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Lumbar Spine Fusion in Obese and Morbidly Obese Patients

Rahul Vaidya, MD, FRCSC,* Julia Carp, BS,† Stephen Bartol, MD, FRCSC,† Nicole Ouellette, RN,* Sandra Lee, DO,‡ and Anil Sethi, MD*

Study Design. Single-center retrospective study.

Objective. The aim of the study was to compare the surgical experience, clinical outcomes, and effect on body weight between obese and morbidly obese patients undergoing lumbar spine fusion surgery.

Summary of Background Data. Obese and morbidly obese patients undergoing spinal fusion surgery are a challenge to the operating surgeon. Only few reports are available on the perioperative data in this group of patients. Further, it is unknown if the degree of obesity has an effect on the surgical experience and clinical outcomes including body weight.

Methods. A retrospective study of 63 patients undergoing lumbar spinal fusion was carried out. The main inclusion criteria were a body mass index (BMI) equal to or greater than 30. Information recorded included surgical set-up time, surgical time, blood loss, American Association of Anesthesiologists score, and surgical complications. At follow-up, the Oswestry Disability Index and visual analog scale for back and leg pain were recorded along with a pain diagram and radiographic evaluation.

Results. The obese group had lower American Association of Anesthesiologists scores. The surgical time was dependent on the number of levels fused and was independent of the BMI. Blood loss during surgery was marginally greater in the obese patients. Neither group showed significant change in weight and BMI. Clinical outcomes showed improvement in visual analog scale for back and leg pain with some improvement in Oswestry scores and were independent of the BMI of the patient. The incidence of postoperative complications was significant in 45% of morbidly obese and 44% of obese patients.

Conclusion. Obese and morbidly obese patients have multiple comorbidities, and the spinal surgeon should be prepared to encounter perioperative complexities. Operative times are longer in comparison with normal weight patients with a higher incidence of postoperative complications. No weight loss occurs after spinal surgery.

Key words: lumbar fusion, obese, morbidly obese, outcomes, weight loss. **Spine 2009;34:495–500**

From the *Department of Orthopedic Surgery, Detroit Receiving Hospital and University Health Center, Detroit, MI; and the Departments of †Orthopedic Surgery, and ‡Radiology, Henry Ford Hospital, Detroit, MI.

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Address correspondence and reprint requests to Anil Sethi, MD, Department of Orthopedic Surgery, Detroit Receiving Hospital and University Health Center, 4201 St. Antoine Blvd., 4D-4, Detroit, MI 48201; Email: drsethi11@rediffmail.com

The prevalence of obesity has reached epidemic proportions in the United States.[1–3] The definition of obesity is having a body weight that is 20% greater than the desirable body weight and having an excess of body fat that frequently results in significant impairment of health.[4,5] Obesity is commonly defined in terms of body mass index (BMI), which takes into account body weight and height. The National Institutes of Health has released guidelines on the classification of obesity.[6,7] Patients with a BMI of 30 to 39 with no significant comorbidity were considered obese. Morbidly obese patients had a BMI of 35 to 39 with a significant comorbidity or a BMI of 40 or greater. The presence of a significant comorbidity included having any one of the following 13 disorders: hypertension, diabetes, anticoagulation, asthma/bronchitis, hyperlipidemia, thyroid disease, psychiatric disorder, angina, alcohol consumption, shortness of breath, sleep apnea, and myocardial infarction.[7]

Spine surgery in the obese is challenging as a result of difficulties in anesthesia, intravenous access, and positioning of the patient, as well as due to the procedure itself.[8] The number of obese and morbidly obese patients requiring spinal surgery is on the rise. Thus, special treatment plans and considerations in the care of these patients are necessary before surgery.[4] Many patients in our study were unable to lose weight because of their inability to exercise. Several of these patients had been denied bariatric surgery due to chronic low back pain and symptoms of depression. These patients underwent spinal surgery with an objective of improving pain and function leading to a possible weight reduction. A statistically significant relationship has been reported between obesity and the incidence of perioperative complications.[9] An earlier study has also compared surgical outcomes between obese and normal weight controls during spine surgery.[10] However, it is not clear from previous reports if the perioperative behavior of patients is dependent on the degree of obesity. The purpose of this report is to compare the surgical experience, clinical outcomes, and effect on body weight between obese and morbidly obese patients undergoing lumbar spine fusion surgery.

