Relationship between peri-operative outcomes and hospital surgical volume of total hip arthroplasty in Japan

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A B S T R A C T

Background: This study aimed to evaluate the relationship between peri-operative complication of total hip arthroplasty (THA) and hospital surgical volume.

Methods: We reviewed discharge administrative data from 8321 patients who underwent primary THA between July and December 2008. Relationships between complications and surgical volume were analyzed with multivariate logistic regression models including age, sex, and Charlson comorbidity index. Hospitals were categorized into four groups according to the 6-month volume of THA procedures.

Results: The most frequent complication was dislocation (1.41%). Next was infection (1.24%). Fracture and pulmonary embolism occurred in less than 1% of procedures. Patients who underwent THA in hospitals with the highest surgical volume had lower risk of dislocation and infection than those treated in the hospitals with the lowest surgical volume (odds ratio [OR] 0.321, 95% confidence interval [CI] 0.167–0.572 and OR 0.123, 95% CI 0.020–0.421). Patients aged 65 years and older were associated with increased risk of dislocation (OR 2.342, CI 1.555–3.624) and fracture (OR 2.799, CI 1.372–6.301). Females demonstrated lower risk of dislocation (OR 0.558, CI 0.352–0.869) and infection (OR 0.560, CI 0.365–0.882).

Conclusion: These results indicated that the increase in the risk of peri-operative dislocation of primary THA may be associated with low hospital surgical volume as well as age and male sex.

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1. Introduction

Osteoarthritis (OA) is the most common joint disorder affecting the elderly population worldwide and a leading cause of pain and disability. OA is estimated to affect 40% of people over 70 years of age [1], and 25.3% of people develop symptomatic hip OA by age 85 years [2]. Pain caused by OA is a major factor affecting quality of life. Total hip arthroplasty (THA) is a highly effective treatment to improve mobility and eliminate pain [3,4]. As people live longer, the demand of joint replacement will be necessary in more cases. However, complications of THA can lead to poor functional outcome for patients; thus, reducing their occurrence is important.

The relationship between the rate of postoperative complications and hospital surgical volume or socioeconomic factors has been unclear. Several studies have indicated that hospitals with a high surgical volume have a lower rate of overall mortality [5–8]. Among 76,627 Medicare patients

who underwent primary or revision THA, a significant association was observed between higher hospital volume and lower 90-day mortality and dislocation rates [9]. Additionally, postoperative complications and hospital surgical volume were associated with total length of hospital stay in 1561 total joint arthroplasty patients [10]. By contrast, several studies have indicated no association between THA complication rate and surgical volume. Using data from 2965 patients, Yasunaga et al. reported that surgeon volume of over 500 procedures was inversely associated with postoperative THA complications, while hospital surgical volume was not significantly associated with postoperative THA complications [11]. Katz et al. also reported that race and income were associated with complication risk in the Medicare population [9].

The purpose of this study was to assess the relationship between peri-operative complications after THA and hospital surgical volume with large-scale nation-wide patient database and with minimal effects of socio-economic status and patient ethnicities. We have employed the DPC (Diagnosis Procedure Combination) database, which is a large-scale nationally representative administrative database of acute care inpatients in Japan and has successfully been used for many clinical epidemiological studies [12–14]. In Japanese setting, the influence of race and socioeconomic factors is negligible because of the universal medical insurance system, which provides almost unrestricted access to health care [15], and ethnic homogeneity [16].

2. Patients and methods

2.1. Data source and study population

The DPC code-based prospective payment scheme consists of 18 major diagnostic categories, 507 diagnostic groups, and 2658 case-mix groups in acute-care hospitals. This diagnosis system was instituted in 2003 by the Ministry of Health, Labour and Welfare of Japan. In this study, we used the DPC database consisting of patient level administrative data including age, sex, in-hospital mortality, length of stay, and hospital reference cost calculated from fee-for-service tariff schedule. Preoperative comorbidities and postoperative complications that occurred during hospitalization were coded with the International Classification of Diseases, Tenth Revision (ICD-10) codes [17]. Additionally, surgical procedures were coded according to a Japanese fee-for-service tariff schedule. We reviewed administrative data from 8607 patients who underwent primary THA between July and December 2008 in the Japanese DPC database. The data were voluntarily offered to us by 855 hospitals that agreed to their use for research, which represent approximately 45% of inpatient admissions to acute-care hospitals in Japan. The data were anonymous and could not be linked to any other information to identify patients upon their collection by the research group. Prior approval by the ethics committee of Tokyo Medical and Dental University was granted to the study. We excluded 161 patients who underwent THA due to fracture (ICD-10, S72), infection (ICD-10, M00-03, M46, M86, M90.1, M90.2), and pathologic fracture (ICD-10

C40, C41, C76.3, C76.5, C79.5, D48.0, M48.5, M49.5, M80, M84.3, M84.4, M90.7) to select elective surgery cases to minimize case-mix heterogeneity. A total of 125 patients were excluded from one hospital where some inpatients can selectively be treated with non-prospective payment schema. Our final analysis included 8321 patients from 601 hospitals.

A previously published coding algorithm was modified [9,18,19], and we defined outcome as the peri-operative complication rate. Complications were defined as dislocation (ICD-10, M24.3, M24.4, S73.0 and requiring repositioning of joint dislocation), infection (ICD-10, M00, M01, M86, T81.4, T84.5-9, T85.7 and surgical debridement for pyogenic arthritis, removal of the prosthesis), pulmonary embolism (ICD-10, I26 and filtering in inferior vena cava or vein thrombectomy), and fracture (ICD-10, S72, M96.6, T84.1 and requiring open reduction and internal fixation or closed reduction) diagnosed after an operation and analyzed as independent variables. To adjust for the impact of patient comorbidity status on in-hospital complications, the Charlson comorbidity index [20] was determined based on the Quan version [21].

2.2. Hospital primary THA volume group

Hospital surgical volume was calculated as the total number of patients who underwent THA. Hospital surgical volume per 6-month period was classified into four groups so that each group contains at least 20 hospitals for statistical stability as follows: 0–16 procedures (Group A, lowest), 17–33 procedures (Group B, lower), 34–54 procedures (Group C, higher), and over 55 procedures (Group D, highest). Hospitals with the lowest volume (0–16 procedures per 6 months) were defined as the reference group.

2.3. Statistical analysis

Patient complication rates were compared across hospital surgical volume groups using the chi-square test for trends in categorical variables and the Wilcoxon/Kruskal–Wallis equality of populations rank test for continuous variables. An unadjusted logistic regression model was used to assess change in the risk of in-hospital complications compared with the reference group. Multivariate logistic regression models adjusting for patient sex, age, and Charlson index were then created to assess the association between in-hospital complications and hospital surgical volume. Risk-adjusted complication rate of hospitals was not used because of expected statistical instability. All analyses were carried out using JMP 9.0 (SAS Institute Inc, Cary, NC, USA) statistical software. Two-sided *p*-values <0.05 were considered statistically significant.

3. Results

Hospital surgical volume for primary THA ranged from 1 to 237 procedures, with a mean of 45.9 and a median of 30 procedures, per 6-month period. Patient characteristics are shown in Table 1. Mean age was 65.2 years, and 83% of patients were female. The mean length of stay (LOS) was 35.4 days. The most frequent diagnosis was osteoarthritis