Postdischarge outcomes after endovascular abdominal aortic aneurysm repair

Prateek K. Gupta, MD,[a] Travis L. Engelbert, MD,[a] Bala Ramanan, MBBS,[b] Xiang Fang, PhD,[c] Dai Yamanouchi, MD,[a] John R. Hoch, MD,[a] and Charles W. Acher, MD,[a] *Madison, Wisc; and Omaha, Neb*

Objective: **Perioperative outcomes after endovascular repair (EVAR) of abdominal aortic aneurysms (AAA) have been rigorously studied; however, inpatient and postdischarge outcomes have not been separately analyzed. The objective of this study was to examine postdischarge 30-day outcomes after elective EVAR.**

Methods: **Patients who underwent an elective EVAR for AAA (n = 11,229) were identified from the American College of Surgeons 2005-2010 National Surgical Quality Improvement Project database. Univariable and multivariable logistic regression analyses were performed.**

Results: **The median length of hospital stay was 2 days (interquartile range, 1-3 days). Overall 30-day mortality was 1.0% (n = 117), with 31% (n = 36) of the patients dying after discharge. Overall 30-day morbidity was 10.7% (n = 1204), with 40% (n = 500) of the morbidities being postdischarge. The median time of death and complication was 9 and 3 days, respectively, after surgery. Eighty-eight percent of the wound infections (n = 205 of 234), 33% of pneumonia (n = 44 of 133), and 55% of venous thromboembolism (n = 36 of 65) were postdischarge. Multivariable analyses showed age, congestive heart failure, admission from nursing facility, postoperative pneumonia, myocardial infarction, and renal failure were independently associated with postdischarge mortality, and peripheral arterial disease, female gender, previous cardiac surgery, age, smoking, and diabetes with postdischarge morbidity ($P < .05$ for all).**

Conclusions: **Patient characteristics associated with a higher risk for postdischarge adverse events after EVAR were identified. Whether improved predischarge surveillance and close postdischarge follow-up of identified high-risk patients will further improve 30-day outcomes after EVAR needs to be prospectively studied. (J Vasc Surg 2014;59:903-8.)**

In the United States, 60% of aortic aneurysms are repaired by endovascular techniques, and this number is increasing every year.[1] The widespread use of the endovascular approach is largely due to its favorable perioperative morbidity and mortality compared with open repair.[2,3] During the last decade, postoperative morbidity and mortality rates after endovascular aortic aneurysm repair (EVAR) have improved.[2,3] Given the short index hospital stay after EVAR, further improvement in outcomes will largely depend on prevention, early identification, and treatment of postdischarge complications after EVAR.

From the Department of Surgery, University of Wisconsin Hospital and Clinics, Madison[a]; and the Department of Surgery[b] and the Department of Biostatistics,[c] Creighton University, Omaha.

Author conflict of interest: none.

The American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) and the hospitals participating in the ACS NSQIP are the source of the data used herein; they have not verified and are not responsible for the statistical validity of the data analysis or the conclusions derived by the authors. This study does not represent the views or plans of the ACS or the ACS NSQIP.

Presented at the Oral Plenary Session (William J. von Liebig Forum; SS1) at the 2013 Vascular Annual Meeting of the Society for Vascular Surgery, San Francisco, Calif, May 30-June 1, 2013.

Reprint requests: Prateek K. Gupta, MD, Department of Surgery, University of Wisconsin Hospital and Clinics, 600 Highland Ave, Madison, WI 53792 (e-mail: pgupta@uwhealth.org).

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

http://dx.doi.org/10.1016/j.jvs.2013.10.057

Our objective was to examine postdischarge 30-day outcomes after elective EVAR using the nationally validated, clinical, American College of Surgeons National Surgical Quality Improvement Program (NSQIP) data set. Knowledge of these outcomes may lead to development of strategies for early identification and close follow-up of at-risk patients and thus, possible prevention of postdischarge complications and readmissions.

METHODS

Data set. Data were extracted from the 2005-2010 NSQIP Participant Use Data Files,[4] which are multicenter, prospective databases with 121 (year 2005 to 2006), 183 (year 2007), 211 (year 2008), 237 (year 2009), and 258 (year 2010) participating academic and community United States hospitals, with data being collected on >250 perioperative variables. In NSQIP, a participating hospital's surgical clinical reviewer (SCR) captures data using a variety of methods, one of which is medical record abstraction. Events occurring after hospital discharge are identified using comprehensive strategies.[5] In addition to examining inpatient medical records and outpatient charts, a minimum of three attempts to contact the patient by telephone or mail are made by the SCR to ensure accurate documentation of postdischarge events. If no response is obtained, the Social Security Death Index and the National Obituary Archives are queried to investigate the potential of a death. Hospitals are required to provide complete 30-day follow-up on at least 95% of the sampled patients.[5]

In NSQIP, the data are collected based on strict criteria formulated by a committee. To ensure the data collected are of a high quality, NSQIP has developed different training mechanisms for the SCR and conducts an inter-rater reliability audit of participating sites.[4] Inter-rater reliability audits show that overall disagreement rates on variables was 1.56% (>140,000 audited fields) in 2008.[6] The processes of SCR training, inter-rater reliability auditing, data collection, and sampling methodology have been previously described in detail.[4,7,8]

