



Research Article

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Effect of Morbid Obesity on Postoperative Outcomes Following Total Knee Arthroplasty

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ABSTRACT

Objectives : Total knee arthroplasty (TKA) is one of the most commonly performed surgeries globally, particularly for patients with moderate-to-severe osteoarthritis. Predictors of postoperative outcomes have been thoroughly studied. Morbid obesity is one of the predictors that has shown controversy in the literature. A retrospective cohort chart review study was done to further explore the effect of morbid obesity on postoperative outcomes following TKA. Methods : After applying the inclusion/exclusion criteria, 507 patients were included and stratified based on the WHO body mass index classification. Demographic data was analyzed between 3 groups (non-obese, obese, and morbid obese), and post-operative complications were analyzed and compared between morbid obese and non-morbid obese. Results : In total, 14 (2.6%) patients required revision, with postoperative deep tissue infection being the most common reason. Postoperative deep tissue infection developed in 4 (4.3%) patients with morbid obesity and in 2 (0.05%) without, which was a statistically significant difference ($P = 0.012$). Furthermore, 5 (5.4%) patients with morbid obesity and 7 (1.7%) without required revision, which showed a statistically significant difference ($P = 0.034$). The overall need for red blood cells (RBC) transfusion due to postoperative anemia was recorded in 11 (11.9%) patients with morbid obesity and 100 (24.1%) without, which was a statistically significant difference ($P = 0.008$). Conclusion : Patients with morbid obesity are less likely to require RBC transfusion due to postoperative anemia but have a higher risk of developing postoperative deep tissue infection and undergoing revision for their prostheses when compared with those without morbid obesity.

Key words: *Total Knee Arthroplasty, Morbid Obesity, Post-Operative Complications, Predictors of Outcome.*

INTRODUCTION

Total knee replacement (TKR) is one of the most commonly performed surgeries worldwide, with almost a million TKRs performed annually [1]. In addition to being highly cost-effective, it has proven to be very effective, with high success rates, in improving the quality of life and function in patients with moderate-to-severe osteoarthritis (OA) [2-4]. Predictors of postoperative outcomes have been extensively studied, and a systematic review has illustrated the impact of patient characteristics on multiple outcome measures including mortality, morbidity, complications, functional outcome, and postoperative pain [4]. Obesity, in contrast, is controversial in terms of predicting the outcomes. Obesity is defined as excessive fat accumulation in adipose tissue resulting in impaired health [5]. The body mass index (BMI) is used to classify the degree of adiposity in individuals, and according to the World Health Organization (WHO), individuals with $BMI \geq 30 \text{ kg/m}^2$ are considered obese and those with $BMI \geq 40 \text{ kg/m}^2$ are considered morbidly obese [6]. Obesity is a major risk factor for OA ; obese individuals are 6.8 times more likely to develop knee OA than those with normal weight, thus increasing their risk of requiring TKR [7-9]. The effect of obesity on postoperative outcomes following TKR has been equivocal, with multiple studies demonstrating conflicting results [10-12]. Another feature is the survival rate of the prostheses and risk of revision. Some studies

have reported that obesity decreases the survival rate of the prosthesis, while others have reported contrasting results [13, 14]. Baker et al. demonstrated that patients with morbid obesity had similar rates of functional improvement compared with patients with a normal BMI, while Rajgopal et al. demonstrated that patients with morbid obesity actually had greater improvements in function than did those without obesity [15, 16]. Therefore, as suggested by a systematic meta-analysis, more studies regarding patient characteristics and their impact on the outcomes of knee arthroplasty are needed to clarify the effect of obesity on these outcomes [2]. Only few studies on TKR, in general, have been conducted with an aim to assess the quality of life and attitude towards TKR [17, 18].

A recent study performed in Riyadh evaluated the obesity and TKR and concluded that obesity was not associated with an increase in either the operative time or length of hospital stay [19]. In view of the high prevalence of obesity in Saudi Arabia, we believe that a large-scale study is needed to assess the effect of morbid obesity on multiple postoperative outcomes following TKR

MATERIALS AND METHODS

Study Design and Setting :

In this retrospective chart-review cohort study, all the patients who underwent TKR between January 2010 and January 2016 at one of the major tertiary care centers in Saudi Arabia were included.

