

Outcomes of surgical revascularization for lower extremity arterial thromboembolism in patients with advanced malignancy

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Objective: The objective of this study was to describe the outcomes of surgical revascularization for lower extremity arterial thromboembolism in patients with advanced malignancy.

Methods: The 2005-2011 American College of Surgeons National Surgical Quality Improvement Program database was used for this study. Preoperative characteristics and postoperative outcomes of patients with known advanced malignancy who underwent surgical revascularization for lower extremity arterial thromboembolic disease were assessed and compared with those of patients without known advanced malignancy. Parsimonious multivariate logistic regression analysis was used to determine the independent association between advanced malignancy and 30-day postoperative mortality and morbidity after adjustment for demographic characteristics, acute and chronic comorbid disease burden, history of peripheral arterial disease, functional and nutritional status, acuity of presentation, and procedure type.

Results: The study included 136 patients with advanced malignancy who underwent surgical revascularization for lower extremity arterial thromboembolism for analysis (65% thromboemblectomy, 26% thromboendarterectomy, and 22% bypass grafting). The 30-day mortality and morbidity rates in these patients were 30.2% and 38.2%, respectively. Compared with patients without advanced malignancy, patients with advanced malignancy had a significantly greater risk of postoperative death (adjusted odds ratio, 5.92; 95% confidence interval, 3.69-9.52; $P < .001$) but not morbidity (adjusted odds ratio, 1.28; 95% confidence interval, 0.87-1.87; $P = .21$).

Conclusions: Our study is the largest to date to describe the outcomes of patients with advanced malignancy who undergo surgical revascularization for arterial thromboembolism of the lower extremities. Such patients suffer high rates of early postoperative mortality and morbidity, especially when emergency operation is required. Early involvement of palliative care specialists is warranted in these patients to ensure that the decision to pursue surgical revascularization is aligned with their goals of care. (*J Vasc Surg* 2014;60:987-92.)

Arterial thromboembolism is an increasingly recognized manifestation of malignancy.¹⁻¹¹ Several factors can predispose cancer patients to arterial thromboembolic disease, including pre-existing atherosclerotic burden, the thrombophilic milieu associated with cancer, and chemotherapy-mediated vascular endothelial damage.^{3,10-12} Regardless of the underlying cause, the question of how best to manage arterial ischemic events in the setting of malignancy is difficult, in part because there is a paucity of evidence available in the literature with which to inform surgeons and patients about the risks and anticipated results of surgical intervention. For example, only five studies with a combined sample size of 44 patients have been published to date that describe

outcomes associated with operation for critical lower limb ischemia in patients with cancer.^{1,4,7-9} On the basis of the conclusions from these studies, it remains unclear which patients from this population should be treated with aggressive surgical intervention rather than with palliation.⁴⁻⁸

The American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) provides a unique opportunity to improve our understanding of the surgical outcomes for relatively uncommon conditions such as cancer-associated arterial thromboembolic disease. With its inclusion of approximately 1.3 million surgical procedures performed at more than 250 member hospitals, ACS NSQIP enables the analysis of study samples that are much larger than can be generated from single-center cohorts.¹³ ACS NSQIP collects information on several variables indicating that a patient has advanced malignant disease (eg, the presence of disseminated cancer or recent chemoradiation) even if cancer is not listed as the principal operative diagnosis. The objectives of our study were therefore to describe the early postoperative outcomes of patients with advanced malignancy who underwent surgical revascularization for arterial thromboembolic disease of the lower extremities and to determine how the

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Author conflict of interest: none.

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The editors and reviewers of this article have no relevant financial relationships to disclose per the JVS policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.

0741-5214/\$36.00

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<http://dx.doi.org/10.1016/j.jvs.2014.04.064>

Table I. Patient- and procedure-related variables included as potential predictors of 30-day postoperative outcomes after surgical revascularization for lower extremity arterial thromboembolism

Variable	Components (if composite variable)
Age	N/A
Gender	N/A
Diabetes mellitus	N/A
Ongoing tobacco use	N/A
Chronic obstructive pulmonary disease	N/A
Prior percutaneous coronary intervention and/or cardiac surgery	N/A
End-stage renal disease	N/A
History of transient ischemic attacks	N/A
Prior cerebrovascular accident	N/A
Chronic steroid use	N/A
Preoperative mechanical ventilation	N/A
Pneumonia	N/A
Acute congestive heart failure	N/A
Myocardial infarction within 6 months before operation	N/A
Angina within 30 days before operation	N/A
Acute renal failure	N/A
SIRS/sepsis	N/A
Prior lower extremity revascularization procedure	N/A
Rest pain and/or extremity gangrene	N/A
Nonindependent functional health status	N/A
Physical disability	Hemiplegia and/or paraplegia and/or quadriplegia
Cognitive disability	Impaired sensorium and/or preoperative coma
Malnutrition	Serum albumin level <3.2 g/dL and/or >10% weight loss in 6 months before operation and/or body mass index <20 kg/m ²
Bleeding disorder	N/A
ASA physical status classification of 4 or 5	N/A
Emergency procedure status	N/A
Nonclean incisional wound	N/A
Procedure type	Thrombectomy/embolectomy or thromboendarterectomy or bypass graft or amputation

ASA, American Society of Anesthesiologists; N/A, not applicable; SIRS, systemic inflammatory response syndrome.

presence of advanced malignancy may affect these outcomes.

METHODS

The NSQIP Participant User Files for 2005 to 2011 were used for this retrospective analysis, which included all patients who had (1) a postoperative diagnosis of lower extremity arterial thrombosis/embolism (International Classification of Diseases, Ninth Revision, Clinical Modification code 444.22 as noted by the postoperative diagnosis provided in the brief operative note, operative report, or final pathology report) and (2) a primary Current Procedure Terminology code for lower extremity embolectomy/thrombectomy, thromboendarterectomy, bypass graft, or amputation. Patients were excluded from analysis if they had an operation within 30 days before their index revascularization procedure. Since this study utilized only de-identified NSQIP data, it was exempt from Institutional Review Board approval and patient consent was not required.

The characteristics and postoperative outcomes of patients with known advanced malignancy were first assessed. Patients were classified as having advanced malignancy if they met one or more of the following criteria: (1) evidence of disseminated cancer, (2) chemotherapy within the 30 days preceding index operation, (3) radiotherapy within

the 90 days preceding index operation, or (4) presence of a tumor of the central nervous system. ACS NSQIP defines disseminated cancer for patients who have “cancer that: (1) has spread to one site or more sites in addition to the primary site and (2) in whom the presence of multiple metastases indicates the cancer is widespread, fulminant, or near terminal.” Chemotherapy is defined as “any chemotherapy for cancer in the 30 days prior to surgery.... Patient is not included if treatment consists solely of hormonal therapy.” Radiotherapy is defined as “any radiotherapy treatment for cancer in the 90 days prior to surgery,” and tumor of the central nervous system is defined as “a space-occupying tumor of the brain or spinal cord, which may be benign or secondary malignancies.”¹⁴ Patients without any of these characteristics were classified as not having advanced malignancy. The primary predictor variable for our analysis was advanced malignancy. Other patient- and procedure-related variables that were assessed are shown in Table I. Patients with missing data for serum albumin level were assumed to have a normal level (>3.2 g/dL). Bleeding disorder as defined by ACS NSQIP includes patients in whom anticoagulation therapy was not stopped before their index operation. Systemic inflammatory response syndrome (SIRS)/sepsis is defined as the presence of SIRS or sepsis. ACS NSQIP defines SIRS as “the presence of two or more of the following within the

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