Materials and Methods

Sixty-three consecutive patients with a BMI of 30 or greater who underwent lumbar spine decompression and fusion with instrumentation posteriorly, between November 2001 and June 2005, were reviewed following an Institutional Review Board approval. Patients were classified into obese and morbidly obese groups based on BMI values as per the National Institutes of Health (1991) guidelines[6] discussed above. There

were 38 women and 25 men. The obese group had 21 women and 11 men. The morbidly obese group consisted of 17 women and 14 men. Patients ranged from 28 to 81 years of age with an average age of 53 years. The obese group had an average age of 51 years and the morbidly obese group had an average age of 56 years. The indications of surgery included lumbar canal stenosis in 32 patients, degenerative disc disease in 14 patients, revision surgery in 8 patients for post laminectomy instability, spondylolisthesis in 5 patients, and degenerative scoliosis in 4 patients. The number of levels fused ranged from 1 to 6. Twenty-six patients had a single level fusion and 23 had a fusion at 2 levels. There were 5 patients each with 3- and 4-level fusion. Four patients underwent fusion at 6 levels. All patients who underwent 6-level fusion had scoliosis with spinal stenosis. Three patients were diagnosed with scoliosis in adolescence and 1 with degenerative scoliosis. Lumbar decompression fusion and instrumentation (LDFI) was carried out on 44 patients, whereas 19 patients underwent transforaminal lumbar interbody fusion (TLIF). Preoperative body weight averaged 103.9 kg ranging from 68 to 158.7 kg. The obese group had an average weight of 92.4 kg and the morbidly obese group had an average weight of 115.7 kg. Height measurements ranged from 1.5 to 1.85 m with an average height of 1.6 m. The obese group had an average height of 1.7 m and the morbidly obese group had an average height of 1.6 m. BMI values ranged from 30 to 53 kg/m^2 with an average BMI of 36.4 kg/m^2. The obese group had an average BMI of 32.3 kg/m^2, whereas the morbidly obese group had an average BMI of 40.8 kg/m^2.

Medical records were obtained for each patient from the electronic hospital charting system and our prospectively collected spine database. Information from the nursing record included time in surgery, procedure start time, procedure end time, and departure. Anesthesia preoperative patient evaluation tool sheets were used to determine American Society of Anesthesiologists (ASA) scores and the number of preoperative comorbidities of each patient. Anesthesia notes were used to determine intraoperative blood loss. Postoperative complications and length of stay were recorded from patient charts. A comparison of the surgical times in 1- and 2-level TLIF and LDFI was carried out between 29 normal weight patients and our cohort of obese and morbidly obese patients that underwent a similar surgery. Average patient follow-up was 20.4 (range: 14–37) months. The obese group had an average follow-up of 21.9 months and the morbidly obese group had an average follow-up of 19 months. One patient had 2 surgeries at different times with different data and was counted as 2 patients. Our spine database collects Oswestry Disability Index questionnaires, a record of the visual analog scale for leg and back pain and a pain diagram at the preoperative visit and every subsequent postoperative visit for all lumbar spine fusions in our practice. After surgery, these parameters are recorded at 2, 6, 12, and 24 weeks, and 1 year, after surgery. In this study, the body weight and height measurement were also documented before surgery and at their latest follow-up. Radiologic assessment included plain radiographs in all patients with CT evaluation when indicated. All patients had a final evaluation at a clinic visit or by telephone just before completion of this study.

Statistical analysis was carried out on Analyze-It software for Microsoft Excel (Analyze-It Software Ltd., Leeds, UK), with a $P < 0.05$ considered significant.

Most of the morbidly obese (24) and obese (18) patients had, before surgery, attempted multiple methods to lose weight without success. There was no specific postoperative counseling on weight loss in this study.

