Obesity and Perioperative Morbidity in Total Hip and Total Knee Arthroplasty Patients

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Abstract: The incidence of obesity in 1071 total hip arthroplasty (THA) patients and 1813 total knee arthroplasty (TKA) patients and its effect on perioperative morbidity were evaluated prospectively. Fifty-two percent of TKA and 36% of THA patients were obese (body mass index ≥30). The obese patients were significantly younger, with a higher proportion of obese TKA patients being women. Higher rates of diabetes and hypertension were found in obese patients. Higher postoperative infection rates were observed in patients with body mass index 35 or higher. The odds ratio was 6.7 times higher risk for infection in obese TKA patients and 4.2 times higher for obese THA patients. The increased risk of infection in obese patients undergoing total joint arthroplasty must be realized by both the patient and surgeon. **Key words:** total hip arthroplasty, obesity, diabetes, hypertension.

Obesity looms as a nationwide epidemic, and obese individuals comprise a disproportionately large subset of patients undergoing total joint arthroplasty (TJA) [1-3]. Most of the literature on obesity and TJA involve patients undergoing total knee arthroplasty (TKA), with somewhat conflicting results. Although some report excellent patient satisfaction and few complications [4-7], other reports cite increased rates of wound complications and associated medical conditions [8-10]. An increased revision rate and lower satisfaction levels were recently reported for TKA in obese patients [11].

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Submitted January 25, 2005, accepted April 27, 2005.
All of authors received support in the form of an unrestricted research grant from Depuy, Zimmer, and Smith and Nephew.
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0883-5403/05/1906-0004$30.00/0
doi:10.1016/j.arth.2005.04.023

There are few reports of the deleterious effect of obesity in patients undergoing total hip arthroplasty (THA). In general, patient satisfaction was high in obese patients undergoing THA, with no increased risk of perioperative complications [4,12,13].

The purpose of this prospective study was to determine the incidence of obesity in patients undergoing TJA in community hospitals followed with a total joint registry. The effect of increased body mass index (BMI) on perioperative morbidity after TJA procedures was also evaluated, particularly the rates of postoperative infections.

Methods

Definitions of Obesity

A BMI of greater than 30 is a widely accepted measurement of obesity [1,2]. In this study, we further designated patients as being "highly obese" if their BMI exceeded 35. Categorizing patients with a BMI greater than 35 has been found to stratify differences among patients undergoing TKA [9]. A BMI greater than 40 is defined as morbid obesity.

Patient Samples

Patients were identified using a prospective registry that records patient demographics and comorbidities, details on the surgical procedure, implant types (including lot numbers and serial numbers), and follow-up clinical data on all patients undergoing THA and TKA within the Kaiser Permanente Health Plan in Southern California. Clinical outcome data included a 10-point scale for pain and satisfaction. Prospective data collection began in April 2001 with institutional review board approval.

Using the registry, 1071 patients undergoing THA and 1813 TKA patients in 2001 and 2002 at 11 different hospital facilities were identified as being obese (BMI >30) or nonobese (BMI ≤30). The patients were then classified into highly obese (BMI >35) and non–highly obese (BMI ≤35) groups, as well as morbidly obese (BMI >40) and non–morbidly obese (BMI ≤40). All patients within the period were included. Preoperative comorbid conditions were recorded on a preoperative registry form. Postoperative complication rates were recorded up to 1 year postoperatively using the registry status report form with data merged with 90-day hospital readmissions from an integrated administrative hospital database. No patients were lost to follow-up. Both superficial and deep space infections were monitored. Superficial infection cases were defined as wound drainage or erythema, which required intravenous antibiotics which prolonged hospital admission or required readmission for management with intravenous antibiotics. Any infection treated operatively or any positive culture was considered a deep infection.

Superficial cellulitis (wound erythema) managed with oral antibiotics on an outpatient bases was not recorded as infection.

