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Research Paper

Preoperative Falls Predict Postoperative Falls, Functional Decline, and Surgical Complications

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ABSTRACT

Background: Falls are common and linked to morbidity. Our objectives were to characterize postoperative falls, and determine whether preoperative falls independently predicted postoperative falls (primary outcome), functional dependence, quality of life, complications, and readmission.
Methods: This prospective cohort study included 7982 unselected patients undergoing elective surgery. Data were collected from the medical record, a baseline survey, and follow-up surveys approximately 30 days and one year after surgery.
Results: Fall rates (per 100 person-years) peaked at 175 (hospitalization), declined to 140 (30-day survey), and then to 97 (one-year survey). After controlling for confounders, a history of one, two, and ≥three preoperative falls predicted postoperative falls at 30 days (adjusted odds ratios [aOR] 2.3, 3.6, 5.5) and one year (aOR 2.3, 3.4, 6.9). One, two, and ≥three falls predicted functional decline at 30 days (aOR 1.2, 2.4, 2.4) and one year (aOR 1.3, 1.5, 3.2), along with in-hospital complications (aOR 1.2, 1.3, 2.0). Fall history predicted adverse outcomes better than commonly-used metrics, but did not predict quality of life deterioration or readmission.
Conclusions: Falls are common after surgery, and preoperative falls herald postoperative falls and other adverse outcomes. A history of preoperative falls should be routinely ascertained.

1. Introduction

In response to growing concern about the increasing incidence and morbidity of falls (Cigolle et al., 2015; WHO, 2012), the Joint Commission (United States) established fall prevention as one of its national patient safety goals in 2015 (The Joint Commission, 2015). Postoperative falls may occur more often than falls in the general population (O'loughlin et al., 1993; Berggren et al., 2008), yet their demographics and epidemiology have not been well-described. A few studies examine the characteristics and risk factors for postoperative falls, but most are retrospective, inpatient, orthopedic, or too small for risk factor assessment (Church et al., 2011; Clarke et al., 2012; Jorgensen et al., 2013).

In the general population, a history of falls is a strong predictor of falling again (Tinetti and Kumar, 2010; Deandrea et al., 2010), worse function (Skalska et al., 2014), and poor quality of life (Stenhagen et al., 2014). Falls are also associated with functional dependence and poor quality of life in the preoperative surgical population (Kronzer et al., 2016b). A link may therefore also exist between falls and outcomes in surgical populations. Indeed, in a restricted patient population, preoperative falls have been associated with postoperative complications, and on a crude basis, with readmission (Jones et al., 2013). However, the value of ascertaining fall history preoperatively has not been definitively established.

To address these limitations and provide the evidence needed to usher change in clinical practice, we conducted a large, prospective study of unselected surgical patients. Our objectives were twofold. First, we aimed to describe characteristics of postoperative falls, including their rate, timing, associated injuries, and risk factors. Second, we aimed to determine whether preoperative falls were associated with postoperative falls (primary outcome), functional dependence, quality

Abbreviations: ASA, American Society of Anesthesiologists; BRFSS, Behavior Risk Factor Surveillance System; METs, metabolic equivalents; MAR, missing at random; NMAR, not missing at random; ProFaNE, Prevention of Falls Network Europe; STROBE, STrengthening the Reporting of OBservational studies in Epidemiology; SATISFY-SOS, Systematic Assessment and Targeted Improvement of Services Following Yearlong Surgical Outcomes Surveys.

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of life, complications, and readmission after controlling for routinely-collected potential confounders. We hypothesized that a history of preoperative falls would independently forecast poor postoperative outcomes.

2. Methods

2.1. Study Design and Population

This prospective cohort study received ethics committee approval at Washington University (Human Research Protection Office number 201505035), conforms to the standards of the Declaration of Helsinki, and was reported in compliance with the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) guidelines for observational studies (S2). It was a substudy of an ongoing registry at Barnes Jewish Hospital called the Systematic Assessment and Targeted Improvement of Services Following Yearlong Surgical Outcomes Surveys (SATISFY-SOS) study (Avidan, 2014).

For the present study, we included a subset of patients from the SATISFY-SOS registry. The data were collected prospectively prior to the design of the current study. The cohort comprised adult patients undergoing elective surgery who attended the preoperative assessment clinic and provided signed informed consent (S8) between January 16, 2014 and October 7, 2015. Approximately 19,400 out of 29,800 potentially eligible patients (65%) consented to participate in the study during this time window. Main reasons for non-participation included no invitation to participate, patient refusal, and lack of English literacy. Data were obtained from the electronic medical record, a presurgical baseline survey (S3), and 30-day and one-year postsurgical surveys (S4–S7). To maximize response rate, we used a multi-modal follow-up sequence involving email, two paper mailings, and up to five phone calls per participant.

