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The frail fail: Increased mortality and post-operative complications in orthopaedic trauma patients

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ABSTRACT

Objective: The burgeoning elderly population calls for a robust tool to identify patients with increased risk of mortality and morbidity. This paper investigates the utility of the MFI as a predictor of morbidity and mortality in orthopaedic trauma patients.
Design: Retrospective review of the NSQIP database to identify patients age 60 and above who underwent surgery for pelvis and lower extremity fractures between 2005 and 2014.
Main outcomes and measures: For each patient, an MFI score was calculated using NSQIP variables. The relationship between the MFI score and 30-day mortality and morbidity was determined using chi-square analysis. MFI was compared to age, American Society of Anesthesiologists physical status classification, and wound classifications in multiple logistic regression.
Results: Study sample consisted of 36,424 patients with 27.8% male with an average age of 79.5 years (SD 9.3). MFI ranged from 0 to 0.82 with mean MFI of 0.12 (SD 0.09). Mortality increased from 2.7% to 13.2% and readmission increased from 5.5% to 18.8% with increasing MFI score. The rate of any complication increased from 30.1% to 38.6%. Length of hospital stay increased from 5.3 days (±5.5 days) to 9.1 days (±7.2 days) between MFI score 0 and 0.45+. There was a stronger association between 30-day mortality and MFI (aOR for MFI 0.45+: 2.6, 95% CI: 1.7–3.9) compared to age (aOR for age: 1.1, 95% CI: 1.1-1.1) and ASA (aOR 2.5, 95% CI: 2.3–2.7).
Conclusions and relevance: MFI was a significant predictor of morbidity and mortality in orthopaedic trauma patients. The use of MFI can provide an individualized risk assessment tool that can be used by an interdisciplinary team for perioperative counseling and to improve outcomes.

Introduction

In 2050, the estimated population in the United States of adults aged 65 and older is projected to be 83.7 million, doubling the estimated 43.1 million in 2012 [1]. In a population-based study of over 400,000 trauma hospital admissions, 27% of patients were over the age of 65 [2], with fall mechanisms alone costing $34 billion dollars annually in the United States [3].

Orthopaedic trauma in geriatric patient is closely linked to morbidity and mortality. Fractures of the pelvis and lower extremities are particularly disabling due to weight-bearing restrictions, which require assistive devices (walker, wheelchair, crutches). Within lower extremity orthopaedic trauma, substantial research has been focused on geriatric patients with hip fractures, and one-year mortality after a hip fracture is estimated between 18% and 33% [4]. Presence of co-morbidities has been associated with increased in-hospital and one-year mortality [5,6]. Similar high rates of morbidity and mortality have been demonstrated in other geriatric lower extremity injuries [7–9] including distal femur fractures [10] and periprosthetic fractures [11].

Numerous strategies for pre-operative risk stratification and physiology optimization have been proposed [12,13], and interdisciplinary management teams have been shown to improve survival and decrease morbidity when geriatric patients are treated in the perioperative period [14–17]. Expeditious medical optimization, timely surgery, early post-operative mobilization, standardized venothromboembolism prophylaxis and delirium prevention protocols improve patient care when coordinated between primary care and orthopaedic providers.

Additionally, patients with multiple co-morbidities can be considered “physiologically-old”, with similar high risk of

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morbidity and mortality after lower extremity trauma; however, they may not be treated with appropriate interdisciplinary care in the peri-injury and peri-operative time period due to their young chronological age.

In recent years, "frailty" or a multi-dimensional state of weakness, vulnerability, and decreased physiologic reserve has been introduced as a diagnosis of "unsuccessful aging". In frail patients, multiple organ systems have a lower threshold of decline and are more susceptible to external stressors of trauma. Though frailty has a well-defined correlation with age, age alone is not necessarily synonymous with frailty. Frailty has been associated with increased post-operative complications, including increased mortality and need for long-term care. Although many scales exist to quantify "frailty," this study uses the modified frailty index (mFI) because of facility of access and its wide application and validation in previous studies. The measures needed to calculate the modified frailty index are routinely documented in national databases and also easily collected in daily clinical interactions, thus further ensuring that study findings are replicable. This specific index has been validated in vascular surgery studies and further evaluated in various patient populations, demonstrating consistent robustness in predicting mortality and morbidity [18–21]. Within orthopaedics, very little research has been performed on frailty as a predictor of morbidity and mortality, and the available studies are limited to the hip fracture population [22–27]. The purpose of this study is to perform a critical evaluation of frailty in orthopaedic trauma patients – and its ability to predict mortality and postoperative complications.

Methods

Data source and inclusion criteria

The American College of Surgeons (ACS) National Surgical Quality Improvement Program (NSQIP) is a national database of surgical data collected from 615 participating hospitals located in Northeast, Midwest, South, and West of the U.S. In this group, 68% are academic centers contributing 250,000 cases and 32% community centers contributing nearly 650,000 cases. In looking at hospital size, 39% had 500+ beds, 54% had between 100 and 499 beds, and 7% had under 100 beds. The database contains 136 variables that include demographic information, preoperative risk factors and postoperative outcomes [28]. This data is collected and verified by a certified clinical nurse at each participating site. NSQIP participant user files from 2005 to 2014 were queried to identify patients age 60 and above undergoing surgery for pelvic, acetabular, and lower extremity orthopaedic trauma based on Current Procedural Terminology (CPT) codes.

MFI calculation

From the original Canadian Study of Health and Aging Frailty Index (CSHA-FI), 11 variables were matched to 16 variables available in the NSQIP database which is shown in Fig. 1 [29]. The 11 variables evaluated were history of diabetes mellitus, congestive heart failure, hypertension requiring medications, myocardial infarction, percutaneous coronary intervention and/

CSHA-FI	NSQIP	MFI Variable
History of diabetes mellitus	Diabetes mellitus—non-insulin Diabetes mellitus—insulin Diabetes mellitus—oral	1
Congestive heart failure	Congestive heart failure within 30 days before surgery	2
Hypertension requiring medication	Hypertension requiring medication	3
Myocardial infarction	History of myocardial infarction within past 6 months before surgery	4
Cardiac problems	Previous percutaneous coronary intervention Previous cardiac surgery History of angina within 1 month before surgery	5
Cerebrovascular problems	History of transient ischemic attack Cerebrovascular accident with no neurologic deficit	6
History of stroke	Cerebrovascular accident or stroke with neurologic deficit	7
Clouding or delirium History relevant to cognitive impairment or loss Family history relevant to cognitive impairment	Impaired sensorium	8
Lung problems	History of COPD Pneumonia	9
Decreased peripheral pulses	History of revascularization or amputation for peripheral vascular disease Rest pain or gangrene	10
Changes in everyday activity Problems with getting dressed Problems with bathing Problems with carrying out personal grooming Problems with cooking Problems with going out alone	Functional health status before surgery-partially dependent Functional health status before surgery-totally dependent	11

Fig. 1. Translation of variables from Canadian Study on Health and Aging to NSQIP variables.

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