Ambulatory Medical Follow-Up in the Year After Surgery and Subsequent Survival in a National Cohort of Veterans Health Administration Surgical Patients

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Objectives: **Among a national cohort of surgical patients, the authors analyzed the association between medical follow-up during the first postsurgical year and survival during the second postsurgical year.**

Design: **Retrospective cohort study.**

Setting: **US Veterans Hospitals.**

Participants: **The study included adults who received surgical care in any Veterans Health Administration facility from 2006 to 2011 who were discharged within 10 days of surgery and who survived for at least 1 year postoperatively.**

Interventions: **None.**

Measurements and Main Results: **The association between the receipt of nonsurgical ambulatory medical care during the first postoperative year and the hazard of death during postsurgical year 2 was measured. Among 236,200 veterans, 93.2% received a nonsurgical medical follow-up visit in postsurgical year 1; of those, 5.1% died during postsurgical year 2. This compares with 9.4% year-2 mortality among patients lacking year-1 medical follow-up ($p < 0.0001$). After adjustment for confounders, medical follow-up in postoperative year 1 again was associated with a significantly lower hazard of death in postoperative year 2 (hazard ratio 0.71; 95% confidence interval 0.66-0.78). Sensitivity analyses examining patient subgroups stratified by procedural specialty demonstrated comparable findings. The results were robust under a variety of simulated scenarios of unmeasured confounding.**

Conclusions: **Within a national cohort of US veterans who presented for surgery, those who received nonsurgical ambulatory follow-up during the first postoperative year demonstrated lower all-cause mortality in the subsequent postoperative year than those who did not receive the same type of follow-up care. Interventions focused on postoperative care coordination of outpatient medical follow-up may have the potential to improve long-term postoperative survival.**

KEY WORDS: care transitions, healthcare delivery, postoperative care, perioperative surgical home

IMPROVING PREVENTIVE MEDICAL care within the US healthcare system is a public health priority,[1] and recent research has highlighted possible contributions that the surgical care episode can provide to a patient's larger preventive care medical team. For example, studies of "prehabilitation,"[2] preoperative smoking cessation,[3-7] and postoperative referral for identification and treatment of poorly controlled hypertension[8-10] have suggested that an opportunity exists for substantial longitudinal cardiovascular risk factor reduction when the scope of concern by perioperative physicians is expanded beyond their traditional focus on the intraoperative and intensive care periods. This expanded scope of concern, as one component of the emerging concept of the perioperative surgical home,[11-15] represents a new practice paradigm for anesthesiologists and other perioperative care providers, but it lacks significant long-term outcomes data examining the relationship among surgical care episodes, medical follow-up, and mortality.

The Institute of Medicine has long recognized the specialty of anesthesiology as a leader in the effort to improve patient safety, but the focus of Anesthesiology's efforts largely has been patient safety during the immediate perioperative period.[16] Yet, many chronic health factors that either go unrecognized or undertreated in the outpatient setting also may be apparent during the perioperative care period, and it remains unknown whether expanding the scope of perioperative medicine to include postsurgical care coordination to address such chronic health problems potentially could improve long-term outcomes.

The attempt to improve long-term health is of particular relevance for cardiothoracic and vascular anesthesiologists because cardiovascular disease remains the leading cause of death among anesthesiologists' patients both perioperatively and long after the surgical encounter. Moreover, several cardiovascular risk factors, including smoking, high blood pressure, and hyperlipidemia, are common and potentially modifiable through care coordination efforts initiated by anesthesiologists. In the process of studying the feasibility and efficacy of such interventions, the association between postsurgical outpatient medical care and subsequent outcomes has not been studied sufficiently. Accordingly, in this observational study, the authors sought to determine whether nonsurgical medical follow-up during the first postoperative year was associated with a subsequent difference in all-cause mortality during postoperative year 2.

METHODS

After appropriate Institutional Review Board approval (HIC Procotol 1002006277), the authors created an electronic health

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record (EHR)-based historic cohort of patients >21 years who received surgical care at a Veterans Health Administration (VHA) healthcare facility between September 2006 and August 2011, using the VHA Corporate Data Warehouse national surgeries extract for cohort identification. The resulting cohort is being used in several studies examining the relationship between perioperative assessments and postoperative outcomes.[10] For this study, the exposure of interest was whether the patient had at least 1 nonsurgical medical visit (described in the following) within the VHA in the 365 days after surgery. To minimize confounding due to perioperative morbidity and mortality, only patients who were discharged within 10 days of surgery and who survived for 365 days after surgery were included in the analysis. For patients who were alive at the end of this 1-year exposure period, the outcome of interest was death occurring within the subsequent 365-day period (ie, a total of 2 years after each index surgery). Unadjusted and adjusted Cox proportional hazard ratios (HRs) were calculated to determine whether medical clinic follow-up during the first postoperative year would be associated with a difference in subsequent all-cause mortality during postoperative year 2.

