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Impact of frailty on surgical outcomes: The right patient for the right procedure

Catalina Mosquera, MD,[a] **Konstantinos Spaniolas, MD,**[b] *and* **Timothy L. Fitzgerald, MD,**[a]
Greenville, NC

Background. *Measuring frailty may improve patient selection for high-risk procedures.*
Methods. *Data were obtained from the American College of Surgeons National Surgical Quality Improvement Program for patients who underwent elective high-risk operative procedures, and a frailty index was used to classify the patients.*
Results. *Our study analyzed 232,352 patients with a mean age of 65 years; the majority of patients were males (54%) and white (78%). The most common procedure was colectomy (41%), followed by lower extremity bypass (25%), gastrectomy (8%), endovascular abdominal aneurism repair (7%), pancreatectomy (7%), cardiac operation (6%), nephrectomy (3%), and pulmonary resection (2%). A majority of the patients were classified as mildly frail (34%), followed by nonfrail (29%), moderately frail (21%), and severely frail (15%). On univariate analysis, age, race, procedure, sex, and frailty scores were associated with complications, prolonged duration of stay, and 30-day mortality (*$P < .0001$*). On multivariate analysis, frailty was associated with complications, prolonged duration of stay, and 30-day mortality. Increasing frailty disproportionately impacted mortality; colectomy showed the greatest mortality in severely frail patients (9.36%), followed by esophagectomy (8.2%), pulmonary resection (6.4%), pancreatectomy (5.8%), cardiac procedures (4.4%), gastrectomy (4.3%), nephrectomy (3.32%), endovascular abdominal aneurism repair (2.49%), and lower extremity bypass (2.41%;* $P = .0001$*). A similar association between duration of stay and morbidity with frailty was noted.*
Conclusion. *Frailty has a significant impact on postoperative outcomes that varies with type of procedure.*
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From the Division of Surgical Oncology[a] *and Division of Bariatric and Minimally Invasive Surgery,*[b] *East Carolina University Brody School of Medicine, Greenville, NC*

An aging populace mandates an increased use of surgical intervention in the elderly. Although age is a predictor of negative outcomes after operation, this is most likely a proxy for other clinical measures.[1,2] Furthermore, the literature on complex surgical procedures is replete with series of reports on low mortality in older patients.[2-5] These reports often espouse optimization of patient selection. Unfortunately, the factors comprising such selection criteria remain poorly defined and subjective.[6]

One measure of fitness for physiologic insult that may provide a more objective appraisal is frailty. Even though frailty remains an ethereal concept, most investigators define frailty as a decrease in physiologic reserve of multiple organ systems with identifiable altered physical function beyond what is expected for normal aging.[1,2,7-9] To date, there is no clear consensus on the optimal method to measure frailty.[9] However, attempts to measure frailty have fallen largely into 2 categories: deficit accumulation and phenotypic measures.[1,2,10,11] Deficit accumulation accounts for cumulative deficits accrued across multiple domains such as ability to perform activities of daily living,

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Reprint requests: Timothy L. Fitzgerald, MD, Brody School of Medicine, 4S24, 600 Moye Boulevard, Greenville, NC 27834. E-mail: fitzgeraldt@ecu.edu.

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mini-cognition test, and falls.[9,12] Phenotypic measures include speed to get up and go, grip strength, weight loss, exhaustion, decrease in muscle mass, and decreased physical activity.[6,9,12]

Most measures of frailty, however, are designed for research purposes and are impractical in real-world settings.[1] The common frailty indices used as research tools are the 70-item Canadian Study of Health and Aging Frailty Index (CSHA-FI), the Comprehensive Geriatric Assessment, the Comprehensive Assessment of Frailty, the Groningen Frailty Index, the Edmonton Frailty Score, the Hopkins Frailty Score, and the Fried Frailty Score.[2,10,11,13] Deficit model frailty indices applicable to clinical settings include the 11-variable Modified Frailty and Risk Analysis Index.[1,14] However, we do not have a clear understanding of the risk for a given frail patient undergoing major abdominal procedure.

A better understanding of the impact of frailty on the surgical patient is imperative. Furthermore, data from frailty indices have the potential to assist surgeons in patient selection, counseling, and modification of risk factors associated with the surgical procedure. In this study, we use an 11-item frailty index derived from the CSHA-FI and specifically designed to analyze data from the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP; Table I).[15] We aimed to analyze the data from NSQIP to advance our knowledge regarding the impact of frailty on postoperative morbidity and mortality. To carry this out, we restricted the analysis to complex surgical procedures for which surgeons and hospital-related factors are strong influences on the rate of mortality.[16] We hypothesized that increasing frailty would be associated with mortality for complex surgical procedures.

Table I. Velanovich Frailty Score

Factor	*Points*
Functional health status before operation	
Totally dependent	1
Metabolic	
Insulin-dependent DM	1
Respiratory	
History of severe COPD or current pneumonia	1
Cardiovascular	
Congestive heart failure within 30 d of operation	1
MI within 6 mo of operation	1
Previous PCI, cardiac surgery, or angina within 1 mo of operation	1
HTN requiring medication	1
History of revascularization/amputation for PVD, or rest pain/gangrene	1
Neurologic	
History of TIA	1
CVA with deficit	1
Impaired sensorium	1

COPD, Chronic obstructive pulmonary disease; *DM*, diabetes mellitus; *HTN*, hypertension; *MI*, myocardial infarction; *PCI*, percutaneous coronary intervention; *PVD*, peripheral vascular disease; *TIA*, transient ischemic attack.

MATERIALS AND METHODS

Data source. In this study, we used the data from ACS-NSQIP Participant Use Files from 2005 to 2012. This is a nationwide dataset containing data entered by trained clinical reviewers. It includes preoperative risk factors, laboratory values, intraoperative data, and the 30-day postoperative morbidity and mortality data. The ACS-NSQIP administration periodically audits the data to ensure reliability. The American College of Surgeons and the hospitals participating in the ACS-NSQIP are the sources of data used herein. However, they have not verified the data, nor are they responsible for the statistical validity of the data analysis or the conclusions arrived at by the authors of this study. Approval for this study was obtained from the East Carolina University and Medical Center Institutional Review Board.

Patient selection. This study focused on patients who underwent high-risk procedures that are linked to surgeon and hospital volume.[16] We used current procedural terminology codes to identify patients who underwent complex surgical procedures (colectomy, pulmonary resection, pancreatectomy, cardiac operation, gastrectomy, nephrectomy, endovascular abdominal aortic aneurysm [E-AAA], and lower extremity bypass [LEB]) between 2005 and 2012.

Definition of frailty. In this study, we used a frailty index previously described by Velanovich et al.[15] We chose this index because it is based on the validated frailty index, namely, the CSHA-FI, and it was specifically adapted for NSQIP (Table I). We included the following factors to derive an 11-point score: functional status and endocrine, respiratory, cardiovascular, and neurologic disease. Patients were roughly divided into 4 groups allowing for the most even distribution. These were defined as non-frail (0), mildly frail (1), moderately frail (2), and severely frail (≥3).

End point. In this study, 30-day outcomes were used as the primary end point. Furthermore, surgical complications were grouped as minor and major as per a previous publication.[17]