Impact of Charlson indices and comorbid conditions on complication risk in bilateral simultaneous total knee arthroplasty

S.K.S. Marya *, Priyadarshi Amit, Chandeep Singh

Department of Orthopaedics and Joint Replacement, Max Institute of Musculoskeletal Sciences, Saket, New Delhi, India

ABSTRACT

Background: The purpose of this study was to evaluate the influence of Charlson indices and comorbid conditions on the risk of perioperative complications in bilateral simultaneous total knee arthroplasty (BSTKA).

Methods: In our retrospective analysis, 556 patients including 133 males and 423 females (mean age 65.8 years), who had undergone bilateral simultaneous total knee arthroplasty between 2011 and 2014 were included. Risk factors (Charlson comorbidity index (CCI), age-adjusted Charlson comorbidity index (ACCI), and comorbid illnesses) and perioperative complications were noted, and subsequently, statistical tests were applied.

Results: There was significant association between Charlson indices and most of the complications ($P < 0.05$) with high-risk ACCI groups (a score > 5) bearing maximum odds for cumulative major complication (OR 4.165, $P < 0.001$, 95% CI 1.874 to 9.256). In addition, hypertension, non-ischemic cardiac illness, and moderate to severe chronic kidney disease proved be to be determinants for major complications ($P = 0.031$, $P = 0.041$, and $P = 0.014$, respectively). We also found significant associations between organ-specific illnesses and complications such as cardiac, pulmonary, neurological and renal complications ($P < 0.05$).

Conclusions: Both CCI and ACCI are predictors of post-operative complications with ACCI being the better predictive determinant. Hence, these predictors should be used for risk stratification prior to patient selection for BSTKA. The influence of hypertension, non-ischemic cardiac illness and moderate to severe chronic kidney disease should also be considered during patient selection. Moreover, optimum organ function at the time of surgery should be a priority to avoid these complications.

© 2016 Elsevier B.V. All rights reserved.

1. Introduction

Bilateral simultaneous total knee arthroplasty (BSTKA) is an established procedure for the treatment of bilateral advanced knee osteoarthritis. It offers advantages over staged bilateral total knee arthroplasty such as reduced hospital stay duration, cost, recovery time, requirement of analgesics and other medications, along with early rehabilitation and higher patient satisfaction at the cost of increased morbidity and mortality [1–6]. Studies have suggested that BSTKA is associated with greater perioperative complications in aging populations with multiple comorbidities [7,8]. Several scales have been devised to measure and grade the burden of comorbid diseases, such as American Society of Anaesthesiology Score, Elixhauser comorbidity measure and Charlson comorbidity index (CCI) [9].

In 1987, Charlson et al. developed CCI as a weighted index for estimating mortality risk due to comorbidities in medical patients [10]. Considering the influence of age on the perioperative complications, a combined index, i.e., age-adjusted Charlson comorbidity index (ACCI) was developed later [11]. These indices have been extensively utilized and validated for predicting survival and the treatment outcomes in multiple cancerous and other medical conditions, as well as for estimating the risk of post-operative complication and mortality in orthopedic patients [9,12–15]. We also believe it to be a potential predictor of the safety of BSTKA. Investigators have also identified a few comorbid conditions as risk factors for major complications after BSTKA [8,16–18]. In our opinion, in the presence of an organ with impaired function due to illness, a surgical stress would result more frequently in a complication specific to that organ. For instance, a patient with heart disease is more likely to develop a cardiac complication after a replacement surgery.

The purpose of this study was to: (1) validate CCI and ACCI for predicting perioperative complications; (2) determine the association between organ-specific comorbid conditions and complications; and (3) identify comorbid conditions as potential risk factors for complications after BSTKA.

2. Material and methods

Our study was a retrospective cohort study of prospectively collected data of patients who underwent BSTKA at our hospital between 2011 and 2014. We included 556 consecutive BSTKA patients during our study period, excluding those with infection, fracture, malignancy or revision surgery. We obtained their details from our hospital's electronic database (computerized patient record system). It included 133 (23.92%) male and 423 (76.08%) female patients. The mean age of our study population was 65.8 ± 7.7 years (range 46 to 85 years). Average body mass index was 29.45 ± 4.98 kg/m² (range 17.73 to 44.45 kg/m²). Osteoarthritis was the cause for surgery in 533 (95.86%) patients and rheumatoid arthritis in 23 (4.14%) patients. The study was approved by the local institute ethics board (Max Healthcare Ethics Committee, Nos. 15–25).

We aimed to analyze the risk factors for various complications related to BSTKA which included Charlson comorbidities along with a few other frequent comorbid conditions in our study population that are reported in the literature as potential risk factors, such as rheumatoid arthritis, hypertension, hypothyroidism, and non-ischemic cardiac illness (arrhythmia, cardiomyopathy, congenital heart diseases) [19]. Charlson comorbidities include 19 medical conditions based on the International Classification of Disease (ICD), each weighted according to its influence on mortality. CCI was measured for each patient by the summation of scores of all the comorbid illnesses present at the time of surgery, which ranges from one to 33 [10]. CCI was categorized into three risk groups (low risk, one; moderate risk, two; high risk, three or more). ACCI was calculated by adding age score to the CCI score which involved an additional one score for each decade in excess of 40 years [11]. ACCI was again grouped into three categories (low risk, 1/2; moderate risk, 3/4; high risk, five or more).

