

The Influence of Obesity on the Outcome of TKR: Can the Impact of Obesity be justified from the Viewpoint of the Overall Health Care System?

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Abstract *Background:* There is controversy in the literature regarding the justification of performing total knee replacement (TKR) in obese patients in view of their increased risk of poor outcomes and how those poorer outcomes impact the health care system overall. *Questions/Purposes:* Is TKR justifiable in the obese patient? Can the negative impact of continuing to perform TKR in the obese be quantified? *Methods:* A Cochrane Library, PubMed (MEDLINE), and Google Scholar search related to the justification of TKR in the obese patient and its impact on the health care system was analyzed. The main criteria for selection were that the articles were focused in the aforementioned questions. *Results:* Two thousand one hundred seventy-three articles were found, but only 50 were selected and reviewed because they were focused on the questions of this paper. Although some articles (with low grade of evidence) did not find that obesity adversely affected the outcome of TKR, most of them found that obesity adversely affected the results of TKR. Regarding complications rates and survival rates, obesity has shown to have a negative influence on outcome after TKR. The improvements in patient-reported outcome measures, however, were similar irrespective of body mass index. Regarding the impact of TKR in obese patients, an extra cost of US\$3,050 has been

reported per patient. Considering that 50% of the US population is obese and that 600,000 TKRs are implanted per year, the impact for the US health system could be as much as 915 million dollars ($300,000 \times 3,050$). *Conclusion:* TKR in obese patients may be justifiable because the functional improvements appear equivalent to those of patients with a lower BMI. However, in obese patients, the risk of complications is higher and the prosthetic survival is lower. Moreover, TKR in obese patients has a huge impact on the health system which should be considered.

Keywords total knee replacement · obesity · economical impact · health system

Introduction

Obesity is an abnormal accumulation of body fat, usually 20% or more over an individual's ideal body weight [32]. Guidelines for obesity use a measurement called body mass index (BMI) which is the individual's weight multiplied by 703 and then divided by twice the height in inches. A BMI of 25.9–29 is considered overweight, a BMI over 30 is considered obese, and a BMI greater than 40 is considered morbid obesity. It has been estimated that 50% of Americans are currently overweight. Excessive weight may cause many serious health problems. In the USA, approximately 300,000 deaths a year are due to obesity which is considered the second leading cause of preventable death [32].

Obese patients suffering advanced painful knee osteoarthritis are often considered poor candidates for total knee replacement (TKR) [10, 19, 34]. There is controversy in the literature regarding the justification of TKR in obese patients and also concerning the economical impact it may have for the health system. The purpose of this review is to analyze whether TKR is justifiable in obese patients and to investigate the economical impact it has on the health system.

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Methods

A review has been performed on the influence of obesity in patients undergoing TKR. The search engines were MEDLINE (PubMed), Google Scholar, and the Cochrane Library, and the final date was 22 January 2014. The keywords used were “TKR” and “obesity.” Two thousand one hundred seventy-three articles were found, but only 50 were selected and reviewed because they were deeply focused on the aforementioned questions.

Results

Of the 2,173 articles reviewed, only 50 were finally considered because they were focused on the questions of this article. Two of the 50 were systematic reviews [5, 6] and 2 were prospective randomized trials [7, 8]. One of the articles is [8] included in the Cochrane Library. The rest had a moderate to low grade of evidence (grades II to IV).

Addressing whether TKR can be justified from a clinical outcome perspective in obese patients, many authors have found no relationship between obesity and the results of TKR [1–6, 9, 10, 13, 19, 30, 34, 38, 40, 42, 45–48, 50]. The majority of the studies reviewed, however, report inferior results in obese patients undergoing TKR [7, 11, 12, 14–18, 21–25, 28, 29, 31, 35–37, 39, 41, 44, 49]. A systematic literature review [43] which evaluated the outcomes of TKR in patients with morbid obesity (BMI >40) found that both clinical and functional domains of the Knee Society Score (KSS) improved after the procedure. The postoperative functional KSS was, in general, less than in controls [43]. Another systematic review of the literature found that obesity has a negative influence on the outcome after TKR. Deep infection occurred more often in obese patients, with an odds ratio of 2.38. Revision of the TKR, defined as exchange or removal of the components for any reason, occurred more often in obese patients, with an odds ratio of 1.30 [27].

