

EPO-144

Patients with Morbid Obesity and Congestive Heart Failure Have Longer Operative Time and Room Time in Total Hip Arthroplasty

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ABSTRACT

More and more patients with total hip arthroplasty have obesity, and previous studies have shown a positive correlation between obesity and increased operative time in total hip arthroplasty. But those studies shared the limitation of small sizes. Decreasing operative time and room time is essential to meeting the increased demand for total hip arthroplasty, and factors that influence these metrics should be quantified to allow for targeted reduction in time and adjusted reimbursement models. This study intend to use a multivariate approach to identify which factors increase operative time and room time in total hip arthroplasty. For the purposes of this study, the American College of Surgeons National Surgical Quality Improvement Program database was used to identify a cohort of over thirty thousand patients having total hip arthroplasty between 2006 and 2012. Patient demographics, comorbidities including body mass index, and anesthesia type were used to create generalized linear models identifying independent predictors of increased operative time and room time. The results showed that morbid obesity (body mass index >40) independently increased operative time by 13 minutes and room time 18 by minutes. Congestive heart failure led to the greatest increase in overall room time, resulting in a 20-minute increase. Anesthesia method further influenced room time, with general anesthesia resulting in an increased room time of 18 minutes compared with spinal or regional anesthesia. Obesity is the major driver of increased operative time in total hip arthroplasty. Congestive heart failure, general anesthesia, and morbid obesity each lead to substantial increases in overall room time, with congestive heart failure leading to the greatest increase in overall room time. All analyses are conducted via SAS® (version SAS 9.4, Cary, NC).

INTRODUCTION

In orthopedic surgery studies, obesity has been associated with longer operative times in total hip and total knee arthroplastic patients [2-4]. It is often thought as the major driver of increased utilization of operative time and room time in orthopedic surgery. However, each study was analyzed only by a univariate analysis which does not control for other factors which might be more prevalent in the obese population and thus confound the impact of obesity on operative time. Furthermore, each of these studies is limited by sample size from 50 to 425 patients, with limited numbers of underweight and morbidly obese patients in the final analyses, making the true impact of morbid obesity on operative time unclear.

The objective of this study is to explore if there are other factors prevalent in the obese population that increase operative time in total hip arthroplasty. Furthermore, it intended to answer if the previous studies which demonstrated increases in operative time in total hip arthroplasty are accurate because of the potential for confounders which are present at higher rates in the obese population than normal weight patients (such as congestive heart failure [CHF], diabetes, or hypertension).

To achieve this, we used the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database from 2006 to 2012 to identify those having total hip arthroplasty based on current procedural terminology (CPT code 27130). First we performed univariate analyses and then a multivariate analysis of the factors increasing operative time and room time in total hip arthroplasty.

MATERIALS AND METHODS

DATA COLLECTION

Patients who underwent total hip arthroplasty from 2006 to 2012 were identified from the ACS NSQIP participant use data files based on current procedural terminology (CPT code 27130). ICD-9 (International Classification of Diseases, Ninth Revision) diagnosis codes and CPT codes were used to ensure that only elective cases of total hip arthroplasty were included. The ACS NSQIP database is the leading nationally validated, risk-adjusted, outcomes-based program to measure and improve the quality of surgical care in hospitals. Use of the NSQIP to evaluate short-term outcomes has been extensively validated in the general surgery and orthopaedic literature. Surgical clinical reviewers use strict definitions to collect patient demographics, comorbidities, laboratory values, operative variables, and postoperative thirty-day morbidity and mortality data. Data collection continues for thirty days regardless of inpatient status, and high data fidelity is ensured through chart review, surgeon contact, and patient telephone communication. These techniques and routine auditing ensure data disagreement rates of <1.8%. After applying our inclusion and exclusion criteria, the total number of patients enrolled in the study was 30,361 patients.