Study Subjects :

All the patients aged 18 years and older were recruited. The patients with a previous history of knee surgeries before TKA or those with missing data in their files were excluded. A total of 551 patients were identified using the official orthopedic surgical records ; 44 were excluded because of incomplete/missing data. The patients were stratified based on the WHO BMI classification into the following categories : underweight, normal weight, overweight, obese, and morbidly obese. The postoperative medical data were then followed up for a minimum of two years.

Data variables and confounders

A conventional sampling technique was used, and all the necessary data was gathered from the patients' files, nursing notes, surgical notes, and discharge summaries. The data collection Microsoft Excel sheet contained 3 main sections :

1. Preoperative data : basic demographics and comorbidities
2. Operative data : side of TKA and length of the operation and hospital stay
3. Postoperative data : all possible postoperative complications, management of complications, and revision rate

All patients were given a prophylactic dose of cefazolin prior to the surgery and had a urinary catheter inserted, which was removed as soon as the patient started to mobilize

DVT prophylaxis was provided to all patients and included prophylactic dose of enoxaparin anticoagulant therapy in addition to proper physiotherapy with early mobilization encouragement.

Possible confounders, such as age and comorbidities, were adjusted before analyzing the data.

Statistical methods

SPSS Version 20 was used to analyze the data. All data collected from the Excel sheet was appropriately coded and transferred to SPSS. Univariate data were analyzed using mean \pm standard deviation (SD), median \pm interquartile range (IQR), and frequencies. Bivariate data were analyzed using the chi-squared test to compare categorical data, t-test and analysis of variance to compare means of different groups, and Kurskal–Wallis test to compare the median of different groups. Fisher's exact test was used to calculate the P value, and a value of <0.05 was considered statistically significant. Subgroup analyses were used to further study and compare patients with morbid obesity with those with normal weight, overweight, and obesity.

Ethical Considerations :

Patients' confidentiality was maintained throughout the study. Their medical record numbers were de-identified and access to the data was restricted exclusively to the investigators. No consent was needed for this type of study. The study was approved by the Institutional Review Board (IRB).

RESULTS

A total of 507 patients were included in the study ; 115 (22.7%) were men, and 146 (28.8%) patients were younger 60 years. Ninety-seven patients (19.1%) were overweight, 304 (59.9%) were obese, and 92 (18.1%) were morbidly

obese. Regarding the side of the surgery, 205 (40.4%) patients had unilateral TKR (Table 1). The 3 most common medical comorbidities were hypertension, diabetes mellitus type 2, and dyslipidemia, observed in 354 (69.8%), 233 (45.9%), and 210 (41.4%) patients, respectively (Chart 1). The overall mean \pm SD length of hospital stay was 12 ± 6 days, and the mean duration of operation was 154.7 ± 66 minutes. Overall, 12 (2.3%) patients required revision of their prostheses, with postoperative deep tissue infection being the most common reason for revision. The most common postoperative complications were anemia and urinary tract infection (UTI) that were observed in 128 (25.2%), and 28 (5.5%) patients, respectively (Chart 2). Only 111 (21.9%) patients required red blood cells (RBC) transfusion, with 79 (15.4%) needing 2 RBC packs.

Table 1 : Basic Demographics

Variable	Category	N	Mean \pm SD**	%
Age group	<60	146	-	28.8
	60-64	107	-	21.1
	65-69	98	-	19.3
	70+	156	-	30.7
Gender	Male	115	-	22.7
	Female	392	-	77.3
BMI group	Underweight	1	-	0.2
	Normal Weight	13	23.7 (\pm 1.8)	2.6
	Overweight	97	27.7(\pm 1.5)	19.1
	Obese	304	34.6(\pm 2.7)	59.9
	Morbidly Obese	92	43.8(\pm 3.7)	18.1
Side of Operation	Unilateral Right	118	-	23.3
	Unilateral Left	87	-	17.1
	Bilateral Simultaneously	111	-	21.9
	Bilateral with Interval*	191	-	37.7

*Both knees operated, but on different times.

