show the feasibility of this technique for aneurysm exclusion and bypass grafting [24].

This technique, however, uses non-autogenous graft material, which proved to be inferior in terms of long-term patency when compared with vein bypass, although, endovascular grafting using the saphenous vein has also been reported [25].

Additional experience and follow up will be needed to assess the value of this minimally invasive procedure in the management of popliteal aneurysmal disease [21].

CONCLUSION

Repair of popliteal artery aneurysms is best done in the asymptomatic phase. Unfortunately, owing to the diversity of presentation and the difficulty in palpating the aneurysm, the diagnosis is often delayed until complications have ensued. Even in the acute ischaemic context, the diagnosis is not uncommonly missed.

Because of a high sensitivity and specificity duplex scan is the standard diagnostic modality.

The indications for conservative treatment include small (<2 cm) asymptomatic aneurysms with no mural thrombus as well as in symptomatic aneurysms in non threatened limbs with poor outflow vessels. In the latter situation, ill advised surgery may end in limb loss.

Exclusion with saphenous vein bypass is safe and effective management, excision being reserved for aneurysms with compression symptoms and is not

recommended in arteritic cases owing to the presence of dense adhesions.

The outcome of management was shown to depend mainly on initial presentation. Patients presenting with acute ischaemia carry the worse limb salvage rate.

Still thrombotic occlusions as opposed to embolic occlusion are worse.

A randomized controlled trial regarding the management of popliteal aneurysms is awaited.

REFERENCES

1. Dawson I, Sie RB, Van Bockel JH:Atherosclerotic popliteal aneurysms. Br J Surg. 1997; 84:293 - 9.

2. Duffy ST, Colgan MP, Sultan S, Moore DJ, Shanik GD: Popliteal aneurysms: a 10 years experience.Eur J Vas Endovase Surg. 1998;16:218 - 22.

3. Dean RH: Peripheral Arterial aneurysms. In Dean RH, Yao JST, Brewster DC, eds. Diagnosis and Treatment in vascular surgery. Norwalk, Connecticut, Appleton and Lange 1995; 239-243.

4. Dent TL, Lindenauer SM, Ernst CB, Fry WJ: Multiple arterioscleroic arterial aneurysms.Arch Surg 1972; 105:338 - 44.

5. Halliday AW, Taylor PR, Wolfe JH, Mansfield AO: The management of popliteal aneurysm: The importance of early surgical repair. Ann R Coll Surg Engl 1991; 73:253 7.

6. Abd EI-Azeim H, EI-Kashef OA, Hamman AS: Popliteal aneurysms as a limb threatening problem: Egyptian Journal of Surgery 1996; 15: 125 –139.

7. Neukirch C, Bahnini A, Delcourt A, Kieffer E: Popliteal aneurysms due to fibromuscular dysplasia: Ann- Vas Surgery 1996; 10:578-81.

8. Cole CW, Thijseen AM, Barber GG: Popliteal aneurysms: An index of generalized vascular disease. Can J Surg 1989; 32:65-68.

9. Vermillion BD, Kimmins SA, Pace WG, Evans WE: A review of one hundred and forty seven popliteal aneurysms with long term follow up. Surgery 1981; 90:1009-14.

10. Varga ZA, Locke- Edmunds JC, Baird RN: A multicenter study of Popliteal aneurysms. Joint Vascular Research Group. J Vasc Surg 1994; 20:171-7.

11. Szilagyi DE, Schwartz RL, and Reddy DJ : Popliteal arterial aneurysms. Their natural history and management. Ar Surg 1981; 116:724-8.

12. Shortell CK, DeWeese JA, Ouriel K, Green RM: Popliteal artery aneurysms : a 25-year surgical experience. J Vasc 1991; 14:771-9.

13. Illig KA, Eagleton MJ, Shortell CK, Ouriel K, DeWeese JA, and Green RM: Ruptured popliteal artery aneurysm. J vasc Surg 1998; 27: 783-7.

14. Stanson AW: Imaging of aneurysms. In: Strandness DE, Van Breda, eds. Vascular Diseases. Surgical and interventional Therapy. New York: Churcill Livingstone 1994;589-603.

15. Rizzo RJ, Flinn WR, Yao JS, Mc Carthy WJ, Vogelzang RL and Pearce WH: Computed Tomography for evaluation of arterial disease in the popliteal fossa. J Vasc Surg 1990; 11:112- 119.

16. Carpenter JP, Barker CF, Roberts B, Berkowitz HD, Lusk EJ, Perloff LJ: Popliteal artery aneurysms : Current management and outcome. J Vasc Surg 1994; 19:65-72.

17. Hands LI, Collin J: Infra-inguinal aneurysms: Outcome for patient and limb. Br J Surgl99l;78:996-8.

18. Whitehouse W, Wakefied TW, Graham LM, Kazmers A, Zellnock G and Gronenwett JF: Limb threatening potential of atherosclerotic popliteal artery aneurysms. Surg 1983; 93:694 -699.

19. Edwards WS: Exclusion and saphenous vein bypass of popliteal aneurysms. Surg Gynaecol Obstet 1969; 128:829-30.

20. Flynn JB, Nicholas GG: An unusual complication of bypassed popliteal aneurysms. Arch Surg 1983; 118:111 - 13.

21. Sarcina A, Bellosta R, Luzzani L, and Agrifoglio G: Surgical treatment of popliteal artery aneurysm. A 20- year experience J-cardio Vas Surg 1997; 38:347 –54.

22. Curiel K and Shortell CK: Popliteal and femoral aneurysms. In: Rutherford RB. ed. Vascular Surgery. Philadelphia : WB Saunders 1995; 1103 - 12.

23. Galland RB, Earnshaw JJ, Baird RN, Lonsdale RJ, Hopkinson BR, Giddings AF, Dawson KJ, Hamilton G: Acute limb deterioration during intraarterial thrombolysis. Br J Surg 1993:80:1118-20

24. Marin ML, Veith FJ, Panetta TF: Transfemoral endoluminal stented graft repair of a popliteal artery aneurysm. J Vasc Surg 1994; 19:754 - 7.

25. Peuch-Leao-P, Kauffman P, Wolosker N, Anacleto AM: Endovascular grafts of a pop1iteal aneurysm using the saphenous veins. J Endovas Surg 1998; 5:64-70