ELSEVIER

CrossMark

Urologic Oncology: Seminars and Original Investigations 33 (2015) 426.e1–426.e12

UROLOGIC ONCOLOGY

Original article

Validation of a frailty index in patients undergoing curative surgery for urologic malignancy and comparison with other risk stratification tools

Danny Lascano, B.A.[a,*], Jamie S. Pak, B.A.[a], Max Kates, M.D.[b], Julia B. Finkelstein, M.D.[a], Mark Silva, M.D.[a], Elizabeth Hagen, B.A.[a], Arindam RoyChoudhury, Ph.D.[c], Trinity J. Bivalacqua, M.D., Ph.D.[b], G. Joel DeCastro, M.D., M.P.H.[a], Mitchell C. Benson, M.D.[a], James M. McKiernan, M.D.[a]

[a] *The J. Bentley Squier Urologic Clinic, Department of Urology at New York-Presbyterian/Columbia University College of Physicians and Surgeons and the Herbert Irvine Comprehensive Cancer Center, New York, New York*

[b] *The James Buchanan Brady Urological Institute, Johns Hopkins Medicine/Johns Hopkins University. Baltimore, MD*

[c] *Department of Biostatistics, Mailman School of Public Health, Columbia University, New York, NY*

Received 26 March 2015; received in revised form 3 June 2015; accepted 4 June 2015

Abstract

Objective: To retrospectively validate and compare a modified frailty index predicting adverse outcomes and other risk stratification tools among patients undergoing urologic oncological surgeries.

Materials and Methods: The American College of Surgeons National Surgical Quality Improvement Program was queried from 2005 to 2013 to identify patients undergoing cystectomy, prostatectomy, nephrectomy, and nephroureterectomy. Using the Canadian Study of Health and Aging Frailty Index, 11 variables were matched to the database; 4 were also added because of their relevance in oncology patients. The incidence of mortality, Clavien-Dindo IV complications, and adverse events were assessed with patients grouped according to their modified frailty index score.

Results: We identified 41,681 patients who were undergoing surgery for presumed urologic malignancy. Patients with a high frailty index score of >0.20 had a 3.70 odds of a Clavien-Dindo IV event (CI: 2.865–4.788, $P < 0.0005$) and a 5.95 odds of 30-day mortality (CI: 3.72–9.51, $P < 0.0005$) in comparison with nonfrail patients after adjusting for race, sex, age, smoking history, and procedure. Using C-statistics to compare the sensitivity and specificity of the predictive ability of different models per risk stratification tool and the Akaike information criteria to assess for the fit of the models with the data, the modified frailty index was comparable or superior to the Charlson comorbidity index but inferior to the American Society of Anesthesiologists Risk Class in predicting 30-day mortality or Clavien-Dindo IV events. When the modified frailty index was augmented with the American Society of Anesthesiologists Risk Class, the new index was superior in all aspects in comparison to other risk stratification tools.

Conclusion: Existing risk stratification tools may be improved by incorporating variables in our 15-point modified frailty index as well as other factors such as walking speed, exhaustion, and sarcopenia to fully assess frailty. This is relevant in diseases such as kidney and prostate cancer, where surveillance and other nonsurgical interventions exist as alternatives to a potentially complicated surgery. In these scenarios, our modified frailty index augmented by the American Society of Anesthesiologists Risk Class may help inform which patients have increased surgical complications that may outweigh the benefit of surgery although this index needs prospective validation.

Keywords: Frail elderly; Surgical outcomes; Urologic oncology; Preoperative evaluation; Patient survival

1. Introduction

Frailty is a growing issue for surgeons, as frail patients have worse health outcomes with increased mortality rates, hospitalizations, and institutionalization rates [1]. Frailty is

Funding for the lead author and primary investigator was awarded through the National Institute of Diabetes and Digestive and Kidney Diseases via a National Institute of Health, Bethesda, MD, USA T35 Grant 5 T35 DK 93430-3.

* Corresponding author. Tel.: +1-201-328-5308; fax: +1-212-305-0116.
E-mail addresses: dl2178@columbia.edu, dlascan1@gmail.com (D. Lascano).

http://dx.doi.org/10.1016/j.urolonc.2015.06.002
1078-1439/

a medical syndrome with multiple contributors and is characterized by diminished strength, endurance, and reduced physiologic function, increasing an individual's vulnerability to dependency and death [2]. Frailty is associated with poor oncological outcomes such as disease progression and disease-specific mortality [3].

