

Review Article

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Do Morbidly Obese (BMI >40) Patients Have Increased Healing Complications Post Orthopedic Total Knee Replacement (TKA)?[?]: A Narrative Review of Recent Literature

Edwin McCray^{2*}, Harshit Terala², John Azat Masoud², Adrienne Coursey², Patrick Guin², Robert Shebiro² and Donald Maharty¹

¹Department of Internal Medicine, Cape Fear Valley Medical Center, 1638 Owen Dr, Fayetteville, NC 28304, USA

²Campbell University School of Osteopathic Medicine, 4350 US-421, Lillington, NC 27546, USA

ABSTRACT

Introduction: Faced with the looming obesity epidemic, orthopedic surgeons are finding an increase in demand and popularity of joint replacement surgeries, particularly those of the knee. Equally alarming is the younger age and higher BMI at which patients are electing to have the procedure performed, despite attempts at weight management and other interventions. Along with the innumerable comorbidities associated with obesity it is proving to be a challenge for orthopedic surgeons especially in terms of postoperative complications for patients at an elevated BMI.

Objective: Our aim is to investigate retrospective analyses within the last ten years and analyze those within the preoperatively morbidly obese class and observe the general increase in complications specifically post-total knee arthroplasties.

Methods: Studies were selected based on publication within the last ten years having a focus on the outcomes and complications of primary total knee arthroplasty comparing both non-obese and obese patients.

Report: Morbidly obese patients had an increase in post-operative infections, wound dehiscence, and genitourinary-related complications. Additionally, morbid obesity had a statistically significant independent risk factor for implant failures, revisions, hospital readmission, and postoperative morbidity. Conversely, patients with BMI > 40 were found to have shorter hospital stays and lower transfusion rates.

Discussion: An overwhelming majority of the studies cited within this article and those within the general literature concluded that there are increased complications with obesity and TKA. Additionally, infection was a common complication after TKA in those that were considered morbidly obese. Lastly, morbid obesity was also found to be an independent risk factor for complications in patients who underwent TKA.

Conclusion: A BMI > 40 appeared to independently increase the risk for a variety of in hospital, short term, and long-term complications following a total knee arthroplasty (TKA), even after consideration of comorbid and other related variables. However, morbid obesity seems to only be a moderate independent risk factor and did not pose systemic complications. Further research with less potential for confounding bias is necessary to further determine the impact of morbid obesity on the outcomes of TKA, as well as to establish a standardized BMI at which negative outcomes are less associated.

*Corresponding author

Edwin McCray, Department of Internal Medicine, Cape Fear Valley Medical Center, 1638 Owen Dr, Fayetteville, NC 28304, USA; E-Mail: e_mccray0909@email.campbell.edu

Received: November 03, 2020; **Accepted:** November 11, 2020; **Published:** November 16, 2020

Introduction

With the escalating rates of obesity in the United States and expanding availability of enhanced medical care, orthopedic surgeons nationwide are resultantly faced with the challenge of increasingly difficult surgeries and advanced complications among obese patients. Affecting approximately 1/3 of the population and over 500 million people worldwide the obesity epidemic often encompasses a constellation of other symptoms and disorders, such as concomitant insulin resistance, hypertension and hyperglycemia, that can ultimately affect postoperative healing [1,2]. Additionally, the most disturbing rates of postoperative infection are seen in total knee replacements in obese patients. A

higher BMI disproportionately impacts the knees more than the hips. Additionally, because there exists an association between knee osteoarthritis and a higher BMI, it is likely that total knee arthroplasties are likely to increase in prevalence in the obese population in the coming years, making it a topic worth discussing further [3]. With the increasing popularity of TKAs orthopedic surgeons are finding an increase in the average BMI of patients electing to do the procedure, as well as a younger age at which the procedure is being performed than in non-obese patients [3,4]. Bearing in mind the comorbidities associated with obesity, both patients and providers should aim for optimal nutrition, appropriate medical management, exercise regimens, and weight management

when evaluating the risks and benefits of this surgery.

