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Perioperative outcomes of infrainguinal bypass surgery in patients with and without prior revascularization

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ABSTRACT

Objective: Although an increasing number of patients with peripheral arterial disease undergo multiple revascularization procedures, the effect of prior interventions on outcomes remains unclear. The purpose of this study was to evaluate perioperative outcomes of bypass surgery in patients with and those without prior ipsilateral treatment.

Methods: Patients undergoing nonemergent infrainguinal bypass between 2011 and 2014 were identified in the National Surgical Quality Improvement Program Targeted Vascular module. After stratification by symptom status (chronic limb-threatening ischemia [CLTI] and claudication), patients undergoing primary bypass were compared with those undergoing secondary bypass. Within the secondary bypass group, further analysis compared prior bypass with prior endovascular intervention. Multivariable logistic regression analysis was used to establish the independent association between prior ipsilateral procedure and perioperative outcomes.

Results: A total of 7302 patients were identified, of which 4540 (62%) underwent primary bypass (68% for CLTI), 1536 (21%) underwent secondary bypass after a previous bypass (75% for CLTI), and 1226 (17%) underwent secondary bypass after a previous endovascular intervention (72% for CLTI). Prior revascularization on the same ipsilateral arteries was associated with increased 30-day major adverse limb event in patients with CLTI (9.8% vs 7.4%; odds ratio [OR], 1.4 [95% confidence interval (CI), 1.1-1.7]) and claudication (5.2% vs 2.5%; OR, 2.1 [95% CI, 1.3-3.5]). Similarly, secondary bypass was an independent risk factor for 30-day major reintervention (CLTI: OR, 1.4 [95% CI, 1.1-1.8]; claudication: OR, 2.1 [95% CI, 1.3-3.5]), bleeding (CLTI: OR, 1.4 [95% CI, 1.2-1.6]; claudication: OR, 1.7 [95% CI, 1.3-2.4]), and unplanned reoperation (CLTI: OR, 1.2 [95% CI, 1.0-1.4]; claudication: OR, 1.6 [95% CI, 1.1-2.1]), whereas major amputation was increased in CLTI patients only (OR, 1.3 [95% CI, 1.01-1.8]). Postoperative mortality was not significantly different in patients undergoing secondary compared with primary bypass (CLTI: 1.7% vs 2.2% [$P = .22$]; claudication: 0.4% vs 0.6% [$P = .76$]). Among secondary bypass patients with CLTI, those with prior bypass had higher 30-day reintervention rates (7.8% vs 4.9%; OR, 1.5 [95% CI, 1.0-2.2]) but fewer wound infections (7.3% vs 12%; OR, 0.6 [95% CI, 0.4-0.8]) compared with patients with prior endovascular intervention.

Conclusions: Prior revascularization, in both patients with CLTI and patients with claudication, is associated with worse perioperative outcomes compared with primary bypass. Furthermore, prior endovascular intervention is associated with increased wound infections, whereas those with prior bypass had higher reintervention rates. The increasing prevalence of patients undergoing multiple interventions stresses the importance of the selection of patients for initial treatment and should be factored into subsequent revascularization options in an effort to decrease adverse events. (J Vasc Surg 2017;■:1-12.)

Peripheral arterial disease (PAD) affects 12% to 20% of people in the United States older than 60 years and is associated with substantial morbidity and mortality.¹ As the proportion of elderly patients as well as the utilization of endovascular procedures continues to increase,

rates of reintervention for PAD have been steadily rising.^{2,3} Among patients undergoing lower extremity bypass surgery in the current era, it is estimated that 22% to 25% underwent prior ipsilateral endovascular interventions and 13% to 19% had prior ipsilateral open

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bypass.⁴⁻⁶ Despite increased rates of reintervention, the impact of subsequent revascularization procedures has only recently been studied.