Patients. Patients undergoing elective EVAR in the NSQIP data sets were identified using the Current Procedural Terminology code (American Medical Association, Chicago, Ill) for the procedure in combination with an International Classification of Diseases, 9th Revision, Clinical Modification diagnosis code of AAA. To eliminate any potentially nonelective patients and to improve generalizability, the following exclusion criteria were also applied: impaired sensorium, coma, tumor involving the central nervous system, hemiplegia/hemiparesis, paraplegia/paraparesis, quadriplegia/quadriparesis, disseminated cancer, chemotherapy ≤30 days, radiotherapy ≤90 days, preoperative do-not-resuscitate status, ventilator requirement before surgery, ascites, esophageal varices, acute renal failure before operation, preoperative transfusion of >4 units packed red blood cells, emergency case classification, preoperative systemic sepsis ≤48 hours, contaminated/dirty wound class, cases with a simultaneous procedure, and previous operation ≤30 days. Preoperative data obtained included demographic, lifestyle, comorbidity, functional status, and other variables. NSQIP studies outcomes through 30 days after the index operation.

Outcome. The primary outcome of interest was postdischarge 30-day mortality. The secondary outcome was postdischarge 30-day overall morbidity, which includes any of wound infection, organ space infection, urinary tract infection, wound dehiscence, pneumonia, reintubation, pulmonary embolism, deep venous thrombosis, failure to wean from ventilator ≤48 hours, renal insufficiency, renal failure requiring dialysis, stroke, coma, peripheral nerve deficiency, cardiac arrest, myocardial infarction, graft complication, transfusion >4 units of red blood cells, and sepsis.

Statistical analysis. The Pearson χ^2 or Fisher exact test was used to perform univariable analysis for categoric variables and the t-test was used for continuous variables. Stepwise multiple logistic regression analyses were performed to assess factors associated with the primary and secondary study outcomes. Preoperative and intraoperative variables, as well as in-hospital complications and length of stay (LOS), were considered as independent variables for the regression analysis. Only variables with a P value of <.1 on univariable analysis were included in the multivariable analysis. Interactions were assessed for multicollinearity and none found. Statistical analyses were performed using SAS 9.2 software (SAS Institute, Cary, NC). A P value of <.05 was considered significant.

RESULTS

Of the 11,229 patients (82.7% men) who underwent an elective EVAR, median age was 75 years. The demographic characteristics, comorbidities, and laboratory values are listed in Table I.

The 30-day mortality was 1.0% (n = 117), with 31% (n = 36) of deaths occurring after discharge from the hospital. The overall 30-day morbidity was 10.7% (n = 1204), with 40% (n = 500) of these occurring postdischarge. Table II lists the postoperative complications.

More than 90% of patients (n = 456 of 500) who developed a postdischarge complication did not experience an inpatient morbidity. However, the occurrence of a complication in the inpatient setting increased the likelihood of developing a postdischarge complication (from 4.3% to 6.5%, $P = .005$). Only 20% of patients (n = 7 of 36) who died postdischarge experienced an in-hospital complication.

Compared with patients who did not have a postdischarge complication, those who experienced a postdischarge complication had a more than a sixfold likelihood of reoperation (3.1% vs 20.4%, respectively; $P < .0001$) and death (0.2% vs 3.0%, respectively; $P < .0001$) ≤30 days of surgery. Patients with postdischarge mortality had a median LOS of 3 days compared with 2 days for survivors ($P = .003$). The median LOS was 2 days for patients with or without a postdischarge complication ($P = .83$).

Multivariable analysis for postdischarge mortality. On multivariable analysis (area under receiver operating characteristic curve, 0.84), congestive heart failure (odds ratio [OR], 4.7; 95% confidence interval [CI], 1.0-21.2), admission from a nursing facility/acute care vs home (OR, 2.2; 95% CI, 1.5-3.0), increase in age per year (OR, 1.09; 95% CI, 1.04-1.15), increased anesthesia time per minute (OR, 1.003; 95% CI, 1.001-1.006), postdischarge pneumonia (OR, 28.3; 95% CI, 8.8-91.0), postdischarge cardiac arrest/myocardial infarction (OR, 49.2; 95% CI, 12.9-187.4), and postdischarge renal failure requiring dialysis (OR, 59.0; 95% CI, 10.8-321.3) were associated with postdischarge 30-day mortality.

Analysis of risk factors for postdischarge mortality. The 30-day postdischarge death rate amongst patients admitted from a nursing facility/acute care was 2.5%. In contrast to patients who survived after EVAR, patients who died postdischarge were more likely to have been admitted from a nursing facility/acute care (13.9% vs 1.8%; $P < .0001$). The mean ± standard deviation age of patients who died postdischarge was higher than those who survived (79.4 ± 7.2 vs 74.1 ± 8.5; $P = .0002$). The anesthesia time (in minutes) of patients who died postdischarge was longer than those who survived (269 ± 113 vs 227 ± 85; $P = .0002$).

The 30-day postdischarge death among patients who had postdischarge renal failure was 27% (n = 3 of 11) and was 19% (n = 4 of 21) among patients who had postdischarge myocardial infarction, and 14% (n = 6 of 44) among patients who had postdischarge pneumonia.