From the Midwestern Vascular Surgical Society

Predictors of surgical site infection after open lower extremity revascularization

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CME Activity

Purpose or Statement of Need The purpose of this journal-based CME activity is to enhance the vascular specialist's ability to diagnose and care for patients with the entire spectrum of circulatory disease through a comprehensive review of contemporary vascular surgical and endovascular literature.

Learning Objectives At the end of this activity, participants should be able to:

- Recognize of the correctable reasons that patients develop surgical site infections after open vascular bypass.
- Modify their practice to reduce the frequency of surgical site infections in vascular patients undergoing open revascularization of the lower extremities.

Target Audience This activity is designed for vascular surgeons and individuals in related specialties.

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ABSTRACT

Objective: Surgical site infection (SSI) after open lower extremity bypass (LEB) is a serious complication leading to an increased rate of graft failure, hospital readmission, and health care costs. This study sought to identify predictors of SSI after LEB for arterial occlusive disease and also potential modifiable factors to improve outcomes.

Methods: Data from a statewide cardiovascular consortium of 35 hospitals were used to obtain demographic, procedural, and hospital risk factors for patients undergoing elective or urgent open LEB between January 2012 and June 2015. Bivariate comparisons and targeted maximum likelihood estimation were used to identify independent risk factors of SSI. Adjusted odds ratios (ORs) were calculated for patient demographics, comorbidities, operative details, and hospital-level factors.

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Results: Our study population included 3033 patients who underwent 703 femoral-femoral bypasses, 1431 femoral-popliteal bypasses, and 899 femoral-distal vessel bypasses. An SSI was diagnosed in 320 patients (10.6%) ≤30 days after the index operation. Adjusted patient and procedural predictors of SSI included renal failure currently requiring dialysis (OR, 4.35; 95% confidence interval [CI], 3.45-5.47; $P < .001$), hypertension (OR, 4.29; 95% CI, 2.74-6.72; $P < .001$), body mass index ≥25 kg/m^2 (OR, 1.78; 95% CI, 1.23-2.57; $P = .002$), procedural time >240 minutes (OR, 2.95; 95% CI, 1.89-4.62; $P <$ .001), and iodine-only skin preparation (OR, 1.73; 95% CI, 1.02-2.91; $P = .04$). Hospital factors associated with increased SSI included hospital size <500 beds (OR, 2.22; 95% CI, 1.09-4.55; $P = .028$) and major teaching hospital (OR, 1.66; 95% CI, 1.07-2.58; $P = .024$). SSI resulted in increased risk of major amputation and surgical reoperation ($P < .01$), but did not affect 30-day mortality.

Conclusions: SSI after LEB is associated with an increase in rate of amputation and reoperation. Several patient, operative, and hospital-related risk factors that predict postoperative SSI were identified, suggesting that targeted improvements in perioperative care may decrease complications and improve vascular patient outcomes. (J Vasc Surg 2017;65:1769-78.)

Surgical site infection (SSI) is one of the most common postoperative complications after vascular reconstruction, particularly lower extremity bypass (LEB) procedures.[1] This complication produces significant morbidity and can result in increased length of stay, hospital readmission, graft failure, and limb loss.[2-4] The published incidence of SSI after LEB has varied from 4.8%[5] to 22.8%,[6] with different rates reported based on the evaluated data set. Prior studies have identified a number of clinical variables that are directly related to the incidence of SSI. Reported patient-related factors include female gender,[3,7] advanced age,[1] obesity,[8] dialysis dependence,[3] and diabetes.[9] More recently, perioperative variables, including blood transfusion and operative duration, have been linked to SSI after LEB.[5] These studies used large registry data sets from multiple hospitals but did not examine structural or process-of-care characteristics of the hospitals where the procedures were performed.

The American College of Surgeons National Surgical Quality Improvement Program Best Practices Initiative recently concluded that hospital-level structural and process-of-care characteristics can have a significant effect on the overall rates of SSI after general surgery procedures.[10] To decrease the incidence of SSI, identifying process measures that link directly to SSI outcomes is important because many process measures are portable and could be implemented across health care systems.

This study used a large statewide vascular surgical quality registry to determine the predictors of SSI after LEB. We sought to identify independent patient preoperative and operative risk factors and to determine whether hospital structural or process-of-care characteristics are predictive risk factors for SSI.

METHODS

Patient selection. The Blue Cross Blue Shield of Michigan Cardiovascular Consortium Vascular Intervention Collaborative (BMC2 VIC) was the data source for this study. BMC2 VIC is a prospective, multicenter, observational registry designed to collect information on patients undergoing vascular surgical procedures in an effort to evaluate outcomes and to improve quality. The details of the BMC2 VIC program have been previously described.[11,12] This 35-hospital consortium in Michigan collected prospective data on patients undergoing vascular surgical procedures with 30-day outcomes. The VIC registry is primarily a quality improvement initiative that involves the analysis of existing data that cannot be used to identify individual patients, and thereby the University of Michigan School of Medicine Insitutional Review Board has determined that it is exempt under 45 CFR 46.101(b) (4), and a waiver for informed consent was granted.

The study included all patients undergoing elective or urgent open LEB procedures between January 2012 and June 30, 2015. During this time, 4913 open bypass procedures were conducted, 3582 of which were LEB procedures. Of these, 2587 LEB procedures were performed on individual patients and 995 LEB procedures were repeatedly performed on 446 patients (mean of 2.23 procedures per patient; range, 2-7). Due to database constraints, the "first" documented procedure for a given patient within the BMC2 VIC may not have been the first vascular intervention the patient underwent because we do not have procedural-specific information for patients who underwent operations before the creation of the BMC2 VIC in 2012 or had several procedures between 2012 and 2015 at hospitals that were not included in our registry. To avoid violations of independence in the statistical analysis, a single procedure was randomly selected for each of the 446 patients with multiple LEB procedures, resulting in 3033 LEB individual patients and procedures being included in the analysis.

A data form was compiled for each patient, including demographic information, medical history, standard blood and chemistry laboratory test results before and after the procedure, procedural indications (claudication, critical limb ischemia, and acute limb ischemia) and types (suprainguinal and infrainguinal), procedural urgency, technical details of procedures, and associated complications, if they occurred. Of note, the BMC2 VIC does not collect the following information: weight loss before surgery, prealbumin, negative wound pressure therapy, Szilagyi grade of infections, or active chemotherapy at the time of the operation.