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Operative Techniques in
Orthopaedics

Factors Influencing Total Hip Arthroplasty in Obese Patients

Menachem M. Meller, MD, PhD, and Aaron Y. Meller, BS

Patients with morbid obesity, defined as a body mass index of greater than 40 kg/m^2 and super obesity defined as a body mass index of greater than 50 kg/m^2, increasingly present for total hip replacements. These individuals incur greater costs, surgical risks, and present greater technical challenges in delivering a successful outcome. This article presents data upon which to guide treatment choice and help improve outcomes.
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KEYWORDS obesity, super-obesity, total hip arthroplasty, bundled payments, patient outcomes

Obesity has been considered a "modifiable" risk factor to be considered in preoperative patient optimization. As a surgical risk factor, it follows defined dose-response characteristics.[1] Unlike other surgical risk factors, such as blood glucose or blood pressure, there has been no agreed-upon threshold with obesity above which to defer surgery. In the short term, it is not nearly as modifiable. There have also been no well-defined added costs that are incurred when performing hip replacement surgery in this population. This lack of information has not prevented health care systems from agreeing to provide care to large populations without risk stratification.

Background

The mechanical effects of obesity and repeated axial loading on the joints accelerate cartilage breakdown and bony changes.[2-5] There are, in addition, the biologic effects of excessive loading that accelerate age-related chondrocyte loss, making cartilage more vulnerable to damage.[6] The biochemical effects of obesity-associated production of proinflammatory mediators, adipokines, and insulin resistance may compromise metabolic function of chondrocytes, further contributing to cartilage destruction.[7,8] The physiologic incompatibility of excess body load and easy muscle fatigue in an obese individual exposes the hip joint to decreased shock absorbance and repetitive microtrauma.[9] There are sex-specific effects that explain the higher incidence of osteoarthritis in women.[10]

Medical and Anesthesia Risks Associated With Class III Obesity Hip Arthroplasty Surgery

Class III obesity (BMI $\geq$ 40.0) should be viewed as more than simply a disorder of body size or shape. The excess adipocytes are metabolically active and secrete metabolically active adipokines. The adipokines are inflammatory mediators that induce microvascular inflammation, insulin resistance, and cardiac, vascular, and pulmonary dysfunction.[11,12]

The growing bariatric surgery experience has allowed for risk stratification based upon preoperative shortness of breath, baseline hypoxia, hypercapnia, right-sided heart failure, and obstructive sleep apnea. Left-sided heart failure and chronic liver and kidney disease need to be sought and optimized. Specific preoperative target guidelines for the metabolic syndrome and hyperlipidemia are now commonplace and incorporated in the preoperative evaluation.

Intraoperative care presents unique challenges regardless of choice of anesthetic. General anesthetic, with the need for endotracheal intubation, often characterizes this group as "high risk." The challenges of airway anatomy and head and neck positioning may require ramp head supports, larger laryngoscopes, and in some cases awake fiber-optic intubation. Rapid sequence induction due to gastroesophageal reflux disease is commonplace. Special equipment for patient positioning, line

Department of Orthopedic Surgery, Mercy Philadelphia Hospital, Philadelphia, PA.
*Address reprint requests to Menachem M. Meller, MD, PhD, Mercy Philadelphia Hospital, 501 S, 54th St, Philadelphia, PA 19143. E-mail: mmmeller@verizon.net

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placement, and central monitoring all require additional time, preparation, training, and resources. Adjustments may be needed in dosing and timing and administration of lipophilic agents. High peak ventilator pressures can be expected as a direct effect of the need to expand a large heavy chest wall. These risks are not adequately defined by the patients' American Society of Anesthesiologists (ASA) class.

Regional anesthetics also present unique challenges in this category. Bony and soft tissue landmarks are often obscured, and difficulties maintaining fixed postures are to be expected. Locating longer thin spinal needles becomes uncertain. Ultrasound guidance may be available for peripheral nerve blocks but not for targeting spinal injection sites.

Postoperative care may require intensive care unit monitoring. Specific triggers would be preoperative sleep apnea, right-sided heart failure, prolonged surgery, and significant blood loss.

The Bariatric Patient

The literature is conflicting on whether a postbariatric patient presents lower surgical risks when presenting for hip replacement surgery.[13,14]

Smith et al, based on a meta-analysis, concludes the following: For most perioperative outcomes, bariatric surgery before total hip arthroplasty or total knee arthroplasty does not significantly reduce the complication rates or improve the clinical outcome.

