Open versus endoscopic great saphenous vein harvest for lower extremity revascularization of critical limb ischemia

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Objective: **This study determined wound complication rates, intervention rates, failure mechanisms, patency, limb salvage, and overall survival after lower extremity revascularization using open vein harvest (OVH) vs endoscopic vein harvest (EVH) for critical limb ischemia.**

Methods: **A single-institution review was conducted of consecutive patients who underwent infrainguinal bypass with a single-segment reversed great saphenous vein between 2005 and 2012.**

Results: **A total of 251 patients with critical limb ischemia underwent revascularization, comprising 153 with OVH and 98 with EVH. The OVH group had a lower mean body mass index (26.7 vs 29.9 kg/m^2; $P = .001$). There were no other differences in demographics, comorbidities, medications, smoking, or in the proximal or distal anastomotic site. Median operative times were 249 minutes (OVH) vs 316 minutes (EVH; $P < .001$). Median postoperative hospital length of stay was 7 days (OVH) vs 5 days (EVH; $P < .001$). Median follow-up was 295 days (OVH) vs 313 days (EVH; $P = .416$). During follow-up, 21 OVH grafts (14%) and 27 EVH grafts (28%) underwent an intervention ($P = .048$). There were a similar number of surgical interventions: 50% (OVH) vs 61% (EVH; $P = .449$). Failed grafts had a mean of 1.2 stenoses per graft, regardless of harvest method. Median stenosis length was 2.1 cm (OVH) vs 2.5 cm (EVH; $P = .402$). At 1 and 3 years, the primary patency was 71% and 52% (OVH) vs 58% and 41% (EVH; $P = .010$), and secondary patency was 88% and 71% (OVH) vs 88% and 64% (EVH; $P = .266$). A secondary patency Cox proportional hazard model showed EVH had a hazard ratio of 2.93 (95% confidence interval, 1.03-8.33; $P = .044$). Overall and harvest-related wound complications were 44% and 29% (OVH) vs 37% and 12% (EVH; $P = .226$ and $P = .002$). At 5 years, amputation-free survival was 48% (OVH) vs 54% (EVH; $P = .305$), and limb salvage was 89% (OVH) and 91% (EVH; $P = .615$).**

Conclusions: **OVH and EVH have similar failure mechanisms, limb salvage, amputation-free survival, and overall survival. EVH is associated with impaired patency, increased need for intervention, longer operative times, shorter hospital stays, and decreased vein harvest site wound complications. OVH of the great saphenous vein may provide optimal patency but was not necessarily associated with better patient-centered outcomes. Similar limb salvage rates and amputation-free survival may justify the use of EVH, despite inferior patency, to capture shorter hospital stays and decreased wound complications. (J Vasc Surg 2014;59:427-34.)**

Peripheral arterial disease is responsible for almost all of the lower extremity bypasses performed each year in the United States. Surgical bypass is the best treatment when possible for TransAtlantic Inter-Society Consensus D lesions due to the poor patency rates of catheter-based endovascular interventions.[1] Autologous vein is the preferred conduit, with significantly better 5-year patency rates than bypasses performed with prosthetic material.[2-7] Unfortunately, the wound complication rate with continuous incisions for great saphenous vein (GSV) harvest can be as high as 30% to 40%.[8,9]

In an attempt to minimize morbidity, skip incisions with intervening skin bridges have been used. Wound complication rates with this approach are 3.2% to 25%.[10-14] Endoscopic vein harvest (EVH) is widely used in coronary artery bypass grafting due to a perceived reduction in wound-related complications, improved patient satisfaction, lower postoperative pain, and reduced postoperative length of stay. Nonetheless, EVH has been used less frequently in lower extremity bypass.[15-18]

Although early studies reported favorable cost, length of stay, readmission, short-term patency, and wound complication profiles with EVH,[8,17-21] recent publications have suggested that with longer follow-up, there may be a patency advantage in favor of traditional open vein harvest (OVH).[22,23] The literature currently provides conflicting evidence on the equivalence of OVH and EVH in cardiac and vascular surgery, an issue brought to the forefront of national attention in 2009 when EVH was implicated in decreased overall survival amongst coronary bypass

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patients.[24] Furthermore, we are not aware of any study that has compared the angiographic features of failing OVH and EVH grafts performed for critical limb ischemia (CLI).

The purpose of this study was to review our lower extremity bypass experience in CLI patients and determine if wound complication rates, limb salvage rates, amputation-free survival, long-term patency, and overall survival were equivalent between OVH and EVH groups. In addition, we sought to determine if OVH and EVH grafts failed differently by comparing angiograms of failing grafts for stenosis location, stenosis length, and the number of stenoses.

