Frailty as a Predictor of Surgical Outcomes in Older Patients

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BACKGROUND: Preoperative risk assessment is important yet inexact in older patients because physiologic reserves are difficult to measure. Frailty is thought to estimate physiologic reserves, although its use has not been evaluated in surgical patients. We designed a study to determine if frailty predicts surgical complications and enhances current perioperative risk models.

STUDY DESIGN: We prospectively measured frailty in 594 patients (age 65 years or older) presenting to a university hospital for elective surgery between July 2005 and July 2006. Frailty was classified using a validated scale (0 to 5) that included weakness, weight loss, exhaustion, low physical activity, and slowed walking speed. Patients scoring 4 to 5 were classified as frail, 2 to 3 were intermediately frail, and 0 to 1 were nonfrail. Main outcomes measures were 30-day surgical complications, length of stay, and discharge disposition. Multiple logistic regression (complications and discharge) and negative binomial regression (length of stay) were done to analyze frailty and postoperative outcomes associations.

RESULTS: Preoperative frailty was associated with an increased risk for postoperative complications (intermediately frail: odds ratio [OR] 2.06; 95% CI 1.18–3.60; frail: OR 2.54; 95% CI 1.12–5.77), length of stay (intermediately frail: incidence rate ratio 1.49; 95% CI 1.24–1.80; frail: incidence rate ratio 1.69; 95% CI 1.28–2.23), and discharge to a skilled or assisted-living facility after previously living at home (intermediately frail: OR 3.16; 95% CI 1.0–9.99; frail: OR 20.48; 95% CI 5.54–75.68). Frailty improved predictive power ($p < 0.01$) of each risk index (ie, American Society of Anesthesiologists, Lee, and Eagle scores).

CONCLUSIONS: Frailty independently predicts postoperative complications, length of stay, and discharge to a skilled or assisted-living facility in older surgical patients and enhances conventional risk models. Assessing frailty using a standardized definition can help patients and physicians make more informed decisions. (J Am Coll Surg 2010;210:901–908. © 2010 by the American College of Surgeons)

Older patients are at increased risk for postoperative complications.[1] If a complication occurs, it can lead to a cascade of events resulting in disability, loss of independence, diminished quality of life, high health care costs, and mortality.[2] As the aging population expands, older patients are increasingly presenting for surgical evaluation.[3] Surgical decision making in this population is challenging because of the heterogeneity of health status in older adults and the paucity of tools for predicting operative risk. Commonly used predictors of postoperative complications have substantial limitations; most are based on a single organ system or are subjective, and none estimate a patient's physiologic reserves.[4] For example, the Lee and Eagle criteria account for cardiac function only,[5,6] and the popular American Society of Anesthesiology (ASA) score is determined by a subjective estimate of organ system disease and likelihood of survival.[7] Despite the widespread adoption of these scoring systems, complications in older patients remain difficult to accurately predict.

Disclosure Information: Nothing to disclose.

Supported by grants from the National Institutes of Health (grant 1T32RR023253-01), and the National Institute of Aging, Older Americans Independence Center (grant P30 AG021334); the Johns Hopkins Center for Innovative Medicine for a Cosner Scholar; the American Geriatrics Society Jahnigen Scholars Program, The Hartford Foundation; and the American Federation of Aging, Research Training in Aging Program and the Mr and Mrs Chad and Nissa Richison Family Foundation.

Received November 10, 2009; Revised January 20, 2010; Accepted January 25, 2010.

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ISSN 1072-7515/10/$36.00
doi:10.1016/j.jamcollsurg.2010.01.028

Abbreviations and Acronyms

ASA = American Society of Anesthesiology
AUC = area under the receiver operating characteristic curve
LOS = length of stay
NSQIP = National Surgical Quality Improvement Program

There is no standardized method of measuring physiologic reserves in older surgical patients. Conceptually, decrements in reserves can determine the resilience of an older adult to recover from an operation. Frailty is increasingly recognized as a unique domain of health status that can be a marker of decreased reserves and resultant vulnerability in older patients. Frailty can be conceptualized as a global phenotype of physiologic reserves and resistance to stressors.[8,9] In nonsurgical populations, this phenotype has been associated with adverse health outcomes.[8,10-12] However, implications of frailty for surgical patients have not been studied. We hypothesized that frailty predicts operative risk in older surgical patients, and the addition of frailty to other risk models will enhance our ability to identify patients at risk for complications.

METHODS

Study design and participants

We conducted a prospective study of surgical patients age 65 years or older who presented to the Johns Hopkins Hospital anesthesia preoperative evaluation center for elective surgery during a 1-year period (June 22, 2005 to July 1, 2006). Participants underwent a standardized preoperative interview and frailty assessment by a research assistant. Demographic information, a comprehensive medical history including current prescription medications, and the patient's preoperative living situation were obtained during the interview. Data were analyzed by authors (DS, KB, JT) not involved in data collection or frailty assessment. The study was approved by the Johns Hopkins University School of Medicine institutional review board, and written informed consent obtained from all participants.

Patients were recruited on selected days of the week with days of the week rotated on a regular basis. Using this sampling method, we identified a total of 666 eligible patients on the days sampled; 21 declined participation in the study and 2 participants requested removal from the study after enrollment. We excluded patients with Parkinson disease (n = 2), previous stroke (n = 11), a Mini-Mental Status Examination score <18 (n = 2), and those taking carbidopa/levodopa, donepezil hydrochloride, or antidepressants (n = 34) because previous studies have found that these medications cause symptoms that are potentially collinear with domains of frailty.[8] Final sample size was 594.

Frailty score

We evaluated frailty based on a validated scoring system[8,9] that characterizes frailty as an age-associated decline in 5 domains: shrinking, weakness, exhaustion, low physical activity, and slowed walking speed. Detailed criteria are listed in Table 1. Each domain yielded a dichotomous score of 0 or 1 based on the following criteria:

1. Shrinking (weight loss) was defined as unintentional weight loss ≥10 pounds in the last year.
2. Decreased grip strength (weakness) was measured by having the patient squeeze a hand-held dynamometer. The strength measurement was adjusted by gender and body mass index[8,9] using a table (Table 1).
3. Exhaustion was measured by responses to questions about effort and motivation.[13]
4. Low physical activity was ascertained by inquiring about leisure time activities.
5. Slowed walking speed was measured by the speed at which patient could walk 15 feet.

Other independent variables

Information on other potentially confounding variables were collected, including age, race, gender, comorbidity (history of myocardial infarction, angina, congestive heart failure, claudication, arthritis, cancer, hypertension, diabetes, chronic obstructive lung disease, or smoking),[12] current procedure for cancer (any malignancy on a pathology report), and preoperative residence (home, nursing home, or skilled care facility). We also collected variables about operation category: major versus minor procedure (major, procedure typically requiring hospitalization; minor, procedure typically performed the same day); open versus percutaneous or minimally invasive; and intra-abdominal versus nonintra-abdominal.

Risk indices

We evaluated 4 risk models: the frailty index, American Society of Anesthesiologists (ASA) score, Lee's revised cardiac risk index, and Eagle score. Lee score (0 to 4) was determined by the presence of specific preoperative cardiac risk factors.[6] Eagle score (0 to 6) was similarly based on a standardized criteria.[5] An ASA score (1 to 6) was independently assigned by an anesthesiologist[7] blinded to the patient's frailty score.

Dependent variables

The main dependent variables (obtained from the patient's medical record) were surgical complications within 30