** Represents the mean and SD of BMI values for each group

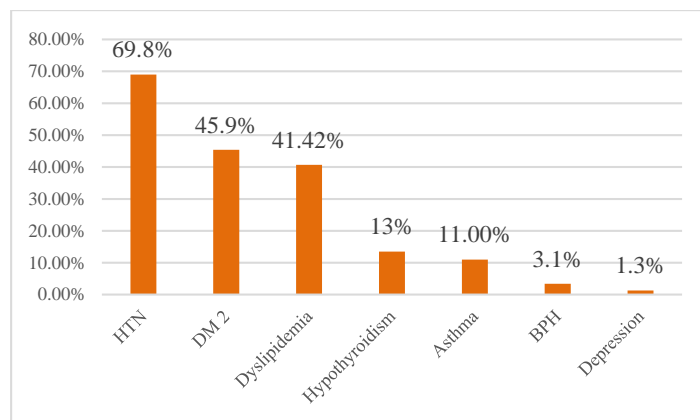


Chart 1 : Patients' Comorbidities

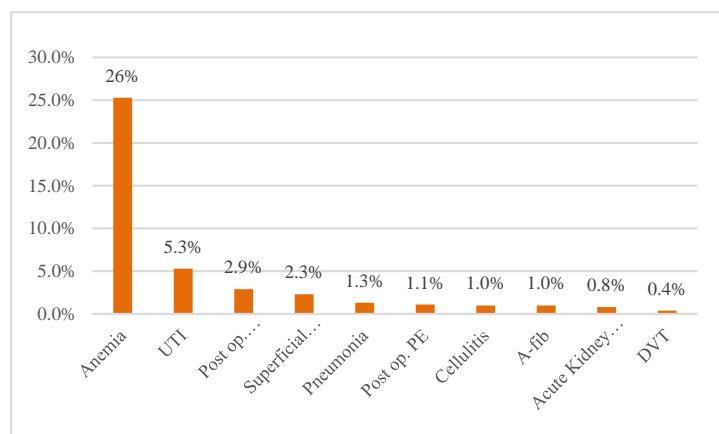


Chart 2 : Post-operative complications

The median (IQR) length of hospital stay was 11 (5) days for patients without obesity, 10 (4) days for those with obesity, and 11 (7) days for those with morbid obesity ; the differences were not statistically significant ($P = 0.37$). The median duration of the surgery was 140 (85) minutes in those without obesity, 135 (70) minutes in those with obesity, and 138 (52) minutes in those with morbid obesity ; the differences were not statistically significant between them ($P = 0.61$; Table 2). In patients who underwent unilateral TKR, the mean duration of hospital stay in those without obesity and those with obesity and morbid obesity was 11.3 ± 4.9 , 10.7 ± 5.3 , and 10.7 ± 4.8 days, respectively, while the duration of the surgery was 131.8 ± 41 , 128.2 ± 37 , and 129.2 ± 36 minutes, respectively, with both variables showing no statistically significant difference between the groups ($P = 0.8$ and 0.6 , respectively ; Table 3). In patients who underwent bilateral TKR, the mean duration of hospital stay in those without obesity and those with obesity and morbid obesity was 15.6 ± 7 , 15.5 ± 7.3 , and 19.3 ± 8.8 days, respectively, while the duration of the surgery was 259 ± 76.8 , 229 ± 58.3 , and 257.2 ± 89.4 minutes respectively ; the differences in these 2 variables were not statistically significant between the groups ($P = 0.14$ and 0.16 respectively ; Table 4).