All of the patients were followed up until six weeks after surgery. The dependent variables or the outcomes of the surgery were systemic complications based on ICD-9-CM (International Classification of Diseases, Ninth revision, clinical modification) codes and mortality [19]. Complications were independently assessed and were further grouped under minor (necessitating additional observation or minor medical treatment) and major (life threatening requiring complex medical or surgical intervention and mortality) complications [8]. Cumulative minor and major complications were also measured. Patients developing multiple complications were counted only once for statistical analysis.

2.1. Statistical analysis

The data was analyzed with SPSS software for windows (SPSS Inc., version 16, Chicago, Illinois). Univariate analysis was performed to measure the frequency of risk factors and outcomes in our study population. Continuous variables were expressed as mean ± SD and categorical variables were reported as absolute number and percentages. Bivariate analysis was performed with the chi-square test and Fisher exact test to assess the association between categorical variables, i.e., risk factors and individual complications. Additionally, odds ratio was calculated using the chi-square test for CCI and ACCI subgroups to determine its influence on cumulative minor and major complications. $P < 0.05$ was considered significant.

3. Results

3.1. Comorbidities

Hypertension was the most common comorbid condition, followed by diabetes mellitus and hypothyroidism. Chronic pulmonary disease was the most common organ-specific disease, followed by coronary artery disease. We observed low-risk CCI in 333 (59.89%), moderate -risk in 153 (27.52%), and high-risk in 29 (5.21%) patients. ACCI was found to be low-risk in 80 (14.39%) patients, moderate-risk in 391 (70.32%), and high-risk in 82 (14.75%) patients. The distribution of comorbid conditions in our study population are summarized in Table 1.

Table 1
Charlson and other comorbid conditions with their frequencies in our study population.

Comorbid conditions	Weighted score	Number (%) of patients
Charlson comorbid conditions		
Coronary artery disease	1	44 (7.91%)
Congestive heart failure	1	1 (0.18%)
Chronic pulmonary disease	1	53 (9.53%)
Peptic ulcer disease	1	0
Peripheral vascular disease	1	0
Mild liver disease	1	1 (0.18%)
Cerebrovascular disease	1	4 (0.72%)
Connective tissue disease	1	7 (1.25%)
Diabetes mellitus	1	149 (26.79%)
Dementia	1	0
Hemiplegia	2	1 (0.18%)
Moderate to severe renal disease	2	11 (1.97%)
Diabetes mellitus with end organ damage	2	6 (1.07%)
Any prior tumor	2	6 (1.07%)
Leukemia	2	0
Lymphoma	2	0
Moderate to severe liver disease	3	0
Metastatic solid tumor	6	0
Acquired immunodeficiency syndrome	6	0
Other comorbid conditions		
Rheumatoid arthritis		23 (4.13%)
Hypertension		350 (62.94%)
Hypothyroidism		75 (13.48%)
Non-ischemic cardiac illnesses		16 (2.87%)

3.2. Complications after BSTKA

Cardiovascular complications were the most common complications seen in 8.45% of our study population followed by respiratory complications in 6.47%. Acute kidney injury was diagnosed in 2.29%; however, none required intervention such as dialysis. One patient developed symptomatic deep venous thrombosis. Two patients developed sepsis; however, none developed superficial or deep prosthetic joint infection. We observed cumulative minor complications in 11.15% and major complications in 5.03% of the patients. There was a single mortality (0.16%) in our population due to respiratory failure in a patient with severe chronic obstructive pulmonary disease (COPD). The post-operative complications with their frequencies are listed in Table 2.

3.3. Risk factors for perioperative complication

Among organ-specific illnesses, we observed significant association between coronary artery disease and minor cardiac complication ($P = 0.03$), chronic lung disease and major respiratory complication ($P = 0.004$), cerebrovascular disorder and minor neurological complication ($P = 0.036$), and chronic kidney disease and acute kidney injury

Table 2
Incidence of surgical outcomes in our study population.

Complications		Severity	Number (%)
Cardiac	Sinus tachy/bradycardia	Minor	34 (6.11%)
	Arrhythmia	Major	7 (1.25%)
	Myocardial infarction	Major	5 (0.89%)
	Congestive heart failure	Major	3 (0.54%)
	Shock	Major	1 (0.18%)
Respiratory	Oxygen desaturation	Minor	11 (1.98%)
	Atelectasis	Minor	23 (4.13%)
	Pneumonia	Major	3 (0.54%)
	Pleural effusion	Major	3 (0.54%)
	Failure	Major	4 (0.72%)
Renal	Acute kidney injury	Minor	13 (2.33%)
	Urinary disturbance	Minor	11 (1.98%)
Gastrointestinal	Ileus	Minor	2 (0.36%)
	Bleed	Minor	6 (1.08%)
Thromboembolic	Deep venous thrombosis	Minor	1 (0.18%)
	Pulmonary embolism	Major	6 (1.08%)
Neurological	Delirium	Minor	4 (0.72%)
	Stroke	Major	1 (0.18%)
	Encephalopathy	Major	2 (0.36%)
Infection	Sepsis	Major	2 (0.36%)
Mortality		Major	1 (0.18%)
Cumulative		Minor	62 (11.15%)
		Major	28 (5.03%)