Clinical Study

Frailty is associated with morbidity in adults undergoing elective anterior lumbar interbody fusion (ALIF) surgery

Kevin Phan, BS[a,b], Jun S. Kim, MD[c], Nathan J. Lee, BS[c], Sulaiman Somani, BS[c], John Di Capua, MHS[c], Parth Kothari, BS[c], Dante Leven, DO[c], Samuel K. Cho, MD[c,*]

[a]NeuroSpine Surgery Research Group (NSURG), Suite 7a, Level 7, Prince of Wales Private Hospital, Sydney, Barker St, Randwick, New South Wales 2031, Australia
[b]Faculty of Medicine, University of New South Wales (UNSW), Gate 2, High St, Kensington, New South Wales 2033, Australia
[c]Department of Orthopaedic Surgery at Mount Sinai, 5 East 98th St, Box 1188, New York, NY 10029, USA

Abstract

BACKGROUND CONTEXT: Prior studies have suggested no significant differences in functional status and postoperative complications of elderly versus nonelderly patients undergoing posterior lumbar interbody fusion; however, similar studies have not been comprehensively investigated in the setting of anterior lumbar interbody fusion (ALIF).

PURPOSE: The objective was to quantify the ability of the modified Frailty Index (mFI) to predict postoperative events in patients undergoing ALIF.

STUDY DESIGN: Secondary analysis of prospectively collected data.

PATIENT SAMPLE: Patients undergoing ALIF in the National Surgical Quality Improvement Program (NSQIP) participant files for the period 2010 through 2014.

OUTCOMES MEASURES: Outcome measures included any postoperative complication, return to operating room (OR), and length of stay >5 days.

METHODS: NSQIP participant files from 2010 to 2014 were used to identify patients undergoing ALIF. The mFI used in the present study is an 11-variable assessment that maps 16 NSQIP variables to 11 variables in the Canadian Study of Health and Ageing Frailty Index. Univariate analysis and multivariable logistic regression models were used to compare the relative strength of association between mFI with outcome variables of interest.

RESULTS: In total, 3,920 ALIF cases were identified and grouped according to their mFI score: 0 (n=2,025), 0.09 (n=1,382), 0.18 (n=464), or ≥0.27 (n=49). As the mFI increased from 0 (no frailty-associated variables) to 0.27 (4 of 11) or higher, there was a significant stepwise increase in any complication from 10.8% to 32.7%. After multivariable regression analysis, no significant association was found between higher mFI scores with urinary tract infections and venous thromboembolism. High frailty scores were significant predictors of any complication (mFI of ≥0.27 [reference: 0]; OR 2.4; p=.040) and pulmonary complications (mFI score ≥0.27; OR 7.5; p=.001).

CONCLUSIONS: In summary, high mFI scores were found to be independently associated with any complication and pulmonary complications in patients who underwent ALIF. The use of mFI together with traditional risk factors may help better identify high-surgical risk patients, which may be useful for preoperative and postoperative care optimization. © 2016 Elsevier Inc. All rights reserved.

Introduction

There is an increasing aging population in the United States and worldwide, with models predicting that by 2030, 5% of the American population will be octogenarians and over 70 million people will be older than 65 years of age [1]. There has also been a concurrent increase in the proportion of elderly patients who undergo surgery, often associated with significantly higher morbidity and mortality postoperatively [1]. Given that geriatric populations account for over 20% of hospitalizations in the United States [2], there is increasing interest in defining exactly which elderly patients are at most risk or vulnerable to postoperative adverse outcomes following surgery [3].

Frailty is a measure of physiological reserve and accumulative deficits across variable organ systems, including functional impairments separate from aging [4]. Frailty represents the severity of the illness and has been demonstrated in multiple surgical populations to be associated with significantly higher levels of perioperative and postoperative complications [4,5]. Several different metrics exist to score frailty and are also based on different variables included and domains of frailty assessed [6]. The modified Frailty Index (mFI) is an accumulative deficit model for frailty based on variables described in the National Surgical Quality Improvement Program (NSQIP) and a prior index, the Canadian Study of Health and Ageing. Modified Frailty Index measure has been validated for the NSQIP database and has been shown to be independently associated with postoperative morbidity, mortality, as well as length of stay (LOS) in different surgical populations [7–11].

