

# Treatment of Popliteal Aneurysm by Open and Endovascular Surgery: A Contemporary Study of 592 Procedures in Sweden

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## WHAT THIS STUDY ADDS

Previous comparisons between open and endovascular repair of popliteal aneurysms have focused on asymptomatic patients, and have short follow up. This study is strengthened by the fact that it is contemporary, population based, without any selection bias, reporting on all kinds of presentations, and has approximately 90% 1 year follow up data. It shows that endovascular repair has significantly inferior results compared with open repair, in particular in the group of patients who present with acute ischaemia. We believe these results will make many vascular surgeons think twice before they treat patients endovascularly in the future.

**Background:** Popliteal aneurysm (PA) is traditionally treated by open repair (OR). Endovascular repair (ER) has become more common. The aim was to describe time trends and compare results (OR/ER).

**Methods:** The Swedish vascular registry, Swedvasc, has a specific PA module. Data were collected (2008–2012) and supplemented with a specific protocol (response rate 99.1%). Data were compared with previously published data (1994–2002) from the same database.

**Results:** The number of operations for PA was 15.7/million person-years (8.3 during 1994–2001). Of 592 interventions for PA (499 patients), 174 (29.4%) were treated for acute ischaemia, 13 (2.2%) for rupture, 105 (17.7%) for other symptoms, and 300 (50.7%) were asymptomatic (31.5% were treated for acute ischaemia, 1994–2002,  $p = .58$ ). There were no differences in background characteristics between OR and ER in the acute ischaemia group. The symptomatic and asymptomatic groups treated with ER were older ( $p = .006$ ,  $p < .001$ ). ER increased 3.6 fold (4.7% 1994–2002, 16.7% 2008–2012,  $p = .0001$ ). Of those treated for acute ischaemia, a stent graft was used in 27 (16.4%). Secondary patency after ER was 70.4% at 30 days and 47.6% at 1 year, versus 93.1% and 86.8% after OR ( $p = .001$ ,  $< .001$ ). The amputation rate at 30 days was 14.8% after ER, 3.7% after OR ( $p = .022$ ), and 17.4% and 6.8% at 1 year ( $p = .098$ ). A stent graft was used in 18.3% for asymptomatic PA. Secondary patency after ER was 94.5% at 30 days and 83.7% at 1 year, compared with 98.8% and 93.5% after OR ( $p = .043$  and  $0.026$ ). OR was performed with vein graft in 87.6% (395/451), with better primary and secondary patency at 1 year than prosthetic grafts ( $p = .002$  and  $< .001$ ), and with a posterior approach in 20.8% (121/581).

**Conclusions:** The number of operations for PA doubled while the indications remained similar. ER patency was inferior to OR, especially after treatment for acute ischaemia, and the amputation risk tended to be higher, despite similar pre-operative characteristics.

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Article history: Received 20 October 2014, Accepted 11 March 2015, Available online 22 April 2015

**Keywords:** Popliteal artery aneurysm, Open repair, Endovascular, Stent graft, Registry, Amputation

## INTRODUCTION

Popliteal artery aneurysm (PA) is a relatively uncommon disease that has been difficult to study.

Three previous studies of a large number of patients with PA have been published. Ravn et al.<sup>1</sup> reported 571 patients with 717 legs treated in Sweden in 1987–2002: pre-operative thrombolysis improved run-off and reduced the risk of amputation when the patient presented with acute ischaemia,<sup>2</sup> and open repair (OR) with a posterior approach

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<http://dx.doi.org/10.1016/j.ejvs.2015.03.026>

(often using the inlay technique) had better long-term results because of the reduced risk of late expansion.<sup>3</sup> It was not meaningful to compare OR and endovascular repair (ER) during this time period. Johnson et al.<sup>4</sup> studied the outcome of open surgical treatment for popliteal aneurysm in 583 cases in 1994–2005. Low operative mortality and good limb salvage rates were reported.

In a retrospective study from seven Italian centres, Pulli et al.<sup>5</sup> described the outcome of 312 treated PAs, of which 134 had received ER. There were discrepancies between the two groups: more symptomatic patients (64% vs. 34%) and acute presentations (23% vs. 6.5%) in the OR group, and worse run-off score than patients treated with ER. Primary and secondary patency rates were similar for OR and ER, but the great differences in case mix were not addressed when the results were analysed. At 24 months the figures were similar, but in both groups more than half of the patients were lost to follow up, limiting the possibility to evaluate the midterm outcome.