Watts et al. reported that compared to a postbariatric patient group, the risk of reoperation was hazard ratio (HR) of 3.2 and revision HR of 5.4. Although his conclusion was that the postbariatric group had dramatic improvement, the title was less compelling suggesting that it may only be so.

Issa et al reported on a group of 45 patients with a body mass index (BMI) of over 50 kg/m^2 that there was a 4.5 times higher odds ratio of undergoing a revision and a 7.7 times higher odds ratio of experiencing a complication.

In a previous Medicare data mining study, we demonstrated surgically significant complications in super-obese patients compared to normal BMI of 25.[1] These include prosthetic joint infection (HR = 6.48), wound dehiscence (HR = 9.81), and readmission (HR = 2.16). When the patients in the super-obese category were compared with morbidly obese patients in the 40.0-49.9, the ratios were still elevated at 1.87, 2.85, and 1.43, respectively.

There is little emphasis on maintaining or monitoring for specific nutritional deficiencies that correspond to the obesity or postbariatric state. Depending on the type of bypass undergone, specific nutritional deficiencies may persist. Common deficiencies include protein, albumin, magnesium, iron, ferritin, zinc, magnesium, vitamin B12, and beta-carotene. The deficiencies appear to be more pronounced following more aggressive malabsorptive procedures such as biliopancreatic diversion. Specific deficiencies include calcium and the fat soluble vitamins (A, D, E, and K) and micronutrients.

Even when successful at achieving weight loss and BMI goals, the body mass redistribution is not uniform. For example, we present an individual (Fig. 1) who was successful at decreasing the BMI from 52-34 kg/m^2.[15] The weight was preferentially lost above the waist, and therefore the hip geometry maintained the pear-shaped body habitus. The waist circumference was 107 cm, and due to steatopygia, the hips were 155 cm. This combination of tissue depth, tissue stiffness, and inability to piston the hip interfered with acetabular cup positioning. A bipolar hip arthroplasty was the only alternative.

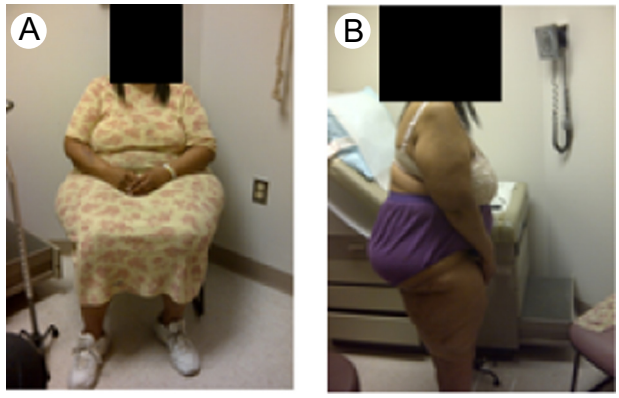

Figure 1 A 50-year-old African American woman with BMI of 42.0 kg/m^2 after bariatric surgery, with waist circumference of 107 cm and hip circumference of 155 cm: (A) seated anterior view and (B) profile standing. (Color version of figure is available online.)

Discussion

BMI has been promoted by the world health organization as a means of categorizing a person as either underweight, normal weight, or overweight. Three classes have been described that correlate with various disease states. Although these numbers and categories have value for general health, they may not fully describe metabolic risks and technical challenges as they relate to performing a hip replacement. We, therefore, consider these values among other factors preoperatively as part of multifactorial patient optimization and risk stratification.

The data we collect somewhat follow the data levels of the American Joint Replacement Registry. Level I data include diagnosis, demographic information, and psychosocial history. Also included are social factors such as marital status, work history, disability status, height, weight, BMI status education, and drug or alcohol use. Steroid use before blood transfusions and recent narcotic use are also included.

Level II data: This level includes medical comorbidities, ASA class, and Charlson comorbidity index as an assessment of organic disease state. In cases of obesity, levels of nutrients to monitor for deficiencies are included. These contain serum levels of comprehensive metabolic panels, vitamin B12, 25OH-D, magnesium, ferritin, prealbumin, fructosamine, and for diabetics an A1C. In the state of Pennsylvania, there are mandatory levels of Hepatitis C quantitative RNA for individuals born between 1945 and 1965 (which includes most arthroplasty patients). A baseline erythrocyte