In patients over the age of 65 years, the US Medicare data reported that lumbar spinal surgery remains a commonly performed procedure, rising from 0.3 to 1.1 per 1000 enrollees [12–14]. Anterior lumbar interbody fusion (ALIF) is a commonly performed spinal surgical procedure. Prior studies have suggested no significant differences in functional status and postoperative complications of elderly versus nonelderly patients undergoing posterior lumbar interbody fusion [15]; however, similar studies have not been comprehensively investigated in the setting of ALIF. Anterior lumbar interbody fusion is subject to a unique complication profile secondary to the approach [16,17]. We hypothesized that mFI would be independently associated with mortality, serious complications, and overall complications in patients undergoing ALIF. Therefore, the objective of the present study was to determine any association between mFI and postoperative events in patients undergoing ALIF.

Methods

Patient selection and data collection

The NSQIP was launched in 1994 as a healthcare quality improvement initiative within the Veteran's Administration (VA) Health System and has since expanded in parallel to private hospitals outside the VA Health System in 1999. The NSQIP participant files for the period 2010 through 2014 were used to identify patients undergoing ALIF. The NSQIP is a national dataset, with over 136 variables collected at each participating site including demographic characteristics, preoperative risk factors, intraoperative variables, and 30-day postoperative outcomes [18]. The data were obtained in compliance with the NSQIP data use agreement under supervision of our institutional review board.

Inclusion criteria for surgical cases were identified based on the Current Procedural Terminology (CPT) codes for anterior lumbar fusion procedures (CPT: 22533, 22558). Exclusion criteria of the present study included those who underwent spinal deformity surgery (CPT 22800, 22802, 22804, 22808, 22810) or posterior surgical approaches (CPT: 22612, 22630, 22633) or combined anterior and posterior procedures. Patients who underwent nonelective surgery were also excluded. Other exclusion criteria included are as follow: being pregnant, ventilator dependent, underweight (body mass index<18.5 kg/m^2), preoperative systemic sepsis, emergency operations, LOS>365 days, central nervous system tumor, disseminated cancer, chemotherapy for malignancy within 30 days before operation, radiotherapy for malignancy within 90 days before operation, and acute renal failure (Figure).

Modified Frailty Index

The mFI used in the present study is an 11-variable assessment described by Velanovich [3], mapping 16 NSQIP variables to 11 variables in the Canadian Study of Health and Ageing-Frailty Index. Determining frailty using as few as 10 variables has been previously validated [19]. An mFI score was calculated for each patient by dividing the number of present conditions by the total number assessed (n/11). The 11 variables assessed were diabetes mellitus, functional status index of 2 or higher, chronic obstructive pulmonary disease or pneumonia, congestive heart failure, myocardial infarction, percutaneous coronary intervention and/or stenting or angina, hypertension requiring medication, peripheral vascular disease or ischemic rest pain, impaired sensorium, transient ischemic attack or cerebrovascular accident, and cerebrovascular accident with deficit. Functional ability is related to the patient's level of independence in performing activities of daily living 30 days preceding surgery (Table 1).

Of note, the NSQIP 2013–2014 does not collect data for several comorbidities in the mFI definition, including myocardial infarction, percutaneous coronary intervention, stenting, angina, peripheral vascular disease or ischemic rest pain, transient ischemic attack, and cerebrovascular accidents. However, the averages of the mFI from 2010 to 2012 and from 2013 to 2014 were both 0.057 (p=.768). Further inspection revealed that the discontinued variables only accounted for a minimal portion of the total mFI and the distribution of mFI across the different operating years was similar. Given these findings, the present study included the 2013–2014 NSQIP to present the most relevant data and to expand the power of this analysis. Future studies on mFI may benefit from using