# Late Longitudinal Comparison of Endovascular and Open Popliteal Aneurysm Repairs

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**Background:** We sought to define suitable anatomy predicting durable exclusion of popliteal artery aneurysms (PAAs) and define optimal patient selection criteria for endovascular repair (ER).

**Methods:** Seventy-five PAAs were repaired in 66 patients (64 male and 2 female) over the past 13 years. Fifty-two aneurysms (69%) were treated with open surgical exclusion and/or bypass using autologous vein (69%) or polytetrafluorethylene (31%) conduit. Extended bypass targets required inflow from the common femoral artery in 15% of limbs and outflow via a tibial artery in 31%. Since May 2001, ER was considered in patients with high medical risk, limited vessel tortuosity, absence of significant occlusive disease (ankle-brachial index $>$ 0.9), and PAA not involving below knee segments. Interventions were performed via antegrade femoral access in 23 limbs (31%) using commercially available endografts. Device diameters ranged between 7 and 13 mm, with a median of 2 devices per PAA, and mean treatment length was 22 cm (range, 5−36 cm). All patients were followed with duplex ultrasound surveillance and were prescribed clopidogrel and/or aspirin.

**Results:** Patients treated endovascularly were older (82 vs. 70 years old, $P = 0.01$), but had shorter length of stay (2 vs. 12 days, $P = 0.01$) and lower complication rates (8% vs. 17%, $P = 0.02$). Mean surveillance interval was 39 months with similar 4-year survival (67.9% open and 73.7% endovascular). Primary and secondary patencies were 67.2%, 67.2% after ER and 65.5%, 78.4% for open at 4 years, respectively. Four of 6 endovascular failures were thrombosis within 4 months of intervention and had conversions to open repair (OR). Secondary interventions were required after 48.1% of endovascular and 54.1% of ORs. Three limbs were lost in the series (2 open and 1 endovascular).

**Conclusions:** Similar outcomes can be expected after endovascular and open PAA repair with adherence to specific anatomic and technical selection requisites.

## INTRODUCTION

With an incidence of 7.39 of 100,000 people, popliteal artery aneurysms (PAAs) account for 80% of all peripheral aneurysms.[1] Commonly accepted indications for repair include size $\geq$2 cm or the presence of symptoms (most commonly acute thrombosis or embolism with limb ischemia, or pain and/or swelling associated with extrinsic popliteal vein compression). Traditional repair has been open surgical excision of the aneurysm with interposition bypass or proximal and distal ligation of the aneurysmal segment with bypass of the excluded

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segment. More recently, however, endovascular management has taken a larger role with multiple series now published citing high technical success rates with relatively low complications and primary and/or secondary patency greater than 70% as far out as 5 years.[2–6]

Recent review of the past quarter century of literature suggested very appreciable overall results for endovascular repair (ER) with primary patency of 74% at 1 year and secondary patency of 85% at 3 years compared with 87% and 81% for open repair (OR), respectively.[7] Unfortunately, the literature is incomplete with a wide range of end points used for comparison, leaving considerable debate as to the preferred management of PAAs. To this end, we seek to present our experience with OR and ER of PAAs, the largest comparative cohort presented in the literature to date.

## METHODS

All patients treated for PAA repair from 1999 to 2013 by a single surgeon in 2 hospitals (1 Veteran Affairs hospital and 1 quaternary care academic hospital) were retrospectively reviewed and all were included for whom operative records were available. Aneurysms were treated electively when >2 cm in size and nonelectively in the setting of acute limb ischemia. Patients were offered ER beginning in 2001 if they were deemed high risk for surgery, had minimal occlusive (ankle-brachial index $\geq$ 0.9, >1 vessel tibial runoff), and aneurysm confinement to the above knee popliteal segment. Patients were nonrandomized to open and ER at surgeon discretion, using the aforementioned endovascular consideration criteria.

ER was performed using ipsilateral open femoral exposure with antegrade access via 9–12F sheaths. Wallgrafts (Boston Scientific) were used from 2001 to 2003 until the Viabahn stent graft (Gore) became available at our institution, at which time it became the preferred device. Postoperatively patients were treated with dual-antiplatelet therapy (aspirin and/or Plavix) for 30 days, followed by lifetime aspirin therapy (unless already on alternative antiplatelet or anticoagulation for comorbidities).

Surgical repair was performed using either a posterior approach for aneurysmectomy with interposition graft or a medial approach for bypass with aneurysm exclusion at the surgeon's discretion. In situ greater saphenous vein was used when available with reversed greater saphenous vein or polytetrafluorethylene (PTFE) being used when in situ non reversed greater saphenous vein was not technically appropriate. Arm vein was not used in this cohort. Postoperatively patients were treated with a minimum of aspirin, and Plavix or Coumadin were added based on comorbidities and duplex criteria.[8]

**Table I.** The endovascular cohort was significantly older and experienced significantly shorter length of stay

| Outcome | Endo | Open |
|---|---|---|
| Age (range)* | 82 ± 9.5 (66–98) | 69.9 ± 6.8 (51–74) |
| Sex | 25/25 Male | 50/52 Male |
| Length of stay, days* (range) | 2 ± 2.3 (1–10) | 12 ± 27 (1–135) |
| Follow-up, months (range) | 37.9 ± 36.3 (1–90) | 38.5 ± 31 (1–117) |
| Limb loss | 1 | 2 |
| Complications | 2 | 9[a] |
| Reinterventions | 9 | 27 |
| Concurrent AAA | 19 (76%) | 36 (70%) |

*$P < 0.05$.
The 2 groups were otherwise similar with expected male predominance and high rate of concomitant AAA presence.
AAA, abdominal aortic aneurysm.
[a]Of the 9 complications in the open group, 6 were superficial wound infections treated with antibiotics.

## RESULTS

Seventy-seven PAAs were repaired in our series (25 ER and 52 OR) with a mean follow-up greater than 3 years. The endovascular cohort was significantly older than the OR group and experienced a significantly shorter length of stay, but the cohorts were otherwise similar with respect to sex, follow-up, limb loss, and complication and reintervention rates (Table I).

Most of the ERs were performed with Viabahn endoprosthesis (80%), which were exclusively used since available at our institution in 2003. A median of 2 devices (range, 1–3) was used to cover a mean length of 22.3 cm (Table II).

OR was primarily indicated for patients with occlusive disease (60%) requiring tibial bypass targets for 19% of patients (Table III). Greater saphenous vein was the preferred conduit, however, greater than 30% of patients were treated with PTFE because of lack of adequate saphenous vein. Similar proportion of bypasses was to tibial targets for PTFE (4 of 16) and vein (6 of 36).

Patient survival at 4 years neared 70% for both groups, with the greatest mortality during the third