It is important to emphasize that although a BMI of 30 is not associated with significantly worse outcomes, a BMI of >40 certainly is. This suggests that there may be a cutoff point above which surgery should be withheld until BMI is reduced. Also, you do not have to have perfect weight but the more overweight you are, the worse it is [31].

Morbid obesity has been associated with increased early postoperative complications, including peripheral edema, diarrhea and gastrointestinal or abdominal pain, wound inflammation or infection, nonsurgical site infections, and respiratory tract or lung infections [16]. At a mean 5-year follow-up, morbidly obese patients have significantly higher rates of complications than obese patients and nonobese patients [31]. This finding is supported by another study which reports obese patients had significantly higher complication rates (10.5% vs. 3.8%) as well [21].

Higher postoperative infection rates have been observed in patients with a BMI of 35 or higher. In patients with morbid obesity (BMI >40), a 10% to 30% prevalence of complications has been found. Of concern is the

significantly higher prevalence of deep prosthetic infection (3–9 times than that of controls) [43]. Infection occurs more often in obese patients, with an odds ratio of 1.90. Deep infection occurs more often in obese patients, with an odds ratio of 2.38 [27].

The morbidly obese also had a significantly higher incidence of wound complications [43]. Obesity may predispose to infection due to compromised wound healing and the risks of infection associated with diabetes. In a comparative study between patients with diabetes and patients without diabetes, the rate of infection was 1.2% and 0.7%, respectively. The revision rate (including infection) was 3.6% and 0.4%, respectively [33]. Diabetes influences wound healing in TKR. Pre operative control of diabetes is necessary to optimize wound healing and to reduce the risks of infection [26].

Preoperative and perioperative management of diabetes is paramount to minimize infection and thereby optimize patient outcomes after TKR [20]. Obese patients without diabetes have a better outcome than those that have diabetes.

Weight and BMI have negative effects on the longevity of primary (TKR) [36]. At a mean 5-year follow-up, morbidly obese patients had significantly lower implant survivorship than obese patients and nonobese patients [36]. Kerkhoffs et al [27] found that revision of the TKR, defined as exchange or removal of the components for any reason, occurred more often in obese patients, with an odds ratio of 1.30.

Summing up, obesity had a negative influence on the outcome after TKR [27]. Obese patients, however, should not be excluded from the benefit of TKR, given that their overall improvements were equivalent to those of patients with a lower BMI [3]. One study supports minimally invasive surgery (MIS; in obese patients undergoing TKR regardless of the level of BMI. It is associated with improved early clinical outcome without sacrificing radiographic positioning of the implants [8]. Given the increase in complications for morbidly obese patients after TKR, these patients should be advised to lose weight before surgery and, if suitable, may benefit from bariatric surgery [43]. It is important to emphasize that diabetes can be a consequence of obesity. Certainly, getting blood sugar under control leads to reduced morbidity [20]. With greater complication risks, the increasing TKR utilization in obese patients is concerning and warrants increased attention [39].

Regarding the economical impact of TKR in obese patients, two papers have analyzed the problem [12, 28, 39]. Hospital resource consumption for unilateral primary TKR is 7% higher (US\$1,025) among morbidly obese patients than among nonobese patients [28]. According to the report of Dowsey et al [12], obesity is associated with higher inpatient index surgery costs (+US\$1,226.89) and episode of care costs (+US\$1,821.36), for a total of about US\$3,050. In other words, each unit increase of BMI is associated with higher inpatient index surgery costs (US\$128.91) and total episode of care costs (US\$158.99).