METHODS

The Oregon Health and Science University Institutional Review Board approved the experimental protocol in this study, and informed consent was waived due to the retrospective nature of the study.

We reviewed our operative database to identify all lower extremity bypasses performed with autologous vein between January 2005 and February 2012. This interval was chosen to correspond with the beginning of our experience with EVH. For this study, we included consecutive bypasses that used a single GSV and were performed for CLI.

All EVHs were performed by two authors (G.L., T.L.) and a vascular surgery resident (postgraduate year 5-8), using the Vasoview Endoscopic Vessel Harvesting System (Maquet, Rastatt, Germany). When longer vein conduits were needed for below-knee bypasses, the below-knee vein segment was harvested through the distal anastomotic incision. OVH usually consisted of a single continuous incision. The harvest technique used was at the discretion of the primary attending surgeon.

All patients underwent preoperative vein mapping to determine whether a suitable vein was available for bypass rather than the harvest method to be used. Follow-up consisted of postoperative clinic visits and duplex ultrasound graft surveillance studies every 6 months after initial visits at 1, 3, and 6 months.

Medical records were reviewed and all data extracted pertaining to demographics, medical comorbidities, physical examination findings, medications, prior lower extremity interventions, operative indication, preoperative vein mapping, operative conduct, short-term and long-term morbidity and mortality, preoperative and postoperative angiographic features, and interventions. Primary patency, primary assisted patency, secondary patency, limb salvage, amputation-free survival, and overall survival were calculated from records.

Renal insufficiency was defined as a mean serum creatinine >1.5 mg/dL at the time of the operation. Medication profiles were those at the time of the initial consultation. Patients were categorized as former smokers if they had quit >8 weeks before the operation.

Preoperative vein mapping was performed by an accredited vascular laboratory, and minimum and maximum reported diameters were taken from official diagnostic reports. Pulses were categorized as palpable when documented as palpable, strong, or 2+. Operative conduct was gathered from operative notes, and operative times were calculated from anesthesia records. Surgical incision and surgical end times were used rather than anesthesia start and stop times. Grafts were preferentially tunneled anatomically, except for those originating in the proximal thigh and going to the anterior tibial artery, which were tunneled subcutaneously.

Postoperative wound complications were defined according to Szilagyi criteria.[25] Wound complications were further categorized as "vein harvest" or "anastomotic incision." Vein harvest complications included those described as being remote from anastomotic site incisions or when notes specifically referenced the "harvest incision" or the endoscopic tunnel.

Major amputations included any below-knee or above-knee amputation, and minor amputations included toe or partial foot amputations. Patency was defined according to established Society for Vascular Surgery standards for graft patency reporting.[26] Arteriograms were obtained in all patients before anticipated bypass revisions, as prompted by clinical change or surveillance duplex findings suggestive of stenosis—focal peak systolic velocity >200 cm/s, systolic velocity ratio >3.0, midgraft velocity <45 cm/s, or an interval drop in the ankle-brachial index of ≥0.2.[27]

Failure mechanisms were determined by reviewing arteriograms for location, number, and length of stenoses. A single stenosis ≤4 cm was categorized as a "single-segment" failure, two or more discrete lesions were reported as a "multisegment" failure, and a single lesion >4 cm was reported as a "long-segment" failure. We defined loss to follow-up as 18 months without a clinic visit or correspondence.

Categoric variables were analyzed using χ^2 or the Fisher exact test. Continuous variables were analyzed using the unpaired Student *t*-test or Mann-Whitney test. Normally distributed variables are expressed as means ± standard deviation, and nonparametric variables are expressed as medians and interquartile range (IQR). Time-to-event variables were analyzed using the log-rank test of Kaplan-Meier analysis. Cox proportional hazard modeling was performed on selected time-to-event outcome variables. Statistical analyses were performed using SPSS 21 software (IBM Corp, Armonk, NY). Significance was set at $P = .05$, and two-sided values are reported where applicable.

RESULTS

Between January 2005 and February 2012, 382 lower extremity bypasses were performed with autologous vein, 251 of which were performed with a single GSV for CLI. The remaining 131 patients were excluded because 64 had a bypass with arm vein, 56 had a bypass for claudication, 5 had bilateral open GSV harvest, 2 had a GSV bypass for trauma, 2 had a GSV bypass for popliteal aneurysms, and 2 had a GSV bypass for infection of a prosthetic bypass performed at another institution.