Statistical Analyses

χ^2 And Fisher exact tests were used to compare highly obese and non–highly obese on categorical variables. Independent *t* tests were applied to assess group differences in continuous variables. Mann-Whitney *U* tests were used to evaluate group differences in ordinal variables and in continuous variables with nonnormal distributions.

Results

Obesity (BMI ≥30) was more prevalent in TKA patients (52%) than THA patients (36%, $P < .001$). TKA patients were also more likely to be highly obese (BMI ≥35; 23%) than THA patients (14%, $P < .001$). Similarly, morbid obesity (BMI ≥40) was more prevalent in TKA (11%) than THA (5%) patients ($P < .001$).

Tables 1 and 2 present patient demographics, comorbidities, and outcomes for highly obese (BMI ≥35) and non–highly obese (BMI ≤35) patients who underwent THA or TKA. The highly obese THA and TKA groups were younger (mean ages 62 and 64 years, respectively) than non–highly obese

Table 1. Demographics, Comorbidities, and Outcomes for Highly Obese and Non–Highly Obese Patients Undergoing Total Hip Arthroplasty

	Highly obese (BMI >35) (n = 149)	Non–highly obese: (BMI ≤35) (n = 922)	*P* value
Demographics			
Age, mean (SD)	62 (9)	66 (13)	<.005
% Women (n)	62% (92)	57% (525)	.30
BMI, mean (SD)	39.5 (34)	27 (4)	<.001
Charnley classification	(n = 120)	n = 735	.79
A: unilateral	54%	60%	
B1: bilateral arthroplasties	13%	11%	
B2: bilateral joint disease	21%	19%	
C1: multijoint	9%	9%	
C2: debilitated by systemic disease	2%	1%	
C3: both C1 and C2	1%	0.4%	
Retired, % (n)	61% (83)	70% (541)	.04
Use ambulatory support, % (n)	77% (150)	71% (718)	.19
Comorbidities, % (n)			
None	6% (9)	18% (168)	<.001
Diabetes	14% (21)	9% (80)	.04
Cardiac	7% (10)	9% (79)	.52
Hypertension	53% (79)	36% (334)	<.001
Gout	3% (5)	3% (26)	.71
Systemic steroids (current)	1% (1)	2% (22)	.23
Alcohol (abuse or disease)	7% (11)	7% (61)	.73
Smoker (current)	9% (14)	6% (56)	.13
Outcomes			
Hospital length of stay (h), mean (SD)	82 (38)	78 (47)	.41
Readmitted to hospital ≤90 d, % (n)	4% (3)	6% (25)	.78
Satisfaction, mean (SD): (0, extremely dissatisfied; 10, extremely satisfied)	9.2 (1.8)	9.4 (1.3)	.19
Improvement in pain from preoperative to postoperative, mean (SD) (0, no pain; 10, worst possible)	5.6 (3)	5.5 (3)	.75
Complications during follow-up, % (n)			
Infection	1.3% (2)	0.3% (3)	.09
Dislocation	0.7% (1)	0.8% (7)	1.0
Medical	0% (0)	0.2% (2)	1.0
DVT	0.7% (1)	0.1% (1)	.26

Table 2. Demographics, Comorbidities, and Outcomes for Highly Obese vs Non–Highly Obese Undergoing Total Knee Arthroplasty