Table 1. Postoperative Complications

	Obese	Morbidly Obese
Major complications		
Myocardial infarction	1	1
Cardiac arrythmia	0	1
Pneumonia	0	1
Post-op ileus	2	2
Pulmonary embolism	1	0
Intra-op hypotension	0	1
Hypovolemic ischemic optic neuropathy	0	1
Acute renal failure	0	1
DVT	0	1
Surgical complications		
Non union	1	2
Adjacent level disease	2	1
Dural leak	1	0
Wound infection	1	0
Hematoma formation	0	1
Wound break down	0	1
Minor complications		
Urinary tract infection	1	3
Urinary retention resolved	2	5
Delerium (mild)	0	1
Candida infection (unrelated)	1	0
Fever (transient)	0	1
Cage migration from fall without sequelae	0	1

■ Results

Preoperative Evaluation

The average number of comorbidities among the 63 patients was 6.9 with a range of 0 to 20 (Table 1). Obese patients averaged 5.1 comorbidities and morbidly obese patients had an average of 8.1 comorbidities. Preoperative ASA scores were available for 58 of the 63 obese and morbidly obese patients. The average ASA score was 2.4; obese patients averaged a score of 2.3 and in morbidly obese patients, the average ASA score was 2.5. Sixty patients reported having a previous surgery with anesthesia.

Intraoperative Evaluation

Set-up time, surgical time, and blood loss during surgery were reviewed for all 63 patients. The average set-up time for surgery was 66.5 minutes. The average set-up time for the obese group was 59.8 minutes and for the morbidly obese group was 73.5 minutes. The average surgical time for all patients was 244.3 minutes; for the obese group it was 225.9 minutes, and for the morbidly obese group it was 262.2 minutes. Average blood loss during surgery for all patients was 987.9 mL; for the obese group blood loss was 1043.7 mL, and it was 928.3 mL for the morbidly obese group. Surgical time and blood loss were also correlated with the number of levels of surgery. The 3 groups consisted of 1-level fusions, 2-level fusions, and 3 or more level fusions. The 1-level group had averages of 154.2 minutes, and 789.5 mL, respectively. The 2-level group had averages of 232.9 minutes and 1033.3 mL, respectively. The 3 or more level group had

Table 2. Comparison of Surgical Time With Normal Weight Patients

	Normal	Obese	Morbidly Obese
LDFI 1 level			
No. pts	7	7	4
Surgical time	124	150	172
LDFI 2 levels			
No. pts	13	6	5
Surgical time	171	252	200
TLIF 1 level			
No. pts	5	8	4
Surgical time	131	189	206
TLIF 2 level			
No. pts	4	4	1
Surgical time	229	297	308

averages of 239.9 minutes and 1250 mL, respectively. A comparison of the surgical time of normal weight, obese, and morbidly obese patients that underwent 1- and 2-level LDFI and TLIF is recorded in Table 2.

Postoperative Evaluation

The average length of hospital stay for all 63 obese and morbidly obese patients was 5.8 days; the obese group averaged 5.4 days and the morbidly obese group averaged 6.1 day. Length of hospitalization for 1-level, 2-level, and 3 or more level fusions was 5 days, 6.6 days, and 5.8 days, respectively.

Oswestry Disability Index

Oswestry scores were recorded for all 63 patients. Scores were recorded before surgery and at 2, 6, 12, and 24 months and 1 year and at the most recent follow-up.

Average Oswestry scores for 1-level fusion were 57, 50, 45, 41, 38, 34, and 29, respectively. Average Oswestry scores for 2-level fusions were 58, 55, 44, 40, 37, 34, and 33, respectively. Average Oswestry scores for 3 or more level fusions were 57, 52, 49, 44, 39, 40, and 36, respectively. For the obese group, average Oswestry scores were 61, 57, 53, 48, 43, 36, and 33, respectively. For the morbidly obese group, average Oswestry scores were 53, 49, 47, 43, 41, 37, and 35, respectively (Figure 1).

