The Journal of Arthroplasty 31 (2016) 1620–1624

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

AAHKS Symposium: Modifying Risk Factors: Strategies that Work

Preoperative Optimization of Total Joint Arthroplasty Surgical Risk: Obesity

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ARTICLE INFO

Article history:
Received 29 January 2016
Accepted 3 February 2016
Available online 21 March 2016

Keywords:
total joint arthroplasty
outcomes
risk factors
obesity
complications

ABSTRACT

Obesity is a problem that is increasing in prevalence in the United States and in other countries, and it is a common comorbidity in patients seeking total joint arthroplasty for degenerative musculoskeletal diseases. Obesity, as well as commonly associated comorbidities such as diabetes mellitus, cardiovascular disease, and those contributing to the diagnosis of metabolic syndrome, have been shown to have detrimental effects on total joint arthroplasty outcomes. Although there are effective surgical and nonsurgical interventions which can result in weight loss in these patients, concomitant benefit on arthroplasty outcomes is not clear. Preoperative optimization of surgical risk in obese total joint arthroplasty patients is an important point of intervention to improve arthroplasty outcomes.

Degenerative hip and knee disease is a painful, debilitating process that drastically affects an individual's quality of life and functional capacity. Total joint arthroplasty (TJA) is a highly successful surgery for the treatment of degenerative knee and hip pain [1]. The advent of TJA has revolutionized the treatment of chronic arthritis, and, when performed on the right patient, provides predictable results and significant improvements in a patient's functional status. Numerous advances in surgical technique, implant design, multimodal pain management, and rehabilitation protocols have led to increased success of TJA. Because of improvements in health care, our population is living longer, and as a result, the number of patients living with degenerative musculoskeletal disease continues to increase. The Center for Disease Control (CDC) predicts the proportion of the US population aged 65 years or older will increase from 12.4% in 2000 to 19.6% in 2030. This equates to an increase in the 65-and-over population from 35 million people in 2000 to a projected 71 million people in 2030 [2]. The US Census Bureau predicts that by 2030, 1 in 5 US citizens will be older than 65 years, and by 2060, there will be almost 100 million people older than 65 years [3]. The average worldwide life span is expected to increase another 10 years by 2050 [4]. This growth in the aging population will more than double the prevalence of degenerative musculoskeletal disease. Given the reliable results, increased implant survivorship, and cost effectiveness of the procedures, TJA surgery continues to thrive. It is projected that 512,000 total hip arthroplasty (THA) and 1.4 million total knee arthroplasty (TKA) procedures will be performed in 2020. TJA not only provides a medical benefit to the patient by alleviating pain and providing increased functional capacity, it also provides a nonmedical benefit to society [5]. A regression analysis by Dall et al [6] looking at the economic burden of musculoskeletal disorders found that working-age patients who had TJA for degenerative arthritis were more likely to gain employment, had $5400-$6200 higher income, missed fewer work days, and were 28% less likely to draw Social Security payments than their counterparts with musculoskeletal disease who did not have TJA. Although the rewards of TJA are great, there also are risks involved with the procedure that can have catastrophic implications. Because of the ever-increasing frequency of TJA and the changing structure of health care cost and reimbursement, it is important to identify and stratify preoperative risk factors that can lead to complications.

A number of studies have sought to identify preoperative risk factors associated with infection or other complications of TJA. One common finding among these studies relates to obesity and increased body mass index (BMI) [7-11]. According to the CDC, the prevalence of morbid obesity in the United States continues to increase year after year. Morbid obesity creates an environment that predisposes the patient to insulin resistance, type II diabetes mellitus, hypertension, and dyslipidemia. Obesity is a modifiable risk factor, but modification is difficult and often frustrating for the

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http://dx.doi.org/10.1016/j.arth.2016.02.085
0883-5403/

surgeon and patient. A number of weight loss programs and procedures have been described for TJA patients, with varying results.

Obesity and Comorbid Conditions in the TJA Population

Obesity has become a major health epidemic in the United States and in industrialized countries over the last several decades, and rates continue to rise. Obesity is most commonly defined as a BMI of more than 30. According to the CDC, from 1984 to 1998, the obese population increased by 22%. In 2012, 35% of the US population was considered to be obese (BMI > 30) [12]. Based on the National Health and Nutrition Examination Survey III sample, 63% of men and 55% of women >25 years old were considered obese. This increase in the obese population is thought to be the result of a high calorie/fatty diet as well as a sedentary life style [13]. Fehring et al reported that the percentage of TJA patients who were obese at their institution increased from 31% in 1990 to 52% in 2005 [14,15]. Obesity is associated with many other medical comorbidities, such as diabetes mellitus, coronary artery disease, hyperlipidemia, liver disease, and heart disease. Obesity increases all risk factors for heart failure and is significantly associated with insulin resistance leading to type 2 diabetes mellitus (T2DM) [16]. In fact, a meta-analysis by Odum et al [15] found that 30% of obese patients undergoing TKA had at least 3 medical comorbidities, whereas only 7% of nonobese people had 3 comorbidities. Obesity also is one of the key components of metabolic syndrome, which is defined as a group of metabolic and clinical conditions that increases the risk of cardiovascular disease [16]. Metabolic syndrome occurs when obesity plus 2 of the following criteria are met: hypertension, dyslipidemia (low high-density lipoproteins), elevated fasting plasma glucose, or hypertriglyceridemia [17].