While many past studies placed patients into either non-obese or obese categories, they failed to show how the risks of postoperative complications vary amongst different obesity classes. According to the World Health Organization, BMI standardization demonstrates the classes can be defined by the following: overweight (BMI 25-29.99), obese class I (BMI 30-34.99), obese class II (BMI 35-39.99), and obese class III (or morbidly obese) (BMI \geq 40) (W.H.O., 2004) [5]. We found it necessary to explore the possibility of BMI having a non-linear relationship with complications after total knee replacements and sought to investigate it as a continuous variable [6]. Consequently, this literature review seeks to investigate specifically whether morbidly obese (BMI \geq 40) patients have increased healing complications post orthopedic TKA.

The studies compiled herein are retrospective analyses using databases of patients from a wide variety of medical institutions across North America who had undergone primary TKAs within the last two decades. Our main goal in assembling the literature was to seek out those who presented their results in terms of the different BMI classes, with a specific focus on those in the morbidly obese category. The patients in our collected studies were largely stratified by the World Health Organization classes of obesity. Many of the studies explored the associated comorbidities and complications with obesity classes and the primary diagnosis for surgery.

However, our focus was to investigate those that fell specifically in the preoperative morbidly obese class and observe the general increase in complications specifically post-TKA procedures.

Methods

From the PubMed database, as a primary inclusion criterion, studies incorporated into this review needed to have key terms, such as “knee”, “arthroplasty”, “obesity”, and “complications.” After compiling 100+ studies from the PubMed database, a secondary inclusion criterion included the following: 1) publication dates within the last decade (2009-2019), which could include TKA patient range within two decades; 2) article focus on morbid obesity and impact on and/or complications of TKAs. Although population size was not considered a component of neither inclusion criteria stated prior, it remained an interpretative focus for analysis later in this review. Furthermore, all literature was made sure to be published in a peer-reviewed fashion. Exclusion criteria consisted of non-peer-reviewed articles, those written in languages other than English, case reports, “grey” literature, and animal studies. Due to issues of accessibility through Campbell University Medical Library or PubMed’s database, some studies prior to application of primary inclusion criteria were excluded.

Report

Post-Operative Infections

A major complication of total knee arthroplasty is postoperative infection. The literature is conflicting, but rates of surgical site infection (SSI) are cited up to 2%. In an attempt to prevent SSI, prophylactic antibiotics are given prior to the procedure; often a cephalosporin (cefazolin) or vancomycin is given. Additionally, intra-articular injections are avoided within 90 days prior to the scheduled operation (excluding analgesics, such as bupivacaine and epinephrine). Risk factors for SSI, periprosthetic infection, deep infection, urinary tract infection (UTI), and wound dehiscence after TKA may include gender, age, lateralization of the operation, BMI, past medical history of diabetes mellitus,

heart disease, cerebral vascular incident, renal impairment, and extended operative time. Further defining the correlation between BMI and TKA post-surgical complications is important, given the population’s increasing rate of obesity. We found six studies examining the relationship between elevated BMI and post-operative infection risk. All six studies included a comparison group comprised of participants whose BMI were not classified as morbidly obese. Five of the six studies concluded that morbid obesity was in fact an independent risk factor for infections during the healing process post-TKA. Along with infection, results showed that patients with a BMI >40 were at a statistically heightened risk for superficial infection, periprosthetic joint infection, wound dehiscence, and urinary tract infection (UTI). Indirectly related to infection, morbid obesity poses an increased risk for pulmonary embolism (PE), reintubation, and renal insufficiency [1,6]. According to Namba patients in the highly obese groups had higher rates of diabetes mellitus by 21%, which may be a confounding variable regarding the higher postoperative infection rates. Studies by Jung and D’Apuzzo found results consistent with the above articles, stating that “multivariate analysis showed statistically significant associations with deep infection for BMI” and “morbidly obese patients had a higher risk of postoperative in-hospital infection,” respectively [2,7,8]. However, a study of over 30,000 subjects concluded that obese and morbidly obese patients had no significant increase in postoperative infections [9]. Variables such as mismatch in age and gender may have introduced confounding bias into this latter study. Morbidly obese patients have a statistically significant increase in infections after total knee arthroplasty. Obesity is not the sole factor contributing to infection risk, but does pose an independent risk factor, which serves to compound with other known postoperative infection risk factors.