	Highly obese (BMI >35) (N = 422)	Non–highly obese: (BMI ≤35) (N = 1391)	*P* Value
Demographics			
Age, mean (SD)	64 (9)	69 (10)	<.001
% Women (n)	76% (316)	58% (801)	<.001
BMI, mean (SD)	41 (5)	29 (4)	<.001
Charnley classification	n = 345	n = 1048	
A: unilateral	35%	46%	.02
B1: bilateral arthroplasties	15%	14%	
B2: bilateral joint disease	34%	32%	
C1: multijoint	9%	7%	
C2: debilitated by systemic disease	1%	1%	
C3: both C1 and C2	0.3%	0.3%	
Retired, % (n)	65% (243)	78% (981)	<.001
Use ambulatory support, % (n)	64% (268)	53% (739)	<.001
Comorbidities, % (n)			
None	6% (23)	17% (236)	<.001
Diabetes	21% (88)	12% (167)	<.001
Cardiac	8% (34)	10% (132)	.37
Hypertension	54% (229)	44% (617)	<.001
Gout	4% (15)	3% (37)	.34
Systemic steroids (current)	0.2% (1)	2% (26)	.02
Alcohol (abuse or disease)	8% (33)	5% (73)	.05
Smoker (current)	3% (13)	5% (74)	.06
Outcomes			
Hospital length of stay (h), mean (SD)	85 (45)	80 (43)	.22
Readmitted to hospital ≤90 d, % (n)	10% (23)	8% (51)	.32
Satisfaction, mean (SD): (0, extremely dissatisfied; 10, extremely satisfied)	9.3 (1.3)	8.9 (1.8)	.003
Improvement in pain from preoperative to postoperative, mean (SD) (0, no pain; 10, worst possible)	4.5 (3)	3.9 (3)	.02
Complications during follow-up, % (n)			
Infection	1.1% (5)	0.3% (4)	.01
Patellar dislocation	0% (0)	0.1% (2)	1.0
Medical	0.9% (4)	0.4% (5)	1.0
DVT	0% (0)	0.6% (8)	.21

groups (mean ages 66 and 69 years, respectively; $P < .005$) and less likely to be retired than the non–highly obese group ($P = .04$, $P < .001$). Although the highly obese and non–highly obese THA groups were similar in sex distributions (62% vs 57%, $P = .30$), the highly obese TKA group consisted of more women than the non–highly obese TKA group (76% vs 58%, $P < .001$). Highly obese THA and TKA patients had lower Charnley scores than non–highly obese patients. The highly obese TKA patients were more likely to use ambulatory support than the non–highly obese group ($P < .001$).

Preoperative comorbidity in the highly obese groups included higher rates of diabetes mellitus (THA 14% vs 9%, TKA 21% vs 12%) and hypertension (THA 53% vs 36%, TKA 54% vs 44%; Tables 1 and 2). Hospital length of stay for highly obese and non–highly obese THA and TKA groups was similar. The highly obese TKA group had a slightly higher hospital readmission rate (10%) than the non–highly obese THA group (8%, $P = .32$). At follow-up, highly obese TKA patients reported higher satisfaction with surgery and greater improvement in pain scores than non–highly obese TKA patients ($P < .01$). There was no statistical difference in pain and satisfaction scores between highly obese and nonobese THA patients.

The THA infection rate was higher in the highly obese group, but included only 2 cases, none of whom had diabetes mellitus (Table 1). Both patients were treated with irrigation and debridement, retention of implants, and intravenous antibiotics. One of the 3 THA infections in the nonobese group was treated with resection arthroplasty, the remainder with irrigation and debridement with implant retention. One of the nonobese infection cases was diabetic and treated with irrigation and debridement. The odds ratio was 4.2 times higher risk for infection for highly obese THA patients.

The highly obese TKA patients had a significantly higher postoperative infection rate (1.1%) than the non–highly obese group (0.3%, $P = .01$; Table 2). Diabetes mellitus was associated with deep infection in only 1 of 5 TKA cases in the highly obese group, and 2 of 4 cases in the nonobese group. Two highly obese and 2 nonobese patients underwent operative irrigation and debridement, with retention of implants. One nonobese patient with diabetes mellitus required resection arthroplasty followed by second stage reimplantation. The remainder of infections were superficial (3 in the highly obese and 1 in the nonobese group) and treated with prolonged intravenous antibiotics and wound care. The odds ratio was 6.7 times higher for risk of infection in highly obese TKA patients.