Recent data also suggest that obese patients are increasingly likely to reach BMI levels that place them into the “super-obese” category or a BMI of >50. From 2001 to 2005, the number of Americans who were obese increased by 24%, whereas during that same period, the number of Americans who moved into the super-obese category increased by 75% [18,19]. In addition to being closely associated with many other medical comorbidities, obesity is directly correlated with the development of osteoarthritis (OA). Obese individuals have been found to have a 3-fold increased risk of OA compared with nonobese patients [20]. The development of OA in these patients not only occurs more frequently but also at an earlier age than in nonobese patient. Advanced OA at a young age is a problem because total joint implants tend to wear out with time.

Impact of Obesity on TJA Technique

Obesity presents several challenges during the actual procedure as a result of body habitus which leads to increased operative time, increased blood loss, issues with retracting leading to suboptimal component positioning, and poor radiographic visibility. A retrospective study by Elson et al [21] evaluating obesity as a risk factor for suboptimal component positioning in THA found that morbidly obese (BMI > 35) patients had over-abducted and under-anteverted cup placement compared with the control group (BMI < 25). This is an important finding because cup malposition can lead to dislocation, fracture of the polyethylene component or uneven wear, squeaking bearing surfaces, increased volumetric wear, and osteolysis. Wang et al [22] found a significant difference in surgical time between patients of normal weight and those who were obese or morbidly obese, with an average time in normal-weight patients of 71 minutes compared with 86 minutes for those with a BMI between 35 and 40, and 97 minutes for those with a BMI of more than 40. This increased operative time is a significant issue as it leads to increased blood loss, increased risk of infection, and increased cost to the patient and hospital.

Ledford et al suggested that percent body fat may be a better predictor of perioperative risks associated with obesity in TJA than BMI. Their retrospective evaluation of 316 patients undergoing primary TJA determined that a higher percent body fat was associated with need for postoperative blood transfusion, increased hospital length of stay (>3 days), and discharge to an extended care facility, whereas there was no significant difference in the BMI group [23]. Another factor to consider when evaluating an obese patient is body habitus, as it can be deceiving. Often patients with a BMI of 30 can be more difficult to operate on than those with a BMI in the 40s because of their body habitus and fat distribution. For example, THA is difficult in patients with gynoid fat distribution in the lower abdomen and around the hips. Meller described a patient with a BMI of 52 who had a gastric bypass and returned for THA 3 years later with a BMI of 33. Despite the weight loss, the surgeon was unable to adequately expose the acetabulum because the patient retained 15 cm of fat overlying her hip. THA was aborted, and a hemiarthroplasty was performed [24]. Because a variety of intraoperative complications can occur in obese patients, it is important to have all implants, deep retractors, and positioners available before the procedure begins.

Perioperative Complications in Obese TJA Patients

Although obesity leads to several perioperative issues, postoperative complications also are significant and can be devastating to the patient. It is not obesity alone that puts patients at risk for these complications but also the medical comorbidities such as diabetes and heart failure that often are associated with obesity. The most common adverse events that occur in the initial postoperative period are deep venous thrombosis, infection, and pulmonary embolus. Apart from the increased risk of medical complications associated with obesity, obese patients often have poorer patient-reported outcome scores compared with nonobese patients [18,25,26]. Jameson et al [26] found that patients with a BMI of 30-35 or >35 had significantly more wound complications than nonobese patients. Those with a BMI >35 also had significantly higher hospital readmission and revision surgery rates. Both this study and one by Arsoy et al determined that although all patients had significant improvement in functional scores after TJA, obese and super-obese patients had significantly less improvement than nonobese patients [18].

Not only do obese patients have lower patient-reported outcomes and functional scores, they also are at significantly increased risk of developing a deep venous thrombosis, pulmonary embolism, deep infection, nerve palsy, and superficial wound complications. One study found a postoperative wound complication rate of 24% in super-obese patients compared with 1.2% in nonobese patients, as well as significantly higher rates of dislocation (7.1% super obese compared with 4.8% control) and fracture (7.1% super-obese vs 3.6% control) [18]. A retrospective study by Maoz et al [8] found that a BMI of >40 was a definite risk factor for developing periprosthetic joint infection after THA, a finding confirmed by a meta-analysis showing that obese patients have a higher infection rate as well as a significantly higher rate of revision surgery [27]. The hospital readmission rate for patients with a BMI >40 is nearly double that of patients with BMI >25 (6% vs 3%) [9]. It is important to recognize the significance of these obesity-related complications and to counsel patients appropriately before surgery. As the health care environment continues to change and the Affordable Care Act is incrementally implemented, hospitals and physicians will be financially penalized for hospital readmissions during the 30-day postoperative period, making