From the Western Vascular Society

Vein harvesting technique for infrainguinal arterial bypass with great saphenous vein and its association with surgical site infection and graft patency

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Objective: **The objective of this study was to investigate the association of vein harvesting technique (VHT) with surgical site infection (SSI) and graft patency after infrainguinal arterial bypass.**

Methods: **The Vascular Quality Initiative database was used to review VHT of all patients undergoing single-segment great saphenous vein graft infrainguinal arterial bypass from 2003 to 2013. Patients were divided into three groups according to the VHT used (continuous incision, skip incision, and endoscopic). Multinomial logistic regression was performed to estimate propensity scores for each treatment group. Propensity score adjustment was included in multivariable analysis of the primary outcomes: SSI and graft primary patency.**

Results: **From 2003 to 2013, 5066 patients underwent single-segment great saphenous vein graft infrainguinal bypass. The VHT was continuous incision in 48.6%, skip incision in 39.7%, and endoscopic in 12.7%. SSI rates did not differ significantly among the groups (continuous, 4.7%; skip, 4.0%; endoscopic, 3.4%; $P = .278$). On multivariable analysis, there was no difference in discharge primary patency between the three groups. At 1 year, primary patency rates were 69.5% for continuous, 73.0% for skip, and 58.6% for endoscopic ($P < .001$). After multivariable analysis, endoscopic vein harvest was independently associated with higher 1-year primary patency loss compared with both continuous (hazard ratio [HR], 1.35; 95% confidence interval [CI], 1.05-1.74; $P = .020$) and skip (HR, 1.53; 95% CI, 1.18-2.00; $P = .002$). There was no significant difference in 1-year primary patency loss between continuous and skip techniques (HR, 0.88; 95% CI, 0.73-1.05; $P = .170$).**

Conclusions: **No association between the choice of VHT and the development of SSI after infrainguinal arterial bypass was identified in the Vascular Quality Initiative population. Endoscopic VHT was associated with significantly reduced 1-year primary patency rate compared with both continuous and skip techniques. (J Vasc Surg 2015;61:1264-71.)**

Wound complications related to the vein harvesting site have major implications and result in significant morbidity in patients undergoing infrainguinal arterial bypass.[1] The reported incidence of complications is 22% to 44% and includes hematoma, dehiscence, infection, and impaired healing.[2-4] Minimally invasive techniques for vein harvesting have the potential benefit of reducing wound-related complications, reducing postoperative pain, and shortening hospital length of stay (LOS).[5-8]

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As the literature expands on this issue, concerns have emerged regarding the potential detrimental effect of the minimally invasive vein harvesting technique (VHT) on graft patency. For patients undergoing myocardium revascularization, the use of endoscopic technique was found to be associated with decreased graft patency and worse cardiac-related outcomes.[9-11] Similarly, decreased patency rates have been reported with endoscopic vein harvest for patients undergoing peripheral bypasses.[5,9,12-16] As such, the objective of this study was to investigate the association between VHT and the incidence of surgical site infection (SSI) and graft primary patency rates.

METHODS

After approval by the Society for Vascular Surgery's Patient Safety Organization Research Advisory Subcommittee, the infrainguinal bypass module of the Vascular Quality Initiative (VQI) database was queried from 2003 to 2013. Data compiled under the auspices of the Society for Vascular Surgery's Patient Safety Organization are in compliance with the Patient Safety Act, which allows patient data to be captured within a quality improvement framework, forgoing the requirement of Institutional Review Board approval or patient consent. Nonidentifiable data can also be used by the participating centers for quality improvement projects and outcomes research.[17] All patients undergoing infrainguinal arterial bypass with use of a single-segment great saphenous vein (GSV) graft that had documented VHT were identified and included in the study. Data abstracted included basic demographics and comorbidities, previous history of cardiovascular interventions, preoperative and postoperative medications, procedure-specific variables, local and systemic complications, and graft patency status. Patients were divided into three study groups according to the VHT used: continuous incision, skip incision, and endoscopic. The primary outcome measures were incidence of SSI, primary graft patency at discharge, and 1-year primary patency. In the VQI, for a wound complication to be attributed to an infectious etiology, a positive culture or the need for antibiotic therapy must be documented. Other forms of wound failure, such as lymphocele, skin or subcutaneous tissue necrosis, and wound dehiscence, are not included in the definition of SSI. Primary patency is defined as a patent bypass graft documented by Doppler signal on the graft, palpable graft pulse, palpable distal pulse, or ankle-brachial index increase >0.15 on graft duplex examination, in the absence of any invasive intervention performed to restore patency.