Implant Failures and Revisions

Aside from infection risk, some studies found an increase in risks to implant survival, resulting in either failure or revision. Although postoperative patients are encouraged to lower their BMI and pursue healthier lifestyle choices, some implants fail or are revised because of postoperative infections, component malalignments, or pain and function dysfunctions.

We found in five studies that compared failure and revision rates amongst various BMIs and found significantly higher rates of early revisions or hardware failures in patients with elevated BMIs or morbid obesity. Electricwala found that early TKA revisions due to infection were 54% in patients with an elevated BMI, while in normal BMI patients only 24% required early TKA revisions due to infection. However, significant increases in acute, early, midterm, or late revision for aseptic loosening, osteolysis, instability, stiffness, or other causes were not seen [1]. Additionally, although Ritter focused on the orientation of tibial and femoral knee prosthetic components, they found a statistically significant increase in failure rates amongst patients with BMIs of \geq 41, compared to patients with BMIs between 23 and 26 [10]. Valgus knee malalignments showed the greatest failure risk, from 1.0% to 7.1%, while well-aligned knees showed the least failure risk, from 1.6% to 2.9%. Even if surgeons corrected the valgus malalignment to attain a neutral tibiofemoral alignment, they found that the second component showed a statistically significant failure rate of 7.8% in these patients [10].

Regarding implant survival, morbidly obese patients had significantly lower rates when compared to patients with normal BMIs. Xu found that morbidly obese patients had a statistically significant lower ten-year implant survival rate at 88.1%, while

normal BMI patients had a ten-year implant survival rate of 98.6% [11]. Similarly, Watts found that morbidly obese patients showed a five-year and ten-year implant survival rate of 96% and 81%, respectively. In patients without morbid obesity, the five-year and ten-year survival rates were 100% and 93%, respectively [12].

Extended Hospital Stays

The length of the hospital stay after a surgical procedure influences factors involved in healing, morbidity, and mortality. Longer hospital stays are also associated with increased medical costs. Woon found in their study that obese and morbidly obese patients had shorter hospital stays, lower transfusions rates, and no increase in inpatient wound infection or venous thromboembolic complications than nonobese patients [9]. Since patients in the different cohorts were not cross matched for age and gender, there is likely a confounding effect leading to these results. Shorter hospital stays post-TKA may be associated with morbid obesity, but these results were likely influenced by the fact that the subjects in the experimental group were on average younger than their counterparts in the control group.

Hospital Readmission Related to Prior Operation

In a study by Jaiben, morbidly obese patients showed significantly increased risk for both readmission and reoperation, as well as a variety of infections, wound dehiscence, reintubation, and renal insufficiency. Although the data showed significance, the fact that outcomes in this study were only tracked for 30 days lowers the quality of this study [6]. Thus, the correlation between hospital readmission after TKA and morbid obesity is unclear. Other factors, such as infection may also drive the readmission rates rather than obesity in and of itself. **Post-Operative Morbidity: Pain and Decreased Joint Function Arthroplasties** aim to improve function and reduce pain to enhance quality of life. Two studies contrasted each other in their patient outcomes. The first by Collins focused on preoperative versus postoperative pain and function, while the second by Watts focused on long-term pain and function outcomes [13]. Using the WOMAC (Western Ontario and McMaster Universities Osteoarthritis Index), Collins found that patients showed significant postoperative improvements from their preoperative pain and function scores after three to 24 months across all BMIs, including the patients with a BMI ≥ 40 [13].

Watts looked beyond 24 months and found that according to the Knee Society, pain and function scores those with a BMI < 30 had higher scores and showed significant long-term improvement in both pain and function when compared to morbidly obese patients. Although joint pain and function improved in patients of all BMIs in the first two years, the findings suggest that patients who had BMIs < 30 had more long-term pain-relief and improved function than morbidly obese patients [12].