Data Sources and Variables

Patients were identified by their unique Patient Integration Control Number assigned by the VHA Master Veteran Index; and for patients with multiple surgeries, 1 encounter per patient was selected at random. Demographic information, surgical specialty, American Society of Anesthesiologists (ASA) Physical Status score,[17] International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) inpatient diagnostic codes dating from January 2000 to the index surgery date were extracted from the VHA Corporate Data Warehouse for inclusion in this analysis. Body mass index (BMI) was calculated as the weight in kilograms divided by the square of the height in meters using the most proximate values to the date of surgery. Extreme heights and weights considered to be clinical outliers (ie, heights <58 inches or >80 inches and weights <80 pounds or >499 pounds) were excluded from BMI calculations. Date of death was determined as listed in the VHA Vital Status Master File using data as provided from the Social Security Administration (SSA). Comparisons between mortality data from the SSA Death Master File and the National Death Index have demonstrated good reliability.[18] Specifically, 92.1% of National Death Index deaths were found in the SSA Death Master File with 95.9% concordance by date and 99.6% concordance by month and year.[18]

Ambulatory visit data for the 365-day postoperative period were collected by querying the VHA National Patient Care Database Medical SAS Outpatient Datasets[19] as has been described in prior reports.[20] Clinic types were identified by the stop codes associated with each visit. A stop code for any of the following clinics was considered positive for the exposure of interest: primary care, cardiology, pulmonology, endocrinology, diabetes, hypertension, women's, infectious disease, and geriatric primary care. This outpatient clinic list was based on the NEXUS clinic group as defined by the VHA External Peer Review Program, with the addition of infectious disease clinics. NEXUS clinic visits are used to determine which veterans are receiving primary care across the VHA system. Infectious disease clinics were included because they are the primary care source for many veterans with human immunodeficiency virus.

Statistical Analysis

An unadjusted survival analysis was performed to determine survival during postsurgical day 366 through postsurgical day 730, comparing the group of patients who received nonsurgical medical clinic follow-up in the 365 days after surgery with those who did not. For the unadjusted analysis, the Kaplan-Meier method with a log-rank test for comparison was used. To account for the intracluster correlation of observations within each VHA facility, a Cox regression model with a shared frailty (ie, random effect) factor[21] was fit with adjustment for demographics (age, sex, self-identified race, and Hispanic ethnicity), BMI, length of stay, and the surgical specialty of the proceduralist. Race was coded as black versus all others, and ethnicity was coded as Hispanic versus all others. The authors also adjusted for smoking status as an ever/never variable. In addition to chronologic age in years, the authors included a variable to adjust for age ≥65 years as a dichotomous variable. This variable was included to account for previously described discontinuities in survival and insurance status that have been documented to occur at age 65 coincident with the sharp increase in Medicare enrollment.[22,23]

To account for baseline comorbid status, the authors controlled for the following 3 types of variables: (a) ASA Physical Status score as recorded on the day of surgery by the treating anesthesiologist, (b) the Charlson Comorbidity Index[24] (CCI), and (c) the Veterans Aging Cohort Study (VACS) comorbidity groupings.[25] The CCI was calculated using preoperative inpatient ICD-9-CM comorbidity data beginning from the year 2000 through the index surgery date. Whereas the CCI calculation relied on a cumulative measurement of ICD-9-CM codes, the ASA Physical Status score was provided by the treating anesthesiologist on the day of surgery as a single overall representation of the patient's comorbid status. Thus, the 2 scores represented independent determinants of a patient's overall comorbid burden that were derived from separate administrative and clinical data. For the VACS comorbidity groupings, the following conditions were included in the model: alcoholism, anemia, anxiety disorder, atrial fibrillation, bipolar disorder, cerebrovascular disease, congestive heart failure, coronary artery disease, diabetes, hyperlipidemia, hypertension, human immunodeficiency virus, liver disease, lung disease, depression, peripheral vascular disease, post-traumatic stress disorder, psychosis, renal disease, and substance abuse.

For each of these conditions, the authors required at least 2 outpatient ICD9-CM codes or 1 inpatient code for each comorbid grouping to qualify as positive for the condition, as has been described previously.[26,27]

Finally, the year of surgery was included in the primary analysis to control for increases in EHR penetrance and other potential time-dependent confounders during the study period.