

From the Society for Clinical Vascular Surgery

Perioperative risk factors for hospital readmission after elective endovascular aortic aneurysm repair

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ABSTRACT

Background: Elective endovascular aneurysm repair (EVAR) is generally well tolerated. However, the incidence of hospital readmission after EVAR and the risk factors and reasons for it are not well studied. This study sought to determine the incidence, to characterize the indications, and to identify perioperative patient-centered risk factors for hospital readmission within 30 days after elective EVAR.

Methods: All patients who underwent EVAR electively in 2012 to 2013 were identified from the American College of Surgeons National Surgical Quality Improvement Program Targeted Vascular database (n = 3886). Preoperative demographics, operation-specific variables, and postoperative outcomes were compared between those who were readmitted within 30 days of the index operation and those who were not. Multivariate logistic regression was then used to determine independent predictors of hospital readmission.

Results: The unadjusted 30-day readmission rate after EVAR was 8.2%. Of all readmissions, 55% were for reasons related to the procedure. Median time to readmission was 12 days. Significant preoperative risk factors associated with readmission were female sex, preoperative steroid use, congestive heart failure, and dialysis dependence ($P < .05$). Multiple postoperative medical complications were independently predictive of readmission, including myocardial infarction and deep venous thrombosis ($P < .05$). Surgical complications that were independently predictive of readmission were surgical site infection (odds ratio, 10.24; 95% confidence interval, 5.31-19.75; $P < .01$) and need for unplanned reoperation (odds ratio, 17.50; 95% confidence interval, 10.43-29.37; $P < .01$). Readmitted patients ultimately had significantly higher rates of 30-day mortality (3.5% vs 0.3%; $P < .01$).

Conclusions: Hospital readmissions remain a costly problem after vascular surgery and are associated with 30-day mortality after elective EVAR. Whereas female sex and certain irreversible medical comorbidities are nonmodifiable, focusing on medical optimization and identifying those perioperative variables that can affect the need for post-EVAR interventions will be an important step in decreasing hospital readmission. (J Vasc Surg 2018;■:1-8.)

Keywords: Readmissions; Endovascular aortic aneurysm repair

Hospital readmission within 30 days after discharge is a costly burden to patients and the health care system in the United States. This data point is being increasingly scrutinized as a target for quality improvement in surgical practice.^{1,2} In a 2004 study of rehospitalizations among Medicare beneficiaries, vascular surgery patients represented a disproportionate amount of readmissions at a rate of 23.9%. The total additional cost to rehospitalized patients is estimated to exceed \$17 billion.³ More

recently, Orr et al⁴ demonstrated that the cost related to a second hospitalization after four common vascular surgery procedures adds an additional 39% to the cost of the index hospitalization, with >50% of readmissions requiring a reoperation.

A recent study by Gonzalez et al,⁵ however, challenged the notion that hospital readmission rates reflect inadequate discharge practices and quality of care by showing great variability of adjusted year-to-year readmission rates after major vascular surgical procedures. This suggests that readmission rates may be affected by factors not related to quality of care data points currently measured by administrative data, prompting further investigation into perioperative risk factors that may contribute to rehospitalization.

One of the most common procedures performed by vascular surgeons currently is endovascular aneurysm repair (EVAR). EVAR is generally well tolerated when it is performed electively, and compared with open repair, it has been associated with decreased perioperative morbidity and mortality.^{6,7} Because the mean age for elective repair of nonruptured aneurysms is in the mid-70s, these patients typically carry increased

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Author conflict of interest: none.

Presented at the Forty-fourth Annual Symposium of the Society for Clinical Vascular Surgery, Las Vegas, Nev, March 12-16, 2016.

Additional material for this article may be found online at www.jvascsurg.org.

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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

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comorbidities that may have an impact on their postoperative course and risk for readmission. There are limited data in the literature focused on the incidence and prevalence of hospital readmission after elective EVAR and the perioperative risk factors contributing to it. In this study, we aimed to use a targeted national surgical database to report on the incidence of hospital readmission after EVAR and the perioperative risk factors and outcomes associated with it.

