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Clinical Study

Body mass index predicts risk of complications in lumbar spine surgery based on surgical invasiveness

Olivia J. Bono, BA[a], Gregory W. Poorman, BA[a], Norah Foster, MD[a], Cyrus M. Jalai, BA[a], Samantha R. Horn, BA[a], Jonathan Oren, MD[a], Alexandra Soroceanu, MD[b], Subaraman Ramachandran, MD[a], Taylor E. Purvis, BA[c], Deeptee Jain, MD[d], Shaleen Vira, MD[a], Bassel G. Diebo, MD[e], Breton Line, BSME[a], Daniel M. Sciubba, MD[c], Themistocles S. Protopsaltis, MD[a], Aaron J. Buckland, MBBS FRACS[a], Thomas J. Errico, MD[a], Virginie Lafage, PhD[f], Shay Bess, MD[a], Peter G. Passias, MD[a,*]

[a]*Department of Orthopaedic Surgery, NYU Langone Orthopaedic Hospital, 301 E. 17th St, New York, NY 10003, USA*
[b]*Department of Orthopaedic Surgery, University of Calgary, 3330 Hospital Dr NW, Calgary, AB T2N 4N1, Canada*
[c]*Department of Neurosurgery, The Johns Hopkins University School of Medicine, 733 N. Broadway, Baltimore, MD 21205, USA*
[d]*Depatment of Orthopaedic Surgery, University of California, 3333 California St, San Francisco, CA, 94118, USA*
[e]*Department of Orthopaedic Surgery, SUNY Downstate Medical Center, 450 Clarkson Ave, Brooklyn, NY 11203, USA*
[f]*Spine Service, Hospital for Special Surgery, 535 E. 70th St, New York, NY 10021, USA*

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Abstract

BACKGROUND CONTEXT: Obesity as a comorbidity in spine pathology may increase the risk of complications following surgical treatment. The body mass index (BMI) threshold at which obesity becomes clinically relevant, and the exact nature of that effect, remains poorly understood.

PURPOSE: Identify the BMI that independently predicts risk of postoperative complications following lumbar spine surgery.

STUDY DESIGN/SETTING: Retrospective review of the National Surgery Quality Improvement Program (NSQIP) years 2011–2013.

PATIENT SAMPLE: A total of 31,763 patients were undergoing arthrodesis, discectomy, laminectomy, laminoplasty, corpectomy, or osteotomy of the lumbar spine.

OUTCOME MEASURES: Complication rates.

METHODS: The patient sample was categorized preoperatively by BMI according to the World Health Organization stratification: underweight (BMI <18.5), normal overweight (BMI 20.0–29.9), obesity class 1 (BMI 30.0–34.9), 2 (BMI 35.0–39.9), and 3 (BMI≥40). Patients were dichotomized based on their position above or below the 75th surgical invasiveness index (SII) percentile cutoff into low-SII and high-SII. Differences in complication rates in BMI groups were analyzed by Bonferroni analysis of variance (ANOVA) method. Multivariate binary logistic regression evaluated relationship between BMI and complication categories in all patients and in high-SII and low-SII surgeries.

FDA device/drug status: Not applicable.

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The disclosure key can be found on the Table of Contents and at www.TheSpineJournalOnline.com.

* Corresponding author. Division of Spinal Surgery, Departments of Orthopaedic and Neurological Surgery, NYU Langone Medical Center – Orthopaedic Hospital, 301 East 17th St, New York, NY 10003, USA. Tel.: (516) 357 8777; fax: (516) 357 0087.

E-mail address: pgpassias@yahoo.com (P.G. Passias)

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RESULTS: Controlling for baseline difference in SII, Charlson Comorbidity Index (CCI) score, diabetes, hypertension, and smoking, complications significantly increased at a BMI of 35 kg/m^2. The odds ratios for any complication (odds ratio [OR] [95% confidence interval {CI}]; obesity 2: 1.218 [1.020–1.455]; obesity 3: 1.742 [1.439–2.110]), infection (obesity 2: 1.335 [1.110–1.605]; obesity 3: 1.685 [1.372–2.069]), and surgical complication (obesity 2: 1.622 [1.250–2.104]; obesity 3: 2.798 [2.154–3.634]) were significantly higher in obesity classes 2 and 3 relative to the normal-overweight cohort (all p<.05).

