REVIEW ARTICLE

Endovascular versus Open Repair of Asymptomatic Popliteal Artery Aneurysms: A Systematic Review and Meta-Analysis

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ABSTRACT

This systematic review compared outcomes between endovascular and open repair of asymptomatic popliteal artery aneurysms (PAAs). Endovascular repair was associated with increased 30-day graft occlusion (odds ratio [OR] = 3.14; 95% confidence interval [CI], 1.43–6.92) and increased 30-day reintervention (OR = 4.09; 95% CI, 2.79–6.00). The 12-month primary patency rate was significantly higher in the open repair group (hazard ratio = 1.95; 95% CI, 1.14–3.33). Endovascular repair was associated with shorter length of hospital stay (mean difference = −3 d; 95% CI, −4.09 to −1.91; $P < .001$). Endovascular repair is associated with inferior perioperative and postoperative outcomes compared with open repair.

ABBREVIATIONS

CI = confidence interval, OR = odds ratio, PAA = popliteal artery aneurysm

Popliteal artery aneurysms (PAAs) account for 70% of peripheral artery aneurysms (1,2). In asymptomatic patients treated conservatively, the complication rate is approximately 42% (3) over a period of 3–5 years. PAAs have been historically associated with increased amputation rates (4–6) as a result of thromboembolic events. Elective open repair by endoaneurysmorrhaphy and great saphenous vein bypass is considered the gold standard and is offered to patients with aneurysms with a diameter of $\geq$ 2 cm.

Recent advances in endovascular technique and technology offer an increasingly attractive alternative to open repair, especially for elderly patients with multiple comorbidities, as it is less invasive and might be associated with shorter hospital stay and operative time. In the United Kingdom, despite increasing enthusiasm for endovascular repair of PAAs, recent National Institute for Health and Care Excellence guidance (7) on implementing endovascular repair for PAAs as a gold standard is inconclusive because of lack of evidence in the form of randomized controlled trials. Since the publication of a meta-analysis by Cina (2), multiple studies have emerged comparing outcomes of endovascular repair versus open repair of PAAs. Therefore, an updated meta-analysis is required. The objective of the present meta-analysis was to compare endovascular repair and open repair of PPAs in terms of operative, perioperative, and postoperative outcomes.

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MATERIALS AND METHODS

Search Strategy

A systematic search of the literature was performed in the following medical databases: MEDLINE, Embase, and Cochrane Central Register of Controlled Trials. In addition, the reference lists of relevant articles were searched to identify articles missed by the electronic searches. We used the Medical Subject Headings and free keywords "aneurysm," "popliteal artery," "open repair," "endovascular repair," "comparative," "endovascular procedures," "open procedures," "stents," and "outcome." An expanded search was done using Boolean operators. The search was limited to studies published in English and involving human subjects. We used Preferred Reporting Items for Systematic Reviews and Meta-Analyses in the reporting of our study (8).

Inclusion Criteria

Studies were eligible to be included in the meta-analysis if they met the following criteria: studies that (*a*) were of any design that compared outcomes between endovascular repair and open repair of PAAs, (*b*) included at least one of the outcome measures of the present meta-analysis, and (*c*) were published in English from inception until July 2015. These studies are summarized in **Table 1**. Studies reporting asymptomatic PAA repairs were included. Studies were excluded if they failed to report comparative outcomes or if data extraction from published reports failed.

Data Extraction

The following data were recorded for each study: first author, year of publication, country of publication, total number of patients, patient characteristics (age and sex), number of patients in each group (endovascular repair/open repair), graft type, and follow-up period. Authors of included studies were contacted when data were unavailable as appropriate. Two independent reviewers extracted and checked the studies included. Disagreements between the reviewers were resolved by consensus.

Statistical Analysis

Generic inverse variance was used to compare all outcomes between endovascular and open repair groups using odds ratios (ORs) for dichotomous variables and weighted mean differences for continuous variables with their corresponding SEs and 95% confidence intervals (CIs). Primary patency rates were pooled using hazard ratios after being extracted from Kaplan-Meier survival curves as suggested by Parmer, Torri, and Stewart (9). Studies that reported zero events in one of the groups for a specific outcome resulted in difficulty in estimating the OR of that outcome. To overcome this problem, Haldane correction was used where a value of 0.5 was added to both groups for that particular outcome (10). In studies reporting the median and interquartile range, we took the median to be representative of the mean and converted the interquartile range into SD by dividing it by 1.35 (11). We also converted SD and 95% CI to SE by using a standard formula (11). We conducted a sensitivity analysis to assess the contribution of each study to the pooled treatment effect by excluding each study one at a time and recalculating the pooled treatment effect for the remaining studies. Treatment effect was significant if $P < .050$. Heterogeneity between studies was tested with use of the χ^2 test (significant if $P < .100$) and the I^2 test (with substantial heterogeneity defined as values > 50%). When studies showed significant heterogeneity, a random-effects model was used to calculate the pooled effect sizes. A fixed-effects model was used when heterogeneity was insignificant. Review Manager version 5.0 was used for data analysis (12).

Risk of Bias and Quality of Included Studies

Risk of bias was assessed of all articles using the Cochrane Collaboration tool for assessing risk of bias (11) and the Jadad scoring system (13) for clinical trials and the Newcastle-Ottawa quality scale for cohort studies (**Table 2**) (14).

Outcome Measures

Outcomes of this meta-analysis were divided into three areas: (*a*) operative outcomes; operative time recorded in minutes, (*b*) perioperative (30-d) outcomes including graft occlusion, reintervention rate, amputation rate, length of hospital stay recorded in days, and (*c*) postoperative outcomes; 12-month primary patency rate, which is defined as time from surgery to graft or stent occlusion during the first 12 months of the follow-up period, and 12-month secondary patency rate, which is defined as time from surgery to graft or stent occlusion requiring intervention to restore blood flow.

Table 1. Characteristics of Patients and Included Studies

Author, Year	Country	Design	Age (y)	Endovascular (n)	Open (n)	Male Sex (n)	Graft Type
Antonello et al, 2005 (15)	Italy	RCT	63	15	15	26	HEMOBAHN*
Stone et al, 2005 (17)	US	Retro.	72	15	41	52	VIABAHN†, WALLGRAFT‡
Curi et al, 2007 (16)	Spain/US	Retro.	72	7	48	NR	VIABAHN†
Pulli et al, 2012 (18)	Italy	Retro.	73	21	43	62	HEMOBAHN*, VIABAHN†
Pulli et al, 2013 (19)	Italy	Retro.	72	134	178	26	HEMOBAHN*, VIABAHN†
Galinanes et al, 2013 (20)	US	Retro.	76	549	2,413	2,792	NR
Huang et al, 2014 (21)	US	Retro.	76	25	77	101	VIABAHN†
Bjorck et al, 2014 (22)	Multiple	Retro.	70	326	1,145	1,406	NR
Cervin et al, 2015 (23)	Sweden	Retro.	70	95 (legs)	473 (legs)	474	NR
Eslami et al, 2015 (24)	US	Retro.	71	169	221	377	NR

NR = not reported; RCT = randomized controlled trial; Retro. = retrospective.
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