In the time window for this substudy, 17,850 (92%) of participants completed the baseline survey. The main reason for not completing this survey was insufficient time. Of those completing the baseline survey, 9097 responded to the 30-day survey, of whom 2436 responded to the one-year survey. We estimated survey response percentages based on the fraction of participants whose follow-up windows had fully expired at the time of data retrieval. These response percentages were 8216 out of 14,313 (57%) for the 30-day survey and 1462 out of 2390 (61%) for one-year survey. Among the completed follow-up surveys, only those corresponding to the first surgery for each patient were included. We also excluded records with 30-day or one-year survey completion times outside our pre-specified time ranges (Kronzer et al., 2016a), resulting in intervals from surgery to 30-day survey of 20 to 120 days and surgery to one-year survey of 355 to 455 days. A total of 7982 unique patients were included in the analysis; 7902 met criteria for 30-day analysis, and 2320 for one-year analysis.

2.2. Measures

Following the Prevention of Falls Network Europe (ProFaNE) guidelines, we defined a fall as “an unexpected event where you come to rest on the ground, floor or lower level” (Lamb et al., 2005). Our primary explanatory variable was preoperative falls in the six months before surgery, categorized as zero, one, two, and three or greater. For sensitivity analyses, we re-ran each model replacing preoperative falls with a modified falls scale that incorporated the number of falls with the severity of fall-related injuries (Tinetti and Williams, 1997). Injuries were patient-reported. “Severe injury” included severe pain, seeking medical treatment, head injury, fracture, or change from independent to assisted living.

Other explanatory variables included Charlson index (≥3) (Charlson et al., 1987), American Society of Anesthesiologists (ASA) physical status score (≥3) (Cullen et al., 1994), and procedural cardiac risk (≥intermediate risk) (Lee et al., 1999). Although statistically it is not best practice to dichotomize variables, we pre-specified in our plan and specifically chose to dichotomize these variables because, in our institution and elsewhere, those are the thresholds commonly used to determine increased preoperative risk. Charlson index was scored using comorbidities identified from the medical record, while ASA physical status came from the anesthesia record. Procedural cardiac risk represents the procedure-specific, patient-independent, cardiac risk class. Preoperative clinicians estimated procedural cardiac risk based on planned procedures.

Obtained from the follow-up surveys, the five outcome variables of interest included (i) one or more falls, (ii) worse function, and (iii) physical and mental quality of life score (all at both 30 days and one year), along with (iv) one or more in-hospital complications and (v) 30-day readmission. Two versions of each survey were administered during the study period. The first version of each did not use the validated (ProFaNE) definition of falls, so we excluded these surveys from all postoperative falls analyses (Kronzer et al., 2016a). Since the other questions were identical, we used records from both versions for the other four outcomes. Functional dependence came from the Barthel Index, a ten-question index where “100” represents full function (Mahoney and Barthel, 1965). Physical and mental quality of life came from the Veterans Rand 12, a twelve-item questionnaire scored continuously from 0 to 100, where higher scores indicate greater quality of life (Kazis et al., 2006; Selim et al., 2009). Both in-hospital complications and readmission came from the 30-day survey. Complications included any of the following: heart problems, stroke, lung problems, blood clots, kidney or gastrointestinal problems, nerve injury, surgical wound infection, delirium, or other.

We selected demographic and confounder variables specific to each outcome that were both routinely collected and known at the time of surgical planning. Demographic and confounder variables, including those from the preoperative assessment visit, were obtained from the medical record using MetaVision® (iMDsoft, Needham, MA). The preoperative assessment clinician judged physical activity capability, with less than four metabolic equivalents (METs) considered “low” physical activity capability. “Mood Disorder” included depression or anxiety, while “Elimination Issue” included incontinence or toileting difficulty. When patients did not respond to “fill in all that apply” questions, we assumed that they did not experience the item of interest. These included fall-related injuries, in-hospital falls, and complications.

2.3. Statistical Analysis

We used chi square tests to compare proportions and either t-tests or Wilcoxon rank-sum tests to compare continuous variables. The general population fall rate was calculated from the Behavior Risk Factor Surveillance System (BRFSS) dataset, which contains data on the number of falls in the past year for over 200,000 United States adults (CDC, 2014). Because the in-hospital falls question was dichotomous (yes or no) rather than a number, we conservatively assumed one fall per person reporting a fall. We used length of stay for time. To estimate the 30-day and one-year fall rates, we used the reported number of falls, along with each participant's response time. We subtracted ten days for mailed surveys to account for processing time. For patients reporting “three or more falls,” we estimated the true number of falls using the average number of falls among people reporting three or more falls in the BRFSS dataset, assuming similar counts in the surgical population (CDC, 2014).

In the raw dataset, missing data mostly came from functional dependence and quality of life on the 30-day (19%, 18%) and one-year (7%, 13%) surveys since they were each comprised of several items. Race, preoperative falls, Charlson index, ASA physical status, procedural cardiac risk, physical activity, smoking status, postoperative falls, and readmission also had minimal missingness (<5%). Missing data analysis revealed differences in characteristics between these participants with and without missing data. Therefore, to avoid systematic bias, imputing