Table 2 : Overall length of Hospital stay and OR time

		N	Median (IQR)	P-value*
Length of operation (in Minutes)	Overweight or less	111	140(85)	0.608
	Obese	304	137(70)	
	Morbidly Obese	92	138(52)	
	Total	507		
Length of hospital stay (in days)	Overweight or less	111	11(5)	0.376
	Obese	304	10(4)	
	Morbidly Obese	92	11(7)	
	Total	507		

*P-value using Kruskal-Wallis

Postoperative deep tissue infection developed in 4 (4.3%) patients with morbid obesity and 2 (0.05%) without (odds ratio [OR] = 9.2, 95% confidence interval [CI] : 1.6–51.4), which was a statistically significant difference ($P = 0.012$). Furthermore, a comparison of the rates of revision between the 2 groups revealed that 5 (5.4%) patients with morbid obesity and 7 (1.7%) without it required revision (OR = 3.3, 95% CI : 1.027–10.6). This showed a statistically significant difference between the groups ($P = 0.034$).

Table 3 : length of hospital stay and OR time in unilateral TKR

		N	Mean±SD	95% Confidence interval	P-value*
Length of hospital stay (days)	Overweight or less	47	11.33±5	10.2-12.4	0.66
	Obese	116	10.76±5.3	10.1-11.4	
	Morbidly Obese	42	10.73±4.8	9.6-11.8	
	Total	205	10.87±5.1	10.4-11.4	
Operation time (minutes)	Overweight or less	47	131.8±41.1	121.8-141.8	0.8
	Obese	116	128.3±37	122.9-133.6	
	Morbidly Obese	42	129.2±36.1	119.1-139.3	
	Total	205	129.2±37.7	124.9-133.5	

* P-value using ANOVA

Table 4 : Length of hospital stay and OR time in bilateral TKR

		N	Mean±SD	95% Confidence interval	P-value*
Length of hospital stay (in days)	Overweight or less	64	15.65±7	12.8-18.5	0.168
	Obese	188	15.58±7.3	13.7-17.3	
	Morbidly Obese	50	19.37±8.8	15.1-23.6	
	Total	302	16.24±7.6	14.8-17.6	
Operation time (minutes)	Overweight or less	64	258.9±76.8	223.9-293.9	0.145
	Obese	188	229.5±58.3	213.1-245.9	
	Morbidly Obese	50	257.2±89.4	207.6-3.6.7	
	Total	302	241.4±69.7	226.5-256.2	

With respect to postoperative complication rates between patients with and without morbid obesity, anemia was observed in 18 (19.4%) patients with morbid obesity and 110 (26.5%) without, which was not a statistically significant difference ($P = 0.18$). However, a comparison of the overall need for RBC transfusion due to

postoperative anemia between the groups revealed that 11 (11.8%) patients with morbid obesity and 100 (24.4%) without it required RBC transfusion (OR = 0.42, 95% CI : 0.22–0.82), which was a statistically significant difference between the groups (P = 0.008). Additionally, the need for RBC transfusion between bilateral and unilateral TKR groups showed that 54 (17.1%) patients who underwent unilateral TKR and 59 (28%) patients who underwent bilateral TKR required RBC transfusion, which was a statistically significant difference (P<0.05). Deep venous thrombosis (DVT) developed in one (1.1%) patient with morbid obesity and one (0.2%) without it, whereas pulmonary embolism (PE) did not develop in any patient with morbid obesity but it did develop in 6 (1.4%) patients without ; both variables did not demonstrate statistically significant difference between the groups (P = 0.3 and 0.6, respectively). Furthermore, chronic pain was observed in 2 (2.2%) patients with morbid obesity and in 13 (3.1%) without it, which was not statistically significant (P = 0.4). Postoperative superficial wound infection did not occur in any patient with morbid obesity but occurred in 12 (2.9%) patients without it, with a statistically nonsignificant difference (P = 0.1). Lastly, UTI occurred in 7 (7.5%) patients with morbid obesity and in 21 (5.3%) without, but the difference was not statistically significant (P = 0.3).