CONCLUSION: There is a significant increase in complications, specifically infection and surgical complications, in patients with BMI≥35 following lumbar spine surgery, with that rate further increasing with BMI≥40.

Keywords: Complications; Lumbar; Obesity; Predictor; Risk; Spine

Introduction

Obesity has been found to be an independent risk factor for comorbidities such as hypertension, diabetes, and cardiovascular disease [1,2]. Current literature suggests that obese patients, representing nearly 35% of the United States population, need an altered surgical treatment protocol for spine pathologies [3–5]. Additionally, recent literature suggests that obesity contributes to low back pain and greater rates of degenerative spine pathology, which as a result, contributes to a relatively high prevalence of obesity in patients undergoing elective lumbar surgery [5]. Therefore, given the effect of excessive weight on the development of lumbar pathology, a high proportion of patients undergoing elective lumbar spine surgery are obese [6]. In fact, according to the National Surgery Quality Improvement Program (NSQIP) data, almost 80% of patients undergoing spine surgery are overweight or obese [7].

The role of obesity on complications following spinal procedures has been thoroughly investigated [8–10]. Factors associated with higher complications following lumbar spine procedures in obese patients include the associated medical comorbidities, longer surgical duration, and increased blood loss. In a recent study, Seicean et al. reported increased perioperative complications in 49,314 patients undergoing elective lumbar procedures with body mass index (BMI)≥30 kg/m^2 using the NSQIP database. However, after controlling for medical comorbidities, the authors found that the BMI threshold increased to >40 kg/m^2 for higher complications, readmissions, and non-routine discharges [11].

In addition to the medical comorbidities, another important factor that may influence complication rates in obese patients undergoing spine surgeries is the invasiveness of the surgical procedure. However, there is no literature on the effect of surgical invasiveness in obese patients. Given previous findings that proved surgical invasiveness is associated with surgical site infection and increased operation time, it would be beneficial to dichotomize patients based on high or low surgical invasiveness given that invasiveness has been proven to significantly affect outcome [12,13].

Although it is widely regarded that obesity is correlated with complications, it is not entirely clear which complications predominate. This may be related to the high prevalence of "obese" patients as defined by the World Health Organization (BMI greater than 30 kg/m^2), which confounds the results of many series. Marquez-Lara et al. found that in 24,196 lumbar spine procedures, patients with BMI≥25 demonstrated higher risk of deep vein thrombosis, pulmonary embolism, and superficial wound infections compared with normal-weight patients, whereas morbidly obese patients (BMI≥40) had additional risk of postoperative renal failure, sepsis, and urinary tract infection [14]. Because of lack of consistent findings, there is a need for a thorough examination of obesity's effect on complications in lumbar spine surgeries, and to define a threshold at which body mass index becomes a comorbidity.

The primary objective of this study was to report the effects of obesity on specific complications following lumbar spine surgery based on the level of surgical invasiveness. Secondarily, we sought to determine a threshold value at which obesity significantly impacts complications. We hypothesized that obesity is an independent risk factor for complications following lumbar spine surgery and that there is an identifiable BMI that predicts risk of postoperative complications.

Materials and Methods

National Surgery Quality Improvement Program (NSQIP)

The American College of Surgeons NSQIP was implemented in 1991 by the US Department of Veterans Affairs to model patient risk-adjusted outcomes for patient factors and operative procedure. Patient data are collected by a Surgical Clinical Reviewer auditing participating hospitals. It samples all patient populations undergoing general, spinal, or epidural anesthesia. Patient data collected include primary diagnosis in the form of an International Classification of Diseases, Ninth Revision, Clinical Modification code, procedure as indicated by Current Procedural Terminology (CPT) coding, 70 preoperative risk factors, 11 variables related to the surgery, and 24 postoperative outcomes. Complications, outcomes, and any further procedures are recorded for 30 days after enrollment. More detailed information on the NSQIP design is available at www.facs.org/quality-programs/acs-nsqip [15]. Institutional review board approval is exempt from studies using de-identified NSQIP data.