Chronic Obstructive Pulmonary Disease Is Associated With Short-Term Complications Following Total Knee Arthroplasty

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ARTICLE INFO

ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) is a major global health issue and a leading cause of morbidity and mortality. Patients with COPD are at increased risk of complications following surgery. The purpose of this study is to evaluate the postoperative total knee arthroplasty (TKA) outcomes in these patients in comparison to a non-COPD matching cohort. Specifically, we asked the following questions: (1) "Is COPD associated with adverse perioperative outcomes?" and (2) "Does COPD increase the risk of short-term complications following TKA?"
Methods: The American College of Surgeons National Surgical Quality Improvement Program database was used to identify 111,168 patients who underwent TKA between 2008 and 2014. A total of 3975 patients with COPD were identified. Both COPD and non-COPD cohorts were compared in terms of the following outcomes: hospital length of stay, discharge disposition, and 30-day postoperative complications.
Results: COPD was a predictor for a prolonged length of stay and a discharge to an extended care facility ($P < .001$). They were at significantly increased risk of any complication including increased mortality, pneumonia, reintubation, use of a mechanical ventilator for >48 hours, cardiac arrest, progressive renal insufficiency, deep infection, return to operating room, and a readmission within 30 days postoperatively.
Conclusion: Patients with COPD are more likely to experience postoperative complications following TKA when compared to non-COPD patients. Pulmonary evaluation and optimization are crucial to minimize adverse events from occurring in this difficult-to-treat population.

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Chronic obstructive pulmonary disease (COPD) is characterized as a nonreversible progressive limitation of airflow caused by chronic inflammation induced by either particles or noxious gases [1,2]. It poses an important worldwide health burden and is a leading cause of morbidity and mortality with an estimated prevalence of 11% in adults over 40 years of age [1,3]. Despite the large number of afflicted individuals, reports suggest that COPD is actually underdiagnosed [4] and is projected to be ranked third of disorders contributing to increases in mortality worldwide by the year 2020 [1,2]. In addition, it has been demonstrated that patients with COPD are at an increased risk of postoperative complications [5—9].

As the population is aging with longer life expectancies, the prevalence of both COPD and osteoarthritis (OA) is on the rise. These patients may be part of the growing number of those who experience marked disability and diminished quality of life and require a total knee arthroplasty (TKA) [10]. Furthermore, more physicians will provide care for patients with COPD who require TKA or surgical intervention as these trends continue. Multiple studies have reported that it is a risk factor for certain complications following TKA [11,12], leading to potentially more difficult surgical and postoperative patient management.

Although some studies have identified COPD as a surgical risk factor, to the best of the author's knowledge, no studies have comprehensively identified postoperative complications and or adverse outcomes associated with TKA. Therefore, the purpose of this study was to evaluate the perioperative variables and post-operative outcomes of COPD patients who underwent TKA in comparison to a matching non-COPD cohort. We asked the following questions: (1) "Is COPD associated with adverse periop-erative outcomes including increased hospital length of stay (LOS) and discharge to a nonhome facility?" and (2) "Does COPD increase the rate of early postoperative complications (ie, within 30 days) including return to the operating room and a readmission within 30 days following TKA?" We hypothesize that these patients will be at increased risk of developing adverse perioperative outcomes and postoperative complications when compared to patients who do not have COPD.

Methods

Database

The American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database was queried for this study from January 1, 2008, to December 31, 2014. It is a risk-adjusted, case-weighted clinical database containing more than 300 variables and it tracks patients for 30 days after surgery [13]. Skilled reviewers from over 700 contributing mostly high-volume academic and community hospitals prospectively collect these data [13]. The data collection methodology has been described in greater detail elsewhere [14,15]. This study was deemed exempt by our institutional review board as the data used are de-identified and publicly available.

Patient Selection

Patients who had knee OA and who received a primary TKA between January 1, 2008, and December 31, 2014, were identified using International Classification of Disease, 9th edition codes 715.98 and Current Procedural Terminology code 27447. This search yielded a total of 112,034 patients. Patients were excluded if they underwent a nonelective surgery (n = 201; 0.2%) or had a con-current surgery during their admission (n = 209; 0.2%). A total of 111,168 eligible cases (99.6%) were identified. In the ACS NSQIP database, a patient is listed as having COPD if the medical record documents this diagnosis and one of the following within 30 days of surgery: a functional disability due to COPD (ie, dyspnea), chronic bronchodilator therapy, an exacerbation requiring hospi-talization, or a forced expiratory volume in 1 second less than 75% of expected. Of the 111,168 eligible patients, 3975 (mean age, 68.7 ± 9.7 years) had a diagnosis of COPD before surgery and 107,193 pa-tients (mean age, 66.8 ± 9.7 years) did not. Preoperative variables were collected and included demographics, blood lab values, and comorbidities (Table 1).

