The Effect of Previous Coronary Artery Revascularization on the Adverse Cardiac Events Ninety days After Total Joint Arthroplasty

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ABSTRACT

Background: Although coronary artery revascularization therapies are effective for treating coronary artery disease (CAD), these patients may be more susceptible to adverse cardiac events during later non-cardiac surgeries. The purpose of this study is to evaluate post-operative 90-day complications of total joint arthroplasty (TJA) in CAD patients with a history of CAD and to study the risk factors for cardiac complications.
Methods: We performed a retrospective analysis of TJA patients between 2005 and 2015 at our institute by summarizing the history of CAD, cardiac revascularization, and cardiac complications within 90 days after the operation. Multivariate logistic regression was performed to identify the factors that predicted cardiac complications within 90 days after the operation.
Results: A total of 4414 patients were included; of these, 64 underwent cardiac revascularization and 201 CAD patients underwent medical therapy other than revascularization. All the revascularization had history of myocardial infarction (MI). The rate of cardiac complications within 90 days for the CAD with revascularization was 18.7%, 18.4% for the CAD without revascularization, and 2.0% for the non-CAD group. A history of CAD and revascularization, bilateral TJA, general anesthesia, body mass index ≥ 30 kg/m^2, and history of MI were associated with a higher risk of cardiac complications. Patients who underwent TJA within 2 years after cardiac revascularization had a significantly higher cardiac complication rate, and the risk decreased with time.
Conclusion: There is an increased risk of cardiac complications within 90 days after the operation among TJA patients with a history of CAD. Revascularization cannot significantly reduce the risk of cardiac complications after TJA for CAD patients. However, the risk decreased as the interval between revascularization and TJA increased.

Total knee arthroplasty (TKA) and total hip arthroplasty (THA) are effective treatment options for end-stage knee and hip arthropathy that provide effective pain relief and restoration of joint function. In the United States, the annual number of cases is growing, with 570,000 THA cases and 3,480,000 TKA cases expected annually by 2030 [1]. The situation is similar in China. Furthermore, more patients with co-morbidities will undergo arthroplasty procedures as the number of cases continues to increase and coronary artery disease (CAD) is among the most important of these co-morbidities. Arterial revascularization including coronary artery bypass grafting (CABG) and percutaneous coronary intervention (PCI) are both common methods for treatment of CAD. An estimated 397,000 CABG procedures and 954,000 PCI procedures were performed in 2010 in the United States [2]. Although revascularization therapies are effective for treating CAD, these patients may be more susceptible to adverse cardiac events, particularly at the time of later non-cardiac surgeries, compared with the general population [3]. These patients may even experience the potentially fatal complication of subsequent coronary

thrombosis [4]. The reported incidence of a major cardiac complication was 2.1%-9.8% and the mortality rate was 1.2%-5.2% within 30 days to 1 year among cardiac revascularization patients who underwent non-cardiac surgeries [5].

Given the increasing proportion of patients requiring total joint arthroplasty (TJA) and the high prevalence of coronary revascularization, it is necessary to study the major adverse events after TJA in patients with a history of coronary revascularization. Although another study reported a similar risk of post-operative mortality and complications after TJA for cardiac revascularization and non-revascularization patients [6], the study only reported in-hospital complications. This study aimed to examine the relationship between a history of revascularization procedures (CABG and stent placement) and cardiac complications within 90 days after the operation using the joint arthroplasty registry in our hospital and to determine the risk factors for complications. We further evaluated the relationship between the time interval from cardiac revascularization to TJA and cardiac complications.

Materials and Methods

This is a retrospective study. Following Institutional Review Board approval, we obtained data from the joint arthroplasty registry at our hospital from the years 2005 to 2015. The inclusion criteria were all patients who underwent primary THA and TKA. The exclusion criteria were (1) all patients who underwent revision THA or revision TKA and (2) patients with inflammatory arthritis such as rheumatoid arthritis, psoriatic arthritis, or ankylosing spondylitis, who have different demographic factors and different pattern of perioperative complication than osteoarthritis. The patients were regularly followed at post-operative 30 and 90 days at the outpatient clinic. In cases in which it was not possible for the patient to visit the outpatient clinic, the patients were interviewed via a telephone questionnaire. For all patients, demographics, history of cardiac revascularization, history of CAD and medical treatment, and co-morbidities were obtained in addition to 90-day post-operative complications and mortality.