Leg Pain Scores

Leg pain scores were reviewed according to the number of levels of surgery and between the obese and morbidly obese groups. Scores were taken at a preoperative date, and 2, 6, 12, 24 weeks and 1 year after surgery. A score of 0 indicated no pain and a score of 10 indicated worst pain. One-level fusion patients had average leg pain scores of 6.1, 4.4, 3.5, 3.1, 2.6, and 2.3, respectively. Two-level fusion patients had average leg pain scores of 7.4, 5.6, 4.6, 3.8, 3.2, and 2.9, respectively. Three or more level fusion patients had average leg pain scores of 5.8, 4.5, 3.7, 3.4, 3.1, and 3.0, respectively. The obese group had average leg pain scores of 5.8, 4.9, 3.7, 3.4, 3.1, and 2.7, respectively. The morbidly obese group had average leg pain scores of 6.3, 5.4, 4.6, 3.7, 3.4, and 2.9, respectively (Figure 2).

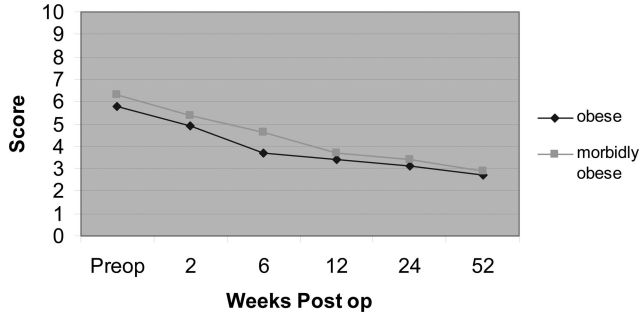

Figure 2. Visual analog scale for leg pain in obese and morbidly obese patients.

Back Pain Scores

Back pain scores were reviewed according to the number of levels of surgery and between the obese and morbidly obese groups. A score of 0 indicated no pain and a score of 10 indicated the worst pain. Scores were taken at a preoperative date, and 2, 6, 12, 24 weeks and 1 year after surgery. One-level fusion patients had average back pain scores of 7.0, 5.9, 5.4, 4.9, 3.9, and 3.3, respectively. Two-level fusion patients had average back pain scores of 7.4, 5.9, 5.5, 4.8, 4.5, and 3.8, respectively. Three or more level fusion patients had back pain scores of 7.0, 6.2, 5.2, 4.6, 4.1, and 4.0, respectively. The obese group had average back pain scores of 6.6, 5.8, 4.9, 4.2, 3.9, and 3.6, respectively. The morbidly obese group had average back pain scores of 7.6, 5.0, 4.8, 4.5, 4.1, and 3.9, respectively (Figure 3).

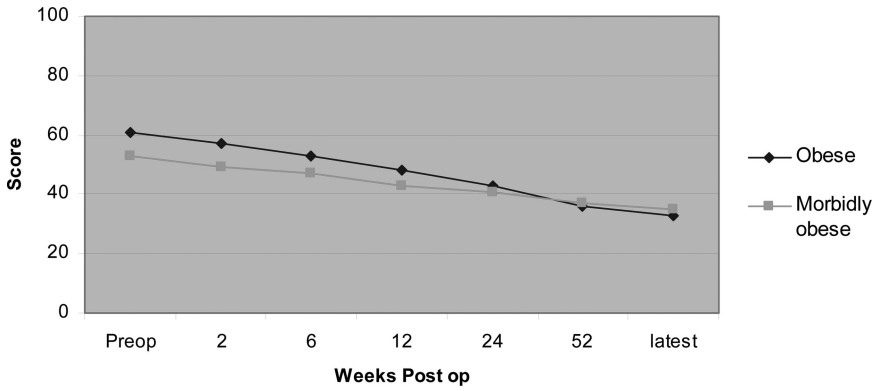

Figure 1. Oswestry disability index in obese and morbidly obese patients.

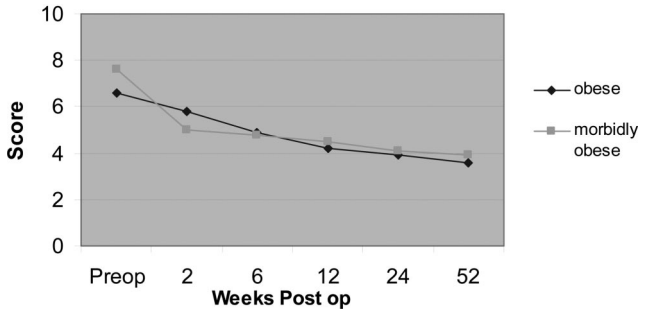

Figure 3. Visual analog scale for back pain in obese and morbidly obese patients.