Perioperative and Postoperative Outcomes

Hospital LOS and discharge destination status comprised admis-sion outcomes. Complication rates were tracked for 30 days post-operatively. These included any complication, mortality, stroke, deep vein thrombosis, pulmonary embolism, cardiac arrest, myocardial infarction (MI), superficial surgical site infection (SSI), deep SSI, or-gan/space SSI, wound dehiscence, pneumonia, reintubation, venti-lator needed for >48 hours, urinary tract infection , progressive renal insufficiency, acute renal failure, systemic sepsis, septic shock, blood transfusion, return to operating room, and 30-day readmission as

Table 1
Comparison of Preoperative Variables Including Demographics, Blood Lab Values, and Comorbidities.

Demographics	Control Group (N = 107,193)	COPD Group (N = 3975)	P Value
Age (y) (mean ± SD)	66.8 ± 9.7	68.7 ± 9.7	<.001
Sex, female (%)	67,437 (63)	2436 (61)	.041
BMI (kg/m^2) (mean ± SD)	32.9 ± 7.1	34.1 ± 7.7	<.001
Active smoker (%)	8350 (8)	1034 (26)	<.001
Functional status (%)			<.001
Independent	105,185 (98)	3814 (96)	
Somewhat independent	1746 (2)	137 (4)	
Completely dependent	63 (<1)	4 (<1)	
ASA class, ≥ 3 (%)	49,418 (46)	3260 (82)	<.001
Anesthesia, general (%)	56,979 (53)	2211 (56)	.001

Lab Values	Control Group	COPD Group	P Value
Sodium (mEq/L) (mean ± SD)	139.5 ± 2.7	1.39.3 ± 3.1	<.001
Creatinine (mg/dL) (mean ± SD)	0.92 ± 0.42	0.98 ± 0.47	<.001
BUN (mg/dL) (mean ± SD)	18.1 ± 7.0	18.4 ± 8.0	.112
Hematocrit (%)	40.6 ± 4.0	40.4 ± 4.4	.006
WBC (cells/mcL) (mean ± SD)	7.0 ± 2.1	7.7 ± 2.4	<.001
Platelets (platelets/mcL) (mean ± SD)	244 ± 66	244 ± 72	.949

Comorbidities	Control Group	COPD Group	P Value
Hypertension (%)	71,162 (66)	3075 (77)	<.001
CHF (%)	204 (<1)	47 (1)	<.001
Diabetes (%)	18,890 (18)	997 (25)	<.001
Acute renal failure (%)	30 (<1)	1 (<1)	>.999
Dialysis (%)	146 (<1)	13 (<1)	.002
Cancer (%)	99 (<1)	8 (<1)	.059
Ascites (%)	19 (<1)	0 (0)	>.999
Steroid use (%)	3159 (3)	307 (8)	<.001
Bleeding disorder (%)	2678 (3)	188 (5)	<.001
Transfusion (%)	51 (<1)	2 (<1)	.715
Wound infection (%)	362 (<1)	41 (1)	<.001

COPD, chronic obstructive pulmonary disease; SD, standard deviation; BMI, body mass index; ASA, American Society of Anesthesiologists; BUN, blood urea nitrogen; WBC, white blood cell; CHF, congestive heart failure.

defined by the ACS NSQIP [13]. Surgical and medical complications were both included in the variable "any complication." However, this study focused more on medical complications and we did not identify surgical complications.

Data Analysis

The data for each cohort were extracted into a Microsoft Excel spreadsheet (2013 Microsoft Office Professional Plus; Redmond, WA). Independent t-tests were applied to numerical values, while chi-square or Fisher exact tests were used for categorical variables. Multivariate regression models were developed using variables which were significantly different after bivariate analysis. These models were used to adjust for confounding variables and identify COPD as a risk factor for each complication. All tests were 2-sided and a significance of $P \leq .05$ was used. Statistical tests were run on IBM SPSS Statistics 23 for Mac (IBM Corporation, Armonk, NY).

Results

Perioperative Outcomes

Bivariate analysis revealed statistical differences ($P \leq .05$) in LOS and nonhome discharge (Table 2). Multivariate regression revealed COPD to be an independent risk factor for LOS, nonhome discharge disposition, return to operating room, and a 30-day