DISCUSSION

Our results established that the BMI does not affect the operative time of both unilateral and bilateral TKR, which is consistent with findings of previous studies [20, 21]. In contrast, results from a study conducted in New York showed a linear relationship between the BMI and operative time [22]. We believe that to accurately compare the differences in operation time, multiple factors should be considered ; for example, the operative time of one surgeon and one orthopedic team only should be considered to eliminate differences due to different operators and teams. Additionally, a clear distinction must be made between anesthesia time and operative time.

The length of hospital stay was not statistically different between patients with and without morbid obesity and those with obesity in our study, implying that the BMI by itself is not a significant predictor of the length of hospital stay, as was also reported by a study in Scotland [23]. Our results were also similar to those of a previous local study by Al Turki et al ; they reported a mean length of hospital stay of 12 days, which was longer than that reported by international studies [20]. The same study in Scotland showed that the length of hospital stay following TKR is 9.4 days, whereas another study performed in the United Kingdom reported it to be 7.6 days [23, 24].

With respect to postoperative complications, patients with and without morbid obesity did not have any significant differences in the incidence of both DVT and PE, which is consistent with the results of a meta-analysis study and another studies [25-27]. This result may be attributed to proper use of DVT prophylaxis which included enoxaparin anticoagulant therapy and proper physiotherapy with early mobilization encouragement.

We found that patients with morbid obesity are nine times more likely than those without morbid obesity to develop postoperative deep tissue infection, which is defined as any infection that requires revision of a part of or complete knee arthroplasty. A recent meta-analysis illustrated multiple conflicting reports on this topic ; however, most studies had reported that patients with morbid obesity had higher chances of postoperative deep tissue infection [28]. Furthermore, other studies have illustrated a higher risk of postoperative deep tissue infection amongst those with morbid obesity [29-31].

Additionally, we found that those with morbid obesity are 3 times more likely to undergo revision for knee prostheses than are those without it. Two previous studies reported similar results and illustrated that as the BMI increases, both revision and deep prosthetic infection rates increase [32, 33].

However, the rate of postoperative superficial wound infection was not found to be statistically significant between patients with and without morbid obesity, which is similar to another study's conclusion ; however, it differed from the findings of another study which showed that the risk of wound infection increases with BMI [4, 34]. The result of the latter study could be because of the fact that wound infection was not clearly distinguished as superficial or deep in that study and might have included both in their results.

The incidence of postoperative anemia was also not found to be statistically significant between patients with and without morbid obesity, which was in contrast with the findings of D'Apuzzo et al., who found a higher incidence of postoperative anemia amongst patients with morbid obesity, but it was not clinically significant [35]. Furthermore, our results demonstrate that patients with morbid obesity have 60% less chances of requiring RBC transfusion due to postoperative anemia compared with those without morbid obesity. This difference was statistically significant. This could be because of other treatment measures used to treat the anemia before reaching the stage of requiring blood transfusion, or the type of surgery that was done ; as it was shown that bilateral TKR has a higher risk for RBC

transfusion compared with unilateral TKR. Other possible reasons include confounding factors that might have increased the requirement of RBC transfusion, such as comorbidities. Nevertheless, the results were significant even after adjustment for these confounding factors.

The study has some limitations. First, the diversity of both orthopedic surgeons and orthopedic teams was not considered, particularly when calculating the length of hospital stay and operation time. Second, the environment and some variables could not be controlled as this was a retrospective study. To our knowledge, this is the first comparative study to be done in Saudi Arabia regarding this issue that included a large number of patients, which allowed for a more feasible comparison with other similar international studies. In addition, our study has looked at other post-operative outcomes and complications, which was not measured in other local studies.

In conclusion, we found that no difference between patients with and without morbid obesity with respect to the durations of surgery and length of hospital stay. There was no difference in the incidence of anemia, PE, DVT, or UTI between them. However, patients with morbid obesity have a higher risk of postoperative deep tissue infection and undergoing revision for their prostheses than do those without morbid obesity. Additionally, those with morbid obesity are less likely to receive RBC transfusions because of postoperative anemia compared with those without morbid obesity. Nevertheless, these results should be cautiously interpreted in view of the conflicting results of other studies. A larger prospective cohort study is recommended to corroborate the results

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