Postoperative Weight

A postoperative weight record was available on 58 of the 63 patients that were included in the study. The average postoperative weight was 104.1 kg; the obese group averaged 93.8 kg (preoperative weight 92.4 kg) and the morbidly obese group averaged 114.3 kg (preoperative weight 115.7 kg). Of the 58 patients, 24 gained weight, 23 lost weight, and 11 stayed the same weight after surgery. Those with a weight gain included 14 obese and 10 morbidly obese patients. Eight obese and fifteen morbidly obese patients lost weight, and 7 obese and 4 morbidly obese patients remained the same weight. Postoperative average BMI value for the 58 patients was 36.4 kg/m^2. The obese group averaged a BMI value of 32.5 kg/m^2 (preoperative 32.2 kg/m^2) and the morbidly obese group averaged a BMI value of 40.3 kg/m^2 (preoperative 40.8 kg/m^2).

Postoperative Complications

Overall, 55.6% of patients did not have any complications after surgery. Forty-four percent of the obese patients and 45% of morbidly obese patients had postoperative complications (Table 1). Two patients died during follow-up and both had a post mortem examination. One patient died of a narcotic overdose 3 months after surgery and the other died of cardiac arrest because of an arrhythmia 8 weeks after surgery. This patient had been non compliant with warfarin. Neither death was a direct result of the surgery as the acute time period had elapsed.

Eight patients required reoperations in the follow-up period. These included 5 obese and 3 morbidly obese patients. Three patients (2 obese and 1 morbidly obese) had an adjacent level disease and their fusion was extended. Three other patients (2 morbidly obese and 1 obese) had a nonunion of 1 level and required a revision surgery. One obese patient was reoperated for infection which cleared after an irrigation and debridement. Implants were retained and the patient was administered 6 weeks of intravenous antibiotics for methicillin resistant staphylococcus aureus infection. He continues to remain under follow-up. Another obese patient required revision surgery for repair of a dural leak. Several patients had multiple complications including 1 that suffered intraoperative hypotension and hypovolemic ischemic optic neuropathy resulting in partial blindness with minor resolution.

■ Discussion

Surgical decision-making in the obese and morbidly obese patient is a challenge for the operating surgeon. Excess weight of patients may cause early mortality and greater morbidity because of its relationship with comorbidities such as hypertension, obstructive sleep apnea, diabetes mellitus, and hyperlipidemia.[11] A previous study[2] on surgical procedures in this group of patients concluded that a correlation exists between obesity and mortality. In the same study, a correlation was also observed between obesity and perioperative complications. The surgeon is thus faced with the possibility of poor outcomes of surgery because of increased morbidity and mortality. This causes a reluctance to operate on obese and morbidly obese patients. This study provides perioperative data and clinical outcomes of the obese and morbidly obese patient that may assist with decision-making.

Before surgery, obese patients had an average comorbidity of 5.1, whereas the morbidly obese patients had average comorbidities of 8.1. A statistical analysis revealed a significant difference ($P = 0.02$) in the 2 groups. However, no significant difference ($P = 0.2$) between ASA scores existed between the 2 groups of patients. Thus, we felt that the anesthetic risk of surgery in the 2 groups were similar. The anesthesiologists at our institution as in many other hospitals are well versed in the care of the bariatric surgery patient who routinely has multiple comorbidities, with a challenging IV access and intubation. They have variances in fluid management and ventilatory support that require additional knowledge in this field.