Discussion

Statement of major findings

An overwhelming majority of the studies cited within this article and those within the general literature concluded that there are increased complications with obesity and TKA. For instance, Tohidi found that morbidly obese patients ≤ 60 years of age had a 50% higher 10-year risk of death compared to those who were not morbidly obese and underwent TKA [14]. However, they noted a major limitation to their conclusion stating that they would first need to compare the rates of death in the morbidly obese population undergoing TKA to morbidly obese patients that are not undergoing TKA to fully agree with this conclusion. The study by Jaiben found that obesity increased several postoperative

risks, including readmission and reoperation after TKA [6]. Within their findings, they also concluded that a postoperative reduction in BMI to approximately 29-30 would likely decrease the obesity related risk factors. Infection was a common complication after TKA in those that were considered morbidly obese. For example, Electricwala found that patients who were overweight or obese and underwent revision TKA were at a 130% increased relative risk and a 30% absolute risk of incurring an early infection [1]. They then emphasized the importance of patient expectations and counseling of the inherent risks of revision TKA, given their respective BMI. According to Electricwala, 54% of morbidly obese patients underwent early TKA revision due to infection, while only 24% of those with a normal BMI underwent the same revision procedure [1]. Namba concluded that significantly younger patients with a BMI > 35 were presenting for TKA, therefore allowing for a better comparison between age and obesity-related osteoarthritis in TKA. More importantly, they found that a significantly greater number of patients who were obese and underwent TKA (BMI > 35) experienced a postoperative infection at a higher rate ($P=0.01$). Previously, reports claimed a notable increase in infection after TKA in morbidly obese patients (BMI > 40), which caused concern for postoperative infection not only in those who are morbidly obese, but also those who fall within lower obesity categories (BMI > 35). Furthermore, patients with a BMI > 40 were not only at an increased risk of intra-articular infection, but they were also at risk for periprosthetic joint infection, wound dehiscence, and UTI [2]. Considering the potential of large studies to introduce confounding factors, such as age and gender, there remained a clear independent risk factor between a BMI > 40 and post-operative infection in those undergoing TKA. In contrast, some studies suggested an improvement in quality of life in morbidly obese after TKA. For instance, Suleiman states that performing TKA on patients with a high BMI may improve quality of life, and that there were no findings to suggest increased risk of complication perioperatively [15]. Furthermore, Xu also studied the relationship between those that were obese and of normal weight who underwent TKA and found that both groups had significant improvements in quality of life and activities of daily living [11]. However, those who were obese had a significantly poor improvement in clinical outcomes and an increased rate of revision TKA.

within a ten-year span. This suggests that although some studies have concluded that there is no increase in infective complications, other complications such as the increased rate of revision TKA was still present and adds to the overall increased rate of complications in the morbidly obese. Ritter found a significant increase in failure rates of TKA in patients with a BMI > 41 compared to those with a BMI between 23 and 26 [10]. Xu [11] found that morbidly obese patients who underwent TKA had a ten-year arthroplasty survival rate of 88.1% compared to those with a normal BMI at 98.6%. Watts found that there was an increased rate of reoperation and infection as well as a decreased life-span of TKA in morbidly obese patients. In patients with a BMI > 40 , the five- and ten-year survival rates after TKA were 96% and 81%, respectively, while patients who were non-obese experienced five- and ten-year survival rates of 100% and 93%, respectively. In a similar study performed by Husted, they found that most patients within a wide range of BMI < 40 had a similar length of hospital stay and readmission after TKA, except if the patient was morbidly obese [12,16]. However, due to probable confounding biases within this study, hospital stay and readmission rate were unclear in those with a BMI > 40 who underwent TKA.

