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Hemodialysis patients have worse outcomes after infrageniculate revascularization procedures

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ABSTRACT

Background: Hemodialysis (HD) has been shown to be an independent predictor of poor outcomes after femoropopliteal revascularization procedures in patients with chronic limb-threatening ischemia. However, HD patients tend to have isolated infrageniculate disease, an anatomic risk factor for inferior patency. We aimed to compare outcomes for HD *versus* non-HD patients after infrageniculate open lower extremity bypass (LEB) and endovascular peripheral vascular interventions (PVIs).

Methods: Data from the Society for Vascular Surgery Vascular Quality Initiative database (2008-2014) were analyzed. All patients undergoing infrageniculate LEB or PVI for rest pain or tissue loss were included. One-year primary patency (PP), secondary patency (SP), and major amputation outcomes were analyzed for HD *versus* non-HD patients stratified by treatment approach using both univariable and multivariable analyses.

Results: A total of 1688 patients were included, including 348 patients undergoing LEB (HD = 44 *versus* non-HD = 304) and 1340 patients undergoing PVI (HD = 223 *versus* non-HD = 1117). Patients on HD more frequently underwent revascularization for tissue loss (89% *versus* 77%, $P < 0.001$) and had ≥2 comorbidities (91% *versus* 76%, $P < 0.001$). Among patients undergoing LEB, 1-y PP (66% *versus* 69%) and SP (71% *versus* 78%) were similar for HD *versus* non-HD ($P \geq 0.25$) groups, but major amputations occurred more frequently in the HD group (27% *versus* 14%; $P = 0.03$). Among patients undergoing PVI, 1-y PP (70% *versus* 78%) and SP (82% *versus* 90%) were lower and the frequency of major amputations was higher (27% *versus* 10%) for HD patients (all, $P \leq 0.02$). After correcting for baseline differences between the groups, outcomes were similar for HD *versus* non-HD patients undergoing LEB ($P \geq 0.21$) but persistently worse for HD patients undergoing PVI (all, $P \leq 0.006$).

Conclusions: HD is an independent predictor of poor patency and higher risk of major amputation after infrageniculate endovascular revascularization procedures for the

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treatment of chronic limb-threatening ischemia. The use of endovascular interventions in these higher risk patients is not associated with improved limb salvage outcomes and may be an inappropriate use of healthcare resources.

Introduction

The treatment of chronic limb-threatening ischemia (CLTI) due to infrageniculate atherosclerosis is challenging, largely in part because the etiology behind the disease is variable. Infrageniculate arterial occlusive disease tends to be more common in patients with diabetes and chronic kidney disease, whereas classic smoking-related atherosclerosis is usually found in the ileofemoral distribution.[1,2]

In an effort to define the optimal treatment approach for infrageniculate CLTI, a number of studies have compared outcomes after open lower extremity bypass (LEB) and endovascular peripheral vascular interventions (PVIs). There are some data to suggest that outcomes after infrageniculate revascularization are better after LEB.[3,4] However, others suggest that outcomes are similar with both approaches or even superior for PVI.[5-7]

The discrepancies in these findings are likely reflective of the different populations being studied. Certain patient subgroups have different outcomes after lower extremity revascularization than others. Specifically, end-stage renal disease patients appear to have different outcomes compared to their nonrenal disease counterparts. Hemodialysis (HD) has been shown to be an independent predictor of poor outcomes after open and endovascular lower extremity revascularization in patients with CLTI.[8,9] Survival and amputation-free survival have also been shown to be lower in HD patients compared to non-HD patients after infrainguinal bypass.[10] However, the majority of currently available data examining outcomes among HD patients are based on interventions for femoropopliteal disease[5,11]; there is a paucity of data comparing outcomes for HD *versus* non-HD patients after infrageniculate revascularization.

In the present study, our aim was to compare outcomes for HD *versus* non-HD patients after infrageniculate PVI *versus* LEB procedures for CLTI.

Methods

Study cohort

We included all patients recorded in the Society for Vascular Surgery (SVS) Vascular Quality Initiative Database between January 1, 2008, and December 31, 2014, who underwent an infrageniculate revascularization for CLTI. Infrageniculate revascularizations included PVI (popliteal and/or tibial) and LEB (popliteal–tibial, popliteal–pedal, or tibial–tibial) interventions at or below the knee. CLTI was defined as the presence of rest pain or tissue loss. Patients were excluded if they underwent concomitant revascularization procedures above the knee, common femoral endarterectomy, or hybrid procedures including LEB with concurrent ipsilateral PVI. Patients were also excluded if they underwent revascularization for an indication other than rest pain or tissue loss (i.e., claudication or acute limb ischemia) or if they were missing primary outcome data. Finally, data from all institutions reporting <50% long-term follow-up data were excluded in accordance with Vascular Quality Initiative (VQI) reporting standards.

The VQI is a quality-centered database developed and maintained by the SVS Patient Safety Organization. Data are entered by individual participating institutions but subject to internal audits to ensure compliance with data accuracy and completeness.[12,13] Long-term follow-up data are entered for 9 to 15 mo postoperatively, which allows for the reporting of 1-y outcomes overall. The Johns Hopkins Institutional Review Board approved the study. Informed consent was waived because the data are available through the SVS Patient Safety Organization as part of a quality improvement initiative.

Exposures

Our comparison groups were patients on HD at the time of revascularization *versus* patients who were not on hemodialysis (non-HD). We compared outcomes for HD *versus* non-HD patients after PVI and LEB separately in an effort to reduce the heterogeneity of the groups being compared.

Outcomes

Long-term follow-up is limited to 1 y in the VQI database. Our primary outcomes were primary patency (PP), secondary patency (SP), major amputation, and overall mortality at 1 y postoperatively. Patency was determined based on individual reporting through the VQI database in accordance with SVS Reporting Standards.[14] PP was defined as a revascularization with uninterrupted patency that did not require any additional procedures beyond the original revascularization. SP was defined as a patent revascularization that was maintained with the assistance of additional revascularization procedures, either to maintain patency or reestablish patency after a reocclusion. Major amputation was defined as any amputation at or above the level of the ankle. Mortality was defined as all-cause mortality, which was obtained through linkage of VQI dataset with the Social Security Death Index.

Statistical analysis

Descriptive statistics were reported using median (interquartile range [IQR]) or count (percent) as appropriate. Baseline characteristics were compared between the HD *versus* non-HD patients undergoing (1) PVI and (2) LEB using univariable statistics, including Student's *t*-tests for continuous variables and Pearson's chi-squared tests for categorical variables. Kaplan–Meier analyses and log-rank tests were used to