Intraoperatively, morbidly obese patients had longer surgical set-up times. This study confirmed that surgical time is least with single-level fusion and increases with 2- and 3-level fusions. Though surgical time in 3-level fusions was greater than 2-level fusions it was not statistically significant. A comparison of surgical time with normal weight patients in 1- and 2-level TLIF and LDFI recorded longer time in both obese and morbidly obese patients (Table 2). Further, morbidly obese patients had less blood loss than the obese patients in our study. It has been reported[10] that measurement of blood loss after spinal surgery in obese and non obese patients that underwent laminotomy or laminectomy showed that the obese group had a greater blood loss. In the same study, after fusion surgery the normal weight group was reported to have a greater blood loss than the obese group. It is clear that surgical blood loss is not dependant on the BMI alone. The predictors for blood loss include number of levels fused, preoperative hemoglobin and body weight.[12] Other factors associated with a higher blood loss are the male gender, higher BMI, and a diagnosis of degenerative scoliosis.[12] Increased intra-abdominal pressure is also known to be a cause of excessive blood loss. Hence, positioning of the patient in a manner that allows the

abdomen to hang free has been recommended in posterior lumbar spine surgery.[13,14]

Before embarking on the study it was our premise that after spinal surgery patients may have less pain, and become more active and hence lose weight. Many patients did in fact state severe back pain as a reason for their inactivity and over weight. Data obtained in this study after surgery for 58 of the 63 patients showed that neither group had a significant weight loss despite improvements in back pain and leg pain scores and some improvement in Oswestry scores. The obese group showed an average gain of 1.5 kg and the morbidly obese group showed an average loss of 1.4 kg. The postoperative protocol used is our standard protocol for all lumbar spine fusion surgery. We did not employ any additional treatments for weight loss after surgery. Currently, only bariatric surgery has been shown to be an effective treatment of weight loss in morbidly obese patients.[7,11] Developing a specific post spinal fusion weight loss program needs consideration and is a topic for future study.

In the present study, we observed a low rate of wound infection. One patient each in the obese and morbidly obese group (3%) had wound infection. Other reports[4,10,15] have stated higher wound infection rates in obese patients. A report evaluating postoperative infections after spinal surgery concluded that infections occurred more commonly with the use of posterior instrumentation.[16] Every patient in our study had posterior instrumentation but our number was small.

Postoperative complications occurred in both obese and morbidly obese patients. Although more complications were observed in obese patients than morbidly obese patients (45.16% *vs.* 43.75%), the difference was not statistically significant. The incidence of complications has been variably reported in literature. There are reports of no difference in complication rate between normal weight and obese patients. Conversely, in a study analyzing the effect of obesity on the results of lumbar spine surgery in the elderly the authors noted an overall complication rate of 40%.[17] A statistically significant relationship between the presence of obesity and the incidence of perioperative complications (36.9%) has also been reported in patients undergoing elective thoracic and lumbar fusion procedures.[18] Complication rates as high as 50% have also been recorded in morbidly obese patients.[4] The incidence of complications in our study is high since we used a broad definition of perioperative complications that included both minor and major complications. Hence, transitory urinary retention and paralytic ileus that occurred in 11 patients was also recorded. Further, urinary tract infection after an indwelling catheter and candida skin infection, which resolved with appropriate treatment and had no direct effect on the outcome of the surgery were also included.

Overall, we found no significant difference between obese and morbidly obese patients undergoing lumbar spinal fusion in our patient population. Before surgery, the obese group had lower ASA scores. Intraoperatively, morbidly obese patients had marginally longer set-up time. The surgical time was dependent on the number of levels fused and was independent of the BMI of the patient in these 2 groups. Though blood loss was greater in obese patients it was not statistically significant. After surgery, both groups did not show significant change in weight and BMI. Further, clinical outcomes were independent of the BMI of the patient. Single-level fusions were observed to have the best outcomes followed by 2-level fusions. The incidence of postoperative complications was nearly similar in both groups but significant at 43% and 45% of patients.

Finally, obese and morbidly obese patients have multiple comorbidities and the spinal surgeon should be prepared to encounter perioperative complexities. Operative times are longer in comparison with normal weight patients with a high incidence of postoperative complications. However, the obese and morbidly obese population should not be denied surgery based on their BMI values alone. Unlike bariatric surgery, which has shown improvement in weight loss and spinal symptoms no weight loss occurs after spinal surgery. It is our view that morbidly obese patients should undergo bariatric surgery before spine surgery in nonemergent situations for improved clinical outcomes.

■ Key Points

- Obesity is associated with multiple comorbidities.
- Perioperative complexities are present in both obese and morbidly obese patients.
- Operative times are longer in comparison with normal weight patients.
- Patients do not lose weight after surgery.

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