The dislocation rates among highly obese THA patients (0.7%) were similar to the non–highly obese group (0.8%). Steroid use was not significantly associated with infection or other morbidity in either group. The rates of medical complications (deep vein thrombosis, cardiac, gastrointestinal, genitourinary, and pulmonary events) were similar between the highly obese and non–highly obese groups.

Discussion

The prevalence of obesity in patients undergoing elective orthopedic procedures is high but is particularly high for the knee joint [1-3]. The prevalence of obesity (BMI ≥30) in the United States is estimated to be 30% in the general population [14]. In our series, 52% of the TKA patients were obese, considerably higher than the national average. The TKA patients with BMI 35 or higher (highly obese) were significantly younger, further supporting the strong association of obesity and knee osteoarthritis [15]. A disproportionately high rate of female patients (75%) with BMI 35 or higher was observed in the TKA patient population, consistent with observations of osteoarthritis of the knee in obese women [16]. Using THA as an end point for severe hip osteoarthritis, an association of obesity and hip osteoarthritis was less apparent, consistent with other reports using radiographic criteria [17].

A statistically significant higher rate of postoperative infection rates was seen in TKA patients with a BMI greater than 35 ($P = .01$). A high rate of wound complications was previously reported with TKA procedures in morbidly obese patients with BMI greater than 40 [8], but other studies investigating TKA in highly obese patients did not show significantly increased infection rates [4,6,9,11]. The current study represents the largest series of highly obese patients (N = 422) undergoing total knee arthroplasty procedures. Factors contributing to infections in obese patients include difficult surgical exposure, longer operative times, poor vascularization of fatty tissues, and a weakened immune response. A statistically higher rate of diabetes mellitus was found in the highly obese TKA patients, but only 1 of 6 infected cases was diabetic. Even without diabetes as a comorbidity, obesity is associated with insulin resistance and hyperglycemia , conditions which contribute to poor leukocyte function [18,19]. The terms "metabolic syndrome" and "syndrome X" has been used to describe patients with the constellation of central obesity, a sedentary lifestyle, and insulin resistance [20].

A trend toward a higher infection rate was seen in highly obese THA patients ($P = .09$), although these patients represented only 14% of patients undergoing hip arthroplasty surgery. The difference in THA infection rates was not statistically significant; however, the odds ratio calculated a 4.3 times higher for risk of infection in the highly obese group. Future studies with larger samples of highly obese THA patients will be required to determine whether there is a statistically higher risk of infection.

A higher rate of comorbidities, specifically, diabetes mellitus and hypertension, was observed in highly obese patients undergoing elective TJA, as has been previously reported [9]. An association with preoperative comorbidity in TKA patients and increased length of stay, increased hospital costs, and decreased postoperative outcome scores has also been previously reported [10].

Rates of postoperative medical complications such as venous thromboembolic phenomenon and cardiac, gastrointestinal, and genitourinary events were not increased with obesity in our series. This is in contrast to some reports where increased medical complications were observed [9], but in agreement with other studies [4,11]. The lack of significant medical complications in our series may be attributed to the younger age of the highly obese patients, selection bias (because high-risk patients would be discouraged from undergoing elective joint arthroplasty), and the smaller sample size compared with the non–highly obese patients.

Limitations of this study include lack of knowledge of the nutritional status of highly obese patients, who may be paradoxically malnourished. Although preoperative antibiotics were recorded for all cases, the timing and dosage of antibiotics were not known. Most highly obese patients require double the dosage of intravenous cefazolin routinely administered to nonobese patients. Antibiotic-impregnated methylmethacrylate was not used in any procedure in this series.

A large proportion of patients undergoing elective TKA and THA procedures are obese. Obese patients undergoing TJA have higher rates of comorbid conditions and higher rates of postoperative wound complications. The surgeon must recognize the increased risk of infection associated with obesity and inform these patients accordingly.

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