



Original Contribution

# Perioperative comorbidities and complications among patients undergoing primary total knee arthroplasty: a retrospective analysis and prospective survey



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Received 11 September 2014; accepted 14 July 2015

## Keywords:

Anesthesia;  
Obesity;  
Total knee arthroplasty

## Abstract

**Study objective:** To determine the demographic characteristics of patients undergoing primary total knee arthroplasty during the years 1989, 1999, and 2009 at our institution and determine whether their characteristics mirror the changing US demographic characteristics.

**Design:** Retrospective chart review of patients and prospective survey of experienced anesthesia providers in total knee arthroplasty.

**Setting:** Tertiary care academic medical center.

**Patients:** All patients 18 years and older who underwent unilateral primary total knee arthroplasty in 1989, 1999, and 2009 were identified through the Mayo Clinic Total Joint Registry. For each year, 200 patients were randomly selected.

**Measurements:** The demographic characteristics, comorbidities, perioperative care, and postoperative outcomes of patients, as well as survey responses from experienced anesthesia providers.

**Main results:** During the 3 study years, a total of 591 patients were included for analysis. A statistically significant increase in body mass index (BMI) was observed over time in patients undergoing primary total knee arthroplasty (average BMI, 29.01 in 1989, 31.32 in 1999, and 32.32 in 2009 [ $P < .001$ ]). Despite the increase in patient comorbidities, the percentage of patients who had postoperative complications decreased over time ( $P = .003$ ), and postoperative disposition (general medicine ward vs intensive care unit) did not change. Our provider survey received a 76% response rate. In total, 82% of anesthesia providers who responded to the survey perceived that both BMI and the number of comorbidities had increased. Of survey respondents, 67% state that they have modified their perioperative anesthesia care because of changes in body habitus and patient comorbidities.

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**Conclusions:** The number of obese patients with comorbidities who present for total knee arthroplasty at our institution has increased over the past 20 years. Despite this fact, a reduction was detected in postoperative complications.

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## 1. Introduction

According to data of the Centers for Disease Control and Prevention, 33.0% of US adults older than 20 years are overweight (body mass index [BMI], 25.0-29.9) [1] and more than one-third of all adults (35.7%) are obese (BMI  $\geq$  30) [1,2]. Obesity has been directly linked to an array of comorbidities, including hypertension, heart disease, stroke, diabetes mellitus, obstructive sleep apnea (OSA), mood disorders, and cancer [3]. Numerous studies have identified obesity as a prominent risk factor for osteoarthritis, leading to significant functional disability of the hip and knee [4,5] and requiring arthroplastic repair at a younger age [6].

Not only does obesity increase the likelihood of requiring knee arthroplasty, it also may put patients at increased risk for complications after surgery [7]. However, studies examining perioperative complications have produced conflicting results; some studies suggest that obesity increases perioperative complications [8-13], whereas other investigators have found no difference [14-17]. Meanwhile, the demand for primary total knee arthroplasty (TKA) is projected to grow by 673% (by approximately 3.48 million procedures) by 2030 [18], resulting in an exponential number of operations in this growing group of patients with complex medical circumstances. Recent data show that the proportion of TKA in obese patients nearly doubled from 2002 to 2009 [19].

The primary aims of this study were to look at the demographic trends (ie, rising BMI) over 20 years (from 1989 to 2009) and to examine the rates of documented BMI-associated comorbidities and complications after TKA. A secondary aim was to survey anesthesia providers regarding their perception on changes in demographic characteristics, comorbidities, and perioperative care, to determine how care providers are adapting to changing demographic patterns.

## 2. Methods

The study received Mayo Clinic Institutional Review Board approval. All patients 18 years of age or older who underwent a primary, unilateral TKA at Mayo Clinic during the calendar years 1989, 1999, and 2009 were identified retrospectively through the Mayo Clinic Total Joint Registry [20]. The registry previously was validated and contains all data collected for each joint replacement surgery performed at Mayo Clinic since 1969. For each year in the study, 200 patients were randomly selected with a computer-generated list. Inclusion criteria consisted of adult patients who completed research authorization and who underwent a primary, unilateral TKA during the aforementioned

years. Exclusion criteria included undergoing surgical revisions, partial knee arthroplasties, bilateral knee arthroplasties, or other surgical procedures performed during the same hospitalization.

All patient data were obtained through the Mayo Clinic electronic medical record (EMR), as well as paper medical records from surgical, anesthesia, physical therapy, nursing, and hospital records for the study years before adoption of the EMR. Patient records were retrospectively reviewed for the following demographic data: age, sex, height, weight, race/ethnicity, and American Society of Anesthesiologists physical status classification. After BMI values ( $\text{kg}/\text{m}^2$ ) were calculated, patients were stratified using established World Health Organization definitions (ie, underweight, BMI < 18.5; normal weight, BMI 18.5-24.9; preobesity, BMI 25.0-29.9; obesity class I, BMI 30.0-34.9; obesity class II, BMI 35.0-39.9; and obesity class III,  $\geq$  40.0) [21]. Comorbid conditions, including hypertension, coronary artery disease, diabetes mellitus type 2, OSA, and chronic kidney disease, were identified in accordance with criteria defined in Table 1. The type of anesthetic used (general or neuraxial anesthesia in addition to peripheral nerve block for postoperative analgesia) was extracted from both electronic and paper anesthetic records. Information related to perioperative complications, as well as the number of postoperative consultations, was derived from the daily progress notes of the primary surgical service, the medical consultation teams, and the anesthesia pain service.

Survey data of provider's perceptions were obtained with a Web-based REDCap (Research Electronic Data Capture) survey [22] distributed to 352 anesthesia providers (ie, physicians and certified registered nurse anesthetists) on the campus of Mayo Clinic in Rochester, Minnesota (Appendix). Survey questions were designed to evaluate provider subjective perceptions of patient demographic trends—specifically, obesity—and the adaptations that these demographic changes have produced during their time in practice. Nonresponders were sent an e-mailed survey reminder after 30 days.

### 2.1. Statistics

Unless indicated otherwise, data are presented as mean (SD) for continuous variables and frequency percentages for categorical variables. Patient demographic characteristics were compared across calendar years through analysis of variance and  $\chi^2$  test for continuous and categorical variables, respectively. Postoperative complications and consultations were compared across periods using the  $\chi^2$  test or Fisher exact test as appropriate. In addition, multivariable logistic regression analyses were performed to assess whether a greater BMI was associated with increased risk of overall

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