Continuous variables were reported as mean ± standard deviation and median with interquartile range. Categorical variables were reported as frequency (percentage). The χ^2 test was used to compare the general association between the baseline factors and type of VHT. To minimize the potential bias associated with pretreatment differences among the study groups, regression adjustment using multiple propensity scores was performed. As previously demonstrated, propensity score adjustment is a valid tool to adjust for pretreatment differences in nonrandomized studies with multiple treatment groups.[18-20] To estimate the propensity scores, multinomial logistic regression analysis was used. In this regression, the treatment group was entered as the dependent variable, and all the pretreatment variables that had a general association with the type of VHT at $P < .20$ were entered as covariates. The probabilities of undergoing vein harvesting with each of the three techniques were derived from the equation and subsequently saved as the multiple propensity scores for each patient. The distribution of each of the saved propensity scores within each study group was plotted for comparison across the three treatment modalities. The propensity scores were considered adequate to be used for adjustment only if a significant overlap of the distribution among the study groups was observed, demonstrating that the groups were comparable.[18,21] Successful use of propensity score adjustment also relies on the ability to achieve between-group balance on each of the baseline variables. To demonstrate that balance was achieved between study groups, pairwise treatment-group comparison of each baseline factor was obtained correcting for the propensity score. Two logistic regression analyses were done with each baseline factor as the dependent variable, including the VHT variable and two of the multiple propensity scores as independent variables. By use of a different indicator for the VHT variable in each of these regressions, a balanced P value for each treatment pair was obtained.

To identify factors associated with the development of SSI in the study population, univariate analysis was performed, and all factors significant at $P < .20$ on univariate analysis were entered into a stepwise logistic regression analysis. The factors independently associated with SSI were identified, and adjusted odds ratios (ORs) with 95% confidence intervals (CIs) were derived from the equation.

In our primary analysis, the association between VHT and SSI was assessed by logistic regression and adjusting for the multiple propensity scores previously obtained. As the sum total of the propensity scores derived for multiple treatment groups is one, only two of the propensity scores needed to be included in the adjustment.

Analogous analysis was performed to investigate the association of VHT and primary graft patency on hospital discharge. Factors independently associated with primary patency at hospital discharge were identified by stepwise logistic regression, using factors identified from univariate analysis.

The association between VHT and primary patency at hospital discharge was evaluated by logistic regression analysis, adjusting for the multiple propensity scores. Adjusted OR and 95% CI were derived.

The 1-year primary patency rates were calculated with the life-table method, and Kaplan-Meier curves were plotted for each of the VHT groups. The log-rank test was used for pairwise comparison of the primary patency time-to-event curves. Cox proportional hazards modeling was then used to perform multivariable analysis of patency among the three study groups, adjusting for the multiple propensity scores.

The crude differences in hospital LOS among the VHT groups were assessed by analysis of variance. A general linear model logistic regression was then created with the hospital LOS as the dependent variable and the VHT and the multiple propensity scores as the independent variables. Adjusted mean differences with 95% CI and adjusted P values were derived from the equation.

All statistical analysis was performed with IBM SPSS Statistics, version 20, and a P value $< .05$ was considered statistically significant.

RESULTS

From 2003 to 2013, 5066 patients undergoing single-segment GSV graft infrainguinal bypass with documented VHT were available in the VQI database. Single-segment GSV bypasses accounted for 55.5% of all bypasses performed during the study period. The VHT used was continuous incision in 48.6%, skip incision in 39.7%, and endoscopic in 12.7% of the cases. Median follow-up was 352 days (interquartile range, 279-421). Follow-up information was documented for 51.9% (2629) of the population, and 44.4% (1168) of these patients were observed for a minimum of 1 year.