METHODS

Data source. This study was performed by a retrospective analysis of the American College of Surgeons (ACS) National Surgical Quality Improvement Program (NSQIP) targeted EVAR Participant Use Data File of procedures performed from January 1, 2012, to December 31, 2013. The ACS NSQIP is a nationally validated, risk-adjusted, outcomes-based program to measure and to improve the quality of surgical care in the United States. The targeted database, which first became available in 2011, collects procedure-specific demographic, anatomic, perioperative, and 30-day postoperative outcomes data. Data regarding reasons for readmission began to be collected in 2012, which was the rationale for commencing our study at this time. The data in the general and procedurally targeted databases are collected and entered by surgical clinical reviewers who are certified by the ACS. Strict variable definitions are used when data are collected to ensure consistency across participating centers, and periodic auditing is used to ensure accuracy.⁸ The targeted EVAR database, which included data from 71 sites, was then merged with the general Participant Use Data File by the deidentified Case ID, allowing both procedure-specific and general variables and outcomes collected in the NSQIP to be analyzed. All participants contributing to the targeted data set were also part of the general NSQIP; thus, there were no patients exclusively in the targeted data set. The NSQIP database is exempt from requiring informed consent from individual patients and did not require Institutional Review Board approval for analysis at our institution.

Cohort and variables. Patients who underwent EVAR between 2012 and 2013, inclusively, in the NSQIP database were identified in the targeted vascular data set. Emergency cases and ruptured aneurysms were excluded from the analysis. This included all consecutive cases at each participating center. With the focus on risk factors for hospital readmission within 30 days, patients who died during the index hospitalization and patients remaining in the hospital beyond 30 days were also excluded. The cohort was then separated by whether they had a documented hospital readmission within 30 days or not. Data were collected regarding readmissions regardless of whether the readmission was to the original index hospital or to another hospital.

ARTICLE HIGHLIGHTS

- **Type of Research:** Retrospective analysis of prospectively collected National Surgical Quality Improvement Program data
- **Take Home Message:** Endovascular aneurysm repair in 3847 National Surgical Quality Improvement Program patients was associated with an 8.2% readmission rate; female sex, congestive heart failure, chronic steroid use, end-stage renal disease, myocardial infarction, deep venous thrombosis, surgical site infection, and unplanned reoperations predicted readmission. Readmitted patients had higher mortality.
- **Recommendation:** This study suggests that there are modifiable risk factors that could lower readmission rates and decrease 30-day mortality after endovascular aneurysm repair.

Preoperative variables analyzed included the patient's age, gender, race, American Society of Anesthesiologists class, body mass index, and comorbid conditions including the following: obesity, diabetes, hypertension requiring medication, congestive heart failure (CHF) within 30 days before surgery, current smoking status within 1 year, history of severe chronic obstructive pulmonary disease, chronic steroid use, bleeding disorders, and pre-existing renal failure requiring dialysis. Anatomic factors analyzed included aneurysm diameter, proximal extent of the aneurysm (infrarenal vs juxtarenal or suprarenal), and distal extent of the aneurysm. Other perioperative factors analyzed included type of anesthesia used (general anesthesia vs spinal/epidural vs regional anesthesia), access type (percutaneous vs cutdown approaches), need for intraoperative or postoperative blood transfusion, need for adjunctive procedures (including an iliac conduit, renal stent, hypogastric embolization, lower extremity revascularization, iliac branched device, aortic bare-metal stent, or iliac bare-metal stent), and total operative time. Access type was coded as actually performed and included bilateral percutaneous, unilateral percutaneous, percutaneous converted to open cutdown, and bilateral femoral cutdown approaches.

Postoperative outcomes analyzed included hospital length of stay (of index hospitalization), intensive care unit length of stay, 30-day mortality, discharge destination, unplanned reoperation, ischemic colitis, lower extremity ischemia, surgical site infection (SSI), and other medical complications including the following: myocardial infarction (MI), stroke, pneumonia, urinary tract infection, acute renal failure, deep venous thrombosis (DVT), and pulmonary embolism. Unplanned reoperation combined the spectrum of reinterventions, from operative débridement to aortic reinterventions. All variables and outcomes were compared between the patients

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