PATIENTS CHARACTERS

The ACS NSQIP reports on over 250 preoperative and postoperative patient characteristics. Notable preoperative patient data categories include demographics, preoperative health and comorbidities, laboratory values, and perioperative variables. Notable demographics include age, sex, and race. Preoperative health and comorbidities charted include functional status (competence with activities of daily living), body mass index (BMI), recent weight loss (10% of total body weight over a six-month period), diabetes mellitus (oral or insulin dependent), smoking status, alcohol consumption, chronic obstructive pulmonary disease (COPD), coronary artery disease (including chronic heart failure or history of myocardial infarction), peripheral vascular disease, history of stroke or transient ischemic attack, dialysis, corticosteroid use, bleeding disorders, preoperative blood transfusion (defined as a transfusion of one or more units of blood within three days of surgery), an open wound (defined as any laceration or ulceration identified on the body and not necessarily isolated to the operatively treated limb in question), radiation therapy (within ninety days prior to surgery), chemotherapy (within thirty days prior to surgery), a recent operation (within thirty days prior to the index procedure), and preoperative sepsis. Preoperative laboratory values captured include white blood-cell count (WBC), hematocrit, platelet count, serum creatinine, blood urea nitrogen, serum albumin, and the international normalized ratio (INR). Operative variables include ASA (American Society of Anesthesiologists) classification, wound class, intraoperative blood transfusions, duration of the operation, and resident involvement.

OUTCOMES

The ACS NSQIP reports many outcomes. For our study, we only use operation time (total operation time) and room time (duration patient in room).

STATISTICAL ANALYSIS AND RESULTS

We initially completed a univariate analysis for candidate factors to increase operative time and room time, and then using these factors we completed a multivariate analysis using a generalized linear model to determine which candidate factors are independent predictors of increased operative time or independent predictors of increased room time. The univariate results are omitted here due to simplicity nature. Operative time and room time were the dependent variables in the analysis, and all other factors were the independent variables in the analysis. Independent variables considered in the analyses included age, gender (male vs female), race (White vs Other), anesthesia technique (General vs Other), diabetes (Yes vs No), smoking (Yes vs No), ETOH (alcohol consumption exceeding 2 drinks/d Yes vs No), hypertension (HYPERMED) (Yes vs No), history of chronic obstructive pulmonary disease (COPD) (Yes vs No), history of CHF (congestive heart failure), and BMI (Underweight (BMI <18.5) vs Normal weight (BMI, 18.5-24.9) vs Overweight (BMI, 25.0-29.9) vs Obese class I (BMI, 30.0-34.9) vs Obese class II (BMI, 35.0-39.9) vs Morbid obesity (BMI ≥40)). BMI was used to group patients into categories of underweight (BMI <18.5), healthy weight (BMI, 18.5-24.9), overweight (BMI, 25-29.9), obese class I (BMI, 30-34.9), obese class II (BMI, 35-39.9), and obese class III or morbid obesity (BMI ≥40), and in the model variable bmi_class indicates those BMI groups via 1,2,3,4,5, and 6, respectively. Results in each of the multivariate analyses for both operative time and room time were considered significant if $P < .05$. Specifically, two models and results are listed below, one for operation time and one for duration time in room. All statistical analysis was performed with use of SAS software (version 9.3; SAS Institute, Cary, North Carolina).

MODEL AND RESULT FOR OPERATION TIME

```

title 'operation time for total hip arthroplasty';
proc genmod data=joe2;
class
sex(ref="female" param=ref)
race(ref="Other" param=ref)
ANESTHES_new(ref="Other" param=ref)
DIABETES(ref="NO" param=ref)
SMOKE(ref="No" param=ref)
ETOH(ref="No" param=ref)
HYPERMED(ref="No" param=ref)
HXCOPD(ref="No" param=ref)
HXCHF(ref="No" param=ref)
bmi_class(ref='2' param=ref);
model optime=sex race ANESTHES_new DIABETES SMOKE ETOH HYPERMED HXCOPD
HXCHF bmi_class age/dist=n link=id;

run;
quit;
```

Class Level Information

Class	Value	Design Variables
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SEX	female	0
	male	1
race	Other	0
	White	1
ANESTHES_new	General	1
	Other	0
DIABETES	NO	0
	YES	1
SMOKE	No	0
	Yes	1
ETOH	No	0
	Yes	1
HYPERMED	No	0
	Yes	1
HXCOPD	No	0
	Yes	1
HXCHF	No	0
	Yes	1
BMI_Class	1	1
	2	0
	3	0
	4	0
	5	0
	6	0