Long-term outcomes comparing primary and secondary bypass have been reported with conflicting results. Several studies demonstrated worse outcomes in those patients undergoing secondary bypass, yet others found equivocal long-term outcomes in patients with prior endovascular interventions.⁶⁻¹² Interestingly, despite data on the long-term impact of secondary bypass, differences in perioperative outcomes remain unclear. Previous studies suggest that prior unsuccessful treatment is not associated with worse perioperative performance of bypass surgery.⁹⁻¹² However, a study of 3504 patients undergoing bypass surgery, of which 33% were secondary bypass, found prior revascularization to be a risk factor for in-hospital return to the operating room and graft occlusion at discharge.⁶ The body of literature on this topic is still limited; most recent studies included only single-institution data with small sample sizes and were unable to adjust for prior procedure type.

Therefore, the purpose of this study was to assess perioperative outcomes in patients undergoing bypass surgery after prior ipsilateral bypass surgery or endovascular intervention using a large national representative clinical registry.

METHODS

Data source. Data were obtained from the prospectively collected Targeted Vascular module of the American College of Surgeons National Surgical Quality Improvement Program (NSQIP). NSQIP is a national, multi-institutional, quality improvement initiative of academic and community-based centers that provides 30-day outcomes in an effort to improve overall patient care. Standardized definitions capture demographics, comorbidities, intraoperative variables, and 30-day postoperative outcomes in a randomly selected subset of patients at each participating institution. The Targeted Vascular module includes additional disease- and procedure-specific characteristics as well as procedure-related outcomes chosen by vascular surgeons. Trained clinical reviewers identify potential procedures by reviewing operative case logs, then collect data and categorize procedures using Current Procedural Terminology (CPT) codes at both the targeted and nontargeted NSQIP. To ensure data quality, NSQIP data collection is validated by rigorous audits as well as by comprehensive studies.¹³⁻¹⁵ Further details on the NSQIP and the Targeted Vascular module are available at <https://www.facs.org/quality-programs/acs-nsqip>. This study was approved by the Beth Israel Deaconess Medical Center Institutional Review Board, and informed consent was waived because of the deidentified nature of this registry.

ARTICLE HIGHLIGHTS

- **Significance:** Outcomes of lower extremity bypass in patients with peripheral arterial disease after previous revascularizations are not well known.
- **Type of Research:** Retrospective analysis of prospectively collected data of the American College of Surgeons National Surgical Quality Improvement Program registry
- **Take Home Message:** Bypass surgery after prior revascularization, open or endovascular, is associated with increased rate of complications.
- **Recommendation:** This paper suggests that physicians should consider failed ipsilateral interventions when counseling patients and planning secondary revascularization procedures.
- **Strength of Recommendation:** 2. Weak
- **Level of Evidence:** C. Low or very low

Patients. All patients undergoing a nonemergent infrainguinal bypass between 2011 and 2014 were included. Patients were stratified by symptom status: intermittent claudication vs chronic limb-threatening ischemia (CLTI). Those without documented symptom status and asymptomatic patients were excluded ($n = 313$ [4.1%]). Secondary bypass was defined as a new bypass with a prior endovascular intervention or bypass treating the same ipsilateral arteries as in the current procedure. Additional procedural detail from previous interventions was not captured by NSQIP, which subsequently did not allow us to determine the timing or indication of the prior procedure. Patients without any history of ipsilateral revascularization procedures were designated as undergoing primary bypass. Baseline and intraoperative characteristics as well as 30-day postoperative outcomes were compared between patients undergoing primary and secondary bypass. In a subgroup analysis among patients undergoing secondary bypass, results were stratified according to the type of prior ipsilateral procedures (endovascular vs bypass).

Clinical and outcome variables. Baseline characteristics included demographics, comorbidities, and preprocedural medication. Age was evaluated as a continuous variable; however, all patients 90 years of age or older are recorded as 90+ by NSQIP to prevent identification of individual patients. Antiplatelet medication preoperatively was considered when one of the following agents was documented: aspirin, clopidogrel, eptifibatide, or aspirin-dipyridamole (Aggrenox). Intraoperative details analyzed included procedure type, type of graft/conduit, and procedure time. Type of conduit was grouped by NSQIP into single-segment greater saphenous vein (without documentation of an ipsilateral or contralateral harvested

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