The Canadian Study of Health and Aging Frailty Index (CSHA-FI) is a clinically validated measure of frailty that includes the extent of comorbidities and quality-of-life variables in an accumulating deficit model of frailty [4]. Rockland et al. defined frailty as a function of the severity of a patient's comorbidities and declines in activities of daily living [4]. They validated their accumulating deficit model of frailty showing that it was equivalent to the phenotypic frailty model defined by the Fried frailty index, which takes into account factors such as walking speed and weight loss [5]. Abbreviated versions of the CSHA-FI have been validated as preoperative risk stratification tools in prospective and retrospective fashion in general surgery, gynecological oncology, and orthopedic surgery [6–11]. An abbreviated version has been validated retrospectively using the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) data set among patients undergoing vascular surgery, colectomy, and emergency and elective general surgery and cardiothoracic patients undergoing lobectomies [11–15]. In all cases, frailty measured by increasing score in the frailty index was associated with adverse outcomes.

We used the variables from the CSHA-FI mapped to the ACS-NSQIP data set to create a modified 15-point frailty index (mFI), with additional variables pertinent to our patient population in a model of frailty that measures accumulating deficits [4,5,16]. We validated our modified FI in patients undergoing genitourinary procedures to see how frailty and comorbidities affect patients across the most common oncological surgeries in urology: prostatectomy, cystectomy, nephrectomy, and nephroureterectomy (Neph-U).

2. Material and methods

Under the data use agreement of the ACS, we reviewed the NSQIP participant use files from 2005 to 2013. The NSQIP database is a national, validated, outcomes-based data set that is managed by the ACS. The hospitals participating in the consortium are the source of the data used herein; they have not verified, and are not responsible, for the statistical validity of the data analysis or the conclusions we have derived.

We collected 11 variables from the CSHA-FI matched to preoperative variables in the NSQIP database of patients who were identified by the primary Current Procedural Terminology as having undergone prostatectomy, cystectomy, nephrectomy, and Neph-U. Nononcological cases were excluded. The following 4 additional variables were added to create our mFI: history of metastasis, chemotherapy/radiation exposure, weight loss, and renal failure (Table 1). History of metastasis and treatment with chemotherapy/radiation denote the severity of a patient's cancer. Weight loss is a marker of frailty validated by the Fried frailty index [1]. Renal failure with creatinine level >3 mg/ml predisposes patients to adverse outcomes [17]. The mFI index score was calculated using the sum of risk factors per patient and divided by the amount of total risk factors. Variables in the frailty index with no mention of severity were dichotomized as absent (0) or present (1); other variables were trichotomized, with 1 being most severe, similar to the study by Mitnitski et al. [5].

The following adverse events were recorded in binary fashion: the 30-day mortality rate, septic shock (SS), failure to extubate (ventilator dependence), unplanned reintubation, myocardial infarction (MI), acute renal failure (ARF), cardiac arrest requiring cardiopulmonary resuscitation (CA), surgical site infection or dehiscence, deep vein thrombosis (DVT), and pulmonary embolism, as defined in the ACS-NSQIP participant user file. Complications were classified as Clavien-Dindo IV as Webb et al. [18] have done by including the following ACS-NSQIP variables: SS,

Table 1
There were 11 ACS-NSQIP variables that were similar to 11 variables in the CSHA-FI. We added 4 ACS-NSQIP variables related to oncology patients to make the FI consisting of 15 variables in total. The number of positive factors in the FI was recorded for each patient and divided by 15 to create a frailty index value

ACS-NSQIP variables	CSHA-FI variables
1. Diabetes mellitus	History of diabetes mellitus
2. Functional status	Impaired mobility and problems dressing oneself
3. History of severe COPD	Lung problems
4. CHF exacerbation in 30 days before surgery	Congestive heart failure
5. History of MI 6 months before surgery	MI
6. Previous PCI, cardiac surgery, or history of angina	Cardiac problems
7. Hypertension requiring medication	Arterial hypertension
8. Peripheral vascular disease or rest pain	Peripheral pulses
9. Impaired sensorium	Clouding/delirium/changes in mental function
10. History of TIA or CVA without neurologic deficit	Cerebrovascular problems
11. History of CVA with neurologic deficit	History of stroke
12. Weight loss within last 6 months greater than 10%	
13. Chemotherapy or radiation before surgery	
14. History of metastasis	
15. Severe renal failure or currently on dialysis	

CVA = cerebrovascular accident; PCI = percutaneous coronary intervention; TIA = transient ischemic attack.