Analysis Of Maximum Likelihood Parameter Estimates

Parameter		DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Intercept		1	104.7850	1.6432	101.5645	108.0055	4066.67	<.0001
SEX	male	1	3.1468	0.4814	2.2033	4.0903	42.73	<.0001
race	White	1	2.1680	0.6037	0.9848	3.3513	12.90	0.0003
ANESTHES_new	General	1	10.5341	0.4746	9.6039	11.4644	492.60	<.0001
DIABETES	YES	1	-0.0069	0.7597	-1.4959	1.4821	0.00	0.9928
SMOKE	Yes	1	-2.1262	0.7133	-3.5242	-0.7281	8.88	0.0029
ETOH	Yes	1	-0.0680	1.7934	-3.5829	3.4469	0.00	0.9698
HYPERMED	Yes	1	0.6687	0.5148	-0.3403	1.6777	1.69	0.1940
HXCOPD	Yes	1	-0.0785	1.1916	-2.4140	2.2571	0.00	0.9475
HXCHF	Yes	1	6.8058	4.1400	-1.3085	14.9202	2.70	0.1002
BMI_Class	1	1	2.9674	2.3377	-1.6144	7.5493	1.61	0.2043
BMI_Class	3	1	1.1570	0.6574	-0.1315	2.4455	3.10	0.0784
BMI_Class	4	1	4.3374	0.7148	2.9364	5.7384	36.82	<.0001
BMI_Class	5	1	8.4164	0.8758	6.7000	10.1329	92.36	<.0001
BMI_Class	6	1	12.7847	1.0454	10.7358	14.8336	149.57	<.0001
Age		1	-0.3419	0.0222	-0.3854	-0.2985	237.59	<.0001

MODEL AND RESULT FOR ROOM TIME

```

title 'Patient Duration in Room';
proc genmod data=joe2;
class
sex(ref="female" param=ref)
race(ref="Other" param=ref)
ANESTHES_new(ref="Other" param=ref)
DIABETES(ref="NO" param=ref)
SMOKE(ref="No" param=ref)
ETOH(ref="No" param=ref)
HYPERMED(ref="No" param=ref)
HXCOPD(ref="No" param=ref)
HXCHF(ref="No" param=ref)
bmi_class(ref='2' param=ref);
model dpatrm=sex race ANESTHES_new DIABETES SMOKE ETOH HYPERMED HXCOPD HXCHF
      bmi_class age/dist=n link=id;
run;
quit;

```

Analysis Of Maximum Likelihood Parameter Estimates

Parameter		DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Intercept		1	146.9938	2.4661	142.1603	151.8273	3552.76	<.0001
SEX	male	1	3.5965	0.7421	2.1420	5.0510	23.49	<.0001
race	White	1	5.0921	0.8843	3.3588	6.8254	33.15	<.0001
ANESTHES_new	General	1	18.0356	0.7325	16.5998	19.4713	606.17	<.0001
DIABETES	YES	1	-1.3629	1.1682	-3.6526	0.9268	1.36	0.2433
SMOKE	Yes	1	-1.8579	1.0934	-4.0009	0.2851	2.89	0.0893
ETOH	Yes	1	-2.3250	2.0529	-6.3487	1.6987	1.28	0.2574
HYPERMED	Yes	1	1.5214	0.7933	-0.0335	3.0764	3.68	0.0551
HXCOPD	Yes	1	0.9215	1.8519	-2.7082	4.5512	0.25	0.6188
HXCHF	Yes	1	19.7248	8.1260	3.7981	35.6515	5.89	0.0152
BMI_Class	1	1	1.8491	3.5661	-5.1402	8.8385	0.27	0.6041
BMI_Class	3	1	0.7864	1.0096	-1.1924	2.7652	0.61	0.4360
BMI_Class	4	1	5.7286	1.0988	3.5750	7.8822	27.18	<.0001
BMI_Class	5	1	10.1081	1.3515	7.4591	12.7571	55.93	<.0001
BMI_Class	6	1	18.1045	1.6058	14.9572	21.2518	127.11	<.0001
Age		1	-0.3443	0.0336	-0.4101	-0.2785	105.15	<.0001

Since the records (30,361 patients) are large, we assume that both operation time and room time follow an approximate normal distribution in the models. It can be seen that the greatest independent predictor of increased operative time (or room time) was morbid obesity, with an increased operative time of 13 minutes in morbidly obese patients as compared with normal weight patients. Increased operative time was found to increase incrementally with BMI class. Also congestive heart failure (CHF) plays a big role in increased use of both in operation time and room time. For detailed results discussion, see J. Joseph Gholson.

CONCLUSION

In conclusion, morbid obesity, congestive heart failure (CHF), and anesthesia are the major drivers of increased operative time (or room time) in total hip arthroplasty. The results of this study have implications for provider time and costs as well as facility costs associated with operating on patients with morbid obesity and CHF.

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