In a report [39], 15% of the 753,268 TKRs performed in an 8-year period (2002–2009) were carried out in obese patients. In 2009, the number of TKRs performed in obese

patients was double than that in 2002. Age-adjusted obesity prevalence was 32% for men and 36% for women. It is estimated that a full 50% of all Americans are overweight [32]. The World Health Organization terms obesity as a worldwide epidemic, and the diseases which can occur due to obesity are becoming increasingly prevalent. The AAOS estimates that 600,000 TKRs are implanted every year. If we calculate that 50% of them (300,000) are implanted in obese patients, the extra cost for the health system is of about US\$915 millions ($3,050 \times 300,000$).

Discussion

The purpose of this article was to review the literature with the aim of answering the following questions: (1) Is TKR justifiable in the obese patient? (2) How it impacts the health care system overall?

The quality of studies reported so far on the topic is poor (low level of evidence, levels II, III, and IV). Most of them are prospective case series (level IV); although there are two systematic reviews of the literature [27, 43] and two prospective randomized trials [8, 30].

Some authors have found that obesity does not influence adversely the results of TKR [1–6, 9, 10, 13, 19, 30, 34, 38, 40, 42, 45–48, 50]. However, other authors have reported that obesity is a significant risk factor for infection and other postoperative complications [7, 11, 12, 14–18, 21–25, 28, 29, 31, 35–37, 39, 41, 44, 49]. It seems rather clear that obesity influences adversely the functional results, the complications rate, the survival rate, and the cost of TKR.

Regarding results, postoperative functional scores and quality of life have been shown to be lower in obese patients after TKR [5, 11, 35, 36, 49, 50]. Obesity had a negative influence on outcome after the procedure and when obese are compared to morbidly obese, the negative effect becomes more obvious [31]. Complication rates for nonobese, obese, and morbidly obese patients are 9%, 15%, and 22%, respectively. A BMI greater than 40 kg/m^2 may be used as a cutoff to help guide patient education and treatment options for primary TKR [31].

Concerning the complications rate, a systematic review [43] found a greater prevalence of complications in morbid obese patients (10%–30%). Of concern was the significantly higher prevalence of deep prosthetic infection (3–9 times than that of controls). The morbidly obese also had a significantly higher incidence of wound complications. One systematic review found that deep infection occurs more often in obese patients, with an odds ratio of 2.38 [27]. Regarding survival rate, BMI has been demonstrated to have a negative effect on the longevity of TKR [35, 50]. Revision of the TKR, defined as exchange or removal of the components for any reason, occurred more often in obese patients, with an odds ratio of 1.30 [27]. Obesity diminishes the implant survival at 5 years and increases the complications rate [31].

Hospital resource consumption has been reported to be 7% higher among obese patients than among nonobese patients [28]. Obesity has been associated with higher inpatient index surgery costs and episode of care costs [12], for a

total of about US\$3,050 extra cost for obese patient. An economical impact of about US\$915 million per year can be estimated directly related to obesity.

Although there is a controversy in the literature regarding the justification of performing TKR in obese patients, and morbidly obese compared to nonobese, it must be acknowledged that obese and morbidly obese patients have similar improvements in functional scores and measures of quality of life (HRQL) at 12 months after TKR [38]. Good results and high patient satisfaction are still to be expected, and it would seem unreasonable to deny patients a TKR simply on the basis of a BMI indicating obesity [22]. On the other hand, the literature seems to indicate that obesity influences adversely the results, increases the rate of complications, and decreases the implant survival. This may be especially true in patients with a body mass index of $>40 \text{ kg/m}^2$. The evidence suggests that these patients should be advised to lose weight prior to TKR and to maintain weight reduction. They should also be counseled regarding the inferior results which may occur if they do not lose weight before surgery [1].

In conclusion, TKR in obese patients is currently justifiable but with an enormous economical impact on the health system and with a higher risk of inferior results.

Disclosures

Conflict of Interest: E. Carlos Rodriguez-Merchan, MD, PhD has declared that he has no conflict of interest.

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