In a study performed by Collins, the morbidly obese surgical patients who underwent TKA were able to reach absolute pain and function scores similar to those patients of normal BMI and class I obesity [12,13]. However, in contrast to the study performed by Collins which followed patients up to a 24-month time span, Watts' time span extended past 24 months and studied morbidly obese patients who underwent TKA to better understand pain and function scores postoperatively [13,12]. Watts found that those with a BMI <30 had better pain relief and functionality than those with a BMI >40 according to their Knee Society pain and function scores. Lastly, in an extensive study performed by D'Apuzzo, morbid obesity was found to be an independent risk factor for complications in patients who underwent TKA [8]. However, a modest increased risk of complications in the early postoperative period in morbidly obese patients was shown. According to Woon, complications with TKA tended to occur after discharge much further from the time of observation [9]. Conclusions reached by Watts found that in morbidly obese patients, there was an increased risk for reoperation and prosthetic joint infection after an aseptic revision of TKA [12]. Watts therefore, went further to discuss preventative medicine to decrease patient BMI before the need for TKA as well as the need to be more vigilant with obese patients and their progression with osteoarthritis [12]. Jung found that obesity is amongst the most important modifiable risk factors with respect to THA and TKA, and that patients undergoing TKA should be educated about the increased intra- and postoperative risks associated with obesity [7].

General limitations of studies

Several of the studies included in our literature review were limited largely by the sample size, demographics chosen and an overall lack of consistent follow-up postoperatively. For example, the Namba as well as Husted studies claimed that there did not exist enough comparative data on non-obese patients, and there was a selection bias towards younger and lower-risk patients [2,16]. On the other hand, Jaiben maintained that they did not track patient outcomes past 30 days, while D'Apuzzo admitted a potentially incomplete data analysis due to an absence of follow-up of patients discharged from the hospital [6,8]. One of the most significant limitations amongst the studies, however, was a lack of preoperative patient clinical evaluation. In the study by Affatato, the author expressed that they did not assess the level of physical activity of the patients before the procedure, claiming that it could have been beneficial to know their living activities, whereas Suleiman asserted that they were unable to assess the preoperative joint status of patients, such as pain, mobility or range of motion in affected joints, which could have also been beneficial for predicting postoperative complications [17,15]. Additionally, Woon argued that a lack of clinical information relevant to patient comorbidities and confounding risks could have additionally impacted their study, and Jung similarly failed to record other confounding risk factors, such as smoking and diabetes, that may cause other prosthetic joint complications [9,7].

Other minor limitations that likely did not have a notable impact on the data include a discrepancy among TKA surgical procedures preferred by surgeons seen in the study by Xu and a lack of coding accuracy found in the study by D'Apuzzo [11,8].

Future Studies

Much of the literature that was reviewed suggested a more in-depth analysis of the comorbidities associated with diabetes and their individual risk associations with postoperative TKA complications. There were several common things that these studies lacked including comprehensive clinical information,

current research, and long-term postoperative analysis. Further studies into the correlation between morbidly obese (BMI >40) patients and postoperative healing complications of TKAs should retrieve accurate pre-clinical information from patients and databases. The studies must expand comparative research on both morbidly obese and non-obese patients, and develop a timeline to track postoperative recovery and complications. Additionally, future studies should incorporate age and gender to better understand the role of obesity, independent of these two factors on TKA. Further research with less potential for confounding bias is necessary to further determine the impact of morbid obesity on the outcomes of TKA, as well as to establish a standardized BMI at which negative outcomes are less associated.

Conclusion

The conclusions reached by each study are reflective of the nature in which obesity and TKA impact each other. Most studies concluded that obesity is an independent risk factor for complications postoperatively which include poor wound healing, greater number of prosthetic joint infections, reoperation, and revision. Risk stratification should be assessed in obese patients undergoing TKA and then extensively explained to patients. Due to the significance found in our reviewed research, surgeons should discuss expected outcomes and the increased risks associated with concomitant obesity and TKA to ensure that each patient is well informed. All physicians should continue to aid and encourage obese patients to lose weight in order to decrease the progression of complications such as infection, osteoarthritis, and other morbidities previously mentioned.

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