The CAD patients were clinically evaluated by a cardiologist and recommended for further examination before undergoing TJA in our institute. If the patients were evaluated as acceptable for the surgery, the protocol below was followed. For the CAD patients who were on anti-platelet therapy, they were asked to discontinue the anti-platelet therapy for 7 days before undergoing TJA. For CAD patients with a history of cardiac revascularization, anti-platelet therapy was substituted with low molecular weight heparin for 7 days before undergoing TJA and was stopped 24 h before operation [7]. Low molecular weight heparin and sequential compression devices were begun within 24 h of operation for thromboembolic prophylaxis and continued during the hospitalization period. A sequential oral anticoagulant was used after discharge. Other CAD-related medications were restored according to the pre-operative regimen as soon as possible.

The patients were divided into 3 groups as follows: CAD with revascularization (CAD with REVASC), CAD with medical treatment except for revascularization (CAD without REVASC), and no history of CAD (non-CAD). Complications that developed within the 90 days of follow-up were recorded and classified as cardiac or non-cardiac. The cardiac complications included unstable angina, acute myocardial infarction (AMI), arrhythmia, and heart failure. We defined major adverse cardiac events (MACEs) as MI, revascularization, and all-cause mortality [8]. Non-cardiac complications included respiratory complications (pneumonia, respiratory failure, pneumothorax), deep vein thrombosis, pulmonary embolism, renal complications, cerebrovascular complications, wound complications, and surgical site infection.

A total of 3330 patients underwent TKA and 1626 patients underwent THA in our institute between 2005 and 2015. All patients were native Chinese. Based on the exclusion criteria, 317 TKA patients and 225 THA patients were excluded. A total of 3013 TKA cases and 1401 THA cases were included in this study, with an average age of 62.2 years (range 38-82). The demographic data of these cases are summarized in Table 1. One patient had a history of both cardiac stent and CABG. Information on smoking status was available for 3529 patients (Table 1). The average body mass index (BMI) for CAD patients with REVASC, CAD patients without REVASC, and non-CAD patients were 27.6 ± 4.8, 27.3 ± 3.4, and 25.9 ± 4.3 kg/m^2, respectively.

Statistical Analysis

The clinical data were analyzed using means and standard deviations. The level of statistical significance was set at $P < .05$. For continuous variables, analysis of variance was used to compare groups. For categorical variables, chi-square analysis was used. To determine the independent predictors associated with 90-day post-operative complications and mortality, univariate and multivariate logistic regression analyses were performed. A full model was created utilizing all possible independent variables, and backward stepwise regression was then used to prune the model. For regression analyses, the 95% confidence intervals (CIs) of odds ratios (ORs) were reported. Significant independent predictor variables were identified as those corresponding to P values <.05 and an OR exclusive of 1.0. All statistical analyses were performed using SPSS 15.0 (SPSS, Inc., Chicago, IL).

Results

All the patients in the CABG/PCI group had a history of MI after pre-operative verification with myocardial perfusion tomography.

Table 1
Characteristics of Patients in the CAD With Revascularization Group, CAD Without Revascularization Group, and Non-CAD Group.

Characteristics	CAD With REVASC (n)	CAD Without REVASC (n)	Non-CAD (n)
Case number	64	201	4149
Age (mean ± SD)	71.9 ± 6.2	70.2 ± 6.6	61.5 ± 12.8
Sex (n)			
Male	23	47	1163
Female	41	154	2986
BMI (n, kg/m^2)			
<25	18	41	1810
25 ≤ BMI < 0	28	111	1688
30 ≤ BMI < 40	12	43	573
≥40	6	0	29
Smoking status (n)			
Current smoker	4	35	422
Former smoker	12	29	298
Non-smoker	37	106	2584
TKA (n)			
Unilateral TKA	36	113	1674
Bilateral TKA	18	48	1123
THA (n)			
Unilateral THA	8	38	1113
Bilateral THA	2	2	239
Anesthesia (n)			
GA	58	185	3860
Non-GA	6	16	289
CABG	8	–	0
PCI	57	–	0
Co-morbidity of DM	16	61	329
History of MI	64	23	-

DM, diabetes mellitus; GA, general anesthesia; n, case number; SD, standard deviation.