In many centres, OR remains the gold standard for treatment of PA, even though there is diversity in the preferred technique: posterior or medial approach, vein or prosthetic graft. As endovascular treatment in general has become more common, it has emerged as an alternative treatment for PA. A minimally invasive procedure, performed under local anaesthetic, with a short hospital stay is an attractive option, but questions remain about its durability. A limited number of studies have been published, with small cohorts of mostly asymptomatic patients, and short follow up. In the Vascunet collaboration, PA repair could be identified in eight countries for comparison of contemporary treatment.<sup>6</sup> The operations per million person years varied from 3.4 in Hungary to 17.6 in Sweden. Overall, surgery was elective in 72% of cases, but in Hungary only 26%. The proportion of endovascular repair varied from 35% in Australia to zero in Switzerland, Finland, and Iceland.

The Swedvasc Registry<sup>7</sup> introduced a specific registration for treatment of PA in 2008, offering a unique possibility to investigate these issues in a modern context. The overall aim was to study contemporary treatment of PA, and how the choice of technique affects 1 month and 1 year outcomes.

## PATIENTS AND METHODS

The Swedish vascular registry, the Swedvasc, was created in January 1987, and since 1992 has registered more than 90% of open and endovascular vascular surgical procedures in the country.<sup>7</sup> In May 2008 the registry was thoroughly revised. Instead of one set of variables for all vascular surgical procedures, which had been used since the start, specific modules were created for different standard operations, based on the indication for surgery. One such set of modules was created for infra-inguinal arterial procedures, with PA as one specific indication.

All procedures for PA, open or endovascular, confined to the popliteal fossa or extending into the superficial femoral

artery are registered in this specific module. Background characteristics and details of surgical technique are registered prospectively. At 30 days and 1 year, complications, patency, and amputation are recorded. Yet, there were some outstanding issues. Were all procedures on true PA, or were some performed on pseudoaneurysms? Were they all primary procedures, or were re-operations also registered? Were all the pre-operative thrombolysis procedures registered in the PA module as part of the reconstruction or as separate interventions for acute ischaemia? To validate the registry data, and to enable analysis of the details mentioned above, a questionnaire was created and sent to the 30 hospitals that had treated and registered the patients, and an additional case record analysis was performed.

## Retrieval of operations

In the Swedvasc, 668 interventions for PA were registered between May 2008 and May 2012. Dual registrations such as pre-operative thrombolysis followed by aneurysm repair were identified in Swedvasc and merged. A protocol was sent out to the 30 institutions having registered the procedures to verify the remaining registrations (592). The principal investigator (A.C.) performed 165 of these protocols in site visits to four larger institutions. The remaining protocols were registered by co-authors of this paper or by the local Swedvasc representatives. The following 86 interventions were excluded or merged with other registrations: pre-operative thrombolysis and percutaneous transluminal angioplasty (29), reoperations (21), interventions on peripheral aneurysms other than PA (26), and other reasons (10). Ten non-registered interventions on PA during the designated period were identified and added (10/592, 1.7%), seven of which were performed on the contralateral leg.

When analysing time trends, data were compared with those during 1994–2002 from a previous publication from the same database,<sup>1–3</sup> except for the incidence of PA repair when 1994–2001 was used,<sup>1</sup> since data from the last 2 months of 2002 were suspected to be incomplete.

## Statistics

The chi-square test was used for categorical variables. For continuous variables Levene's test was used to test normal distribution. If homogeneity was violated, it was adjusted for with the Brown–Forsythe test. The ANOVA test was used to compare differences between multiple subgroups, and the Tukey range test was used for inter-group comparisons. All tests were two-tailed. A  $p$  value  $< .01$  was considered significant, adjusting for multiple comparisons. A  $p$  value  $< .05$  was considered a statistical trend. Multivariate statistics were not considered feasible because of the small number of events (occlusion, amputation, death) in the different subgroups. All statistical analyses were performed using the software package SPSS version 20.0 (IBM SPSS, Inc.).

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