Spine surgery in morbidly obese patients

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Object. The diagnosis, treatment, and postoperative care of morbidly obese patients undergoing spinal surgery require modifications for body habitus. With a growing percentage of the United States population becoming morbidly obese, the surgeon may need elective or emergency treatment plans that address the special needs of these patients. The authors retrospectively reviewed the diagnosis, treatment, and postoperative care of the severely obese patient undergoing spinal surgery.

Methods. To assess the associated results and complications of management that required modification for body habitus, 12 patients were included in the study (nine females); the mean age was 50 years and mean weight was 320 lb. Cases of cervical (two cases), thoracic (four cases), and lumbar surgeries (six cases) were included. The follow-up period ranged from 6 months to 2 years. Patients presented with myelopathy (five cases), radicular pain and weakness (four cases), radiculopathy (two cases), and cauda equina syndrome (one patient). Chronic progressive neurological deterioration secondary to spinal cord compression was demonstrated in nine patients and acute pain and/or weakness secondary to nerve root compression was observed in three patients.

Conclusions. The authors found that although morbidly obese patients may present late in the course of their symptoms and require modifications in the use of standard neuroimaging, operative facilities, and treatment plans, open mindedness and persistence can yield satisfactory results in most cases.

KEY WORDS • obesity • spine surgery • rehabilitation

A high risk of surgery-related perioperative complications in obese patients has been reported in studies performed for other surgical subspecialties. With a growing percentage of the United States population becoming morbidly obese, a need has arisen for elective and emergency treatment plans that address the special considerations involved in the care of these patients. We retrospectively examined the factors involved in caring for morbidly obese patients to assess the results and complications of management that required modification for body habitus.

An arbitrary but established definition of obesity is an increase in body weight of 20% greater than the desirable body weight. The definition of “morbid obesity” used by the Metropolitan Insurance Company is a weight that is 100 lb (46 kg) greater than, or two times, the desired weight.

In this paper we examined the issues involved in the care of patients who weighed greater than two times their ideal weight. Our goal was to determine, by assessing details in our previous cases, what recurrent factors were involved in spinal surgery in the morbidly obese patient and determine how to prevent future complications.

Clinical Material and Methods

At the Hospital of the University of Pennsylvania between June 1994 and June 1997, we performed spinal surgery in 12 patients who weighed from 109 to 211 kg; each patient was at least, or greater than, two times his/her ideal weight. Ideal weights were determined from the BMI calculated ([body weight in kilograms] divided by [(height in meters)2]) which is used to compare relative amounts of excess body fat among groups of individuals of different heights and correlates with the risk of adverse effects on health and longevity. All operations were performed by the senior author (P.M.). The mean body weight was 145 ± 28 kg (320 ± 62 lb), and the mean BMI was 52 ± 7 kg/m2. All values are expressed as the means ± the standard deviations unless otherwise stated. The height and weight of each patient were recorded 1 day preoperatively, primarily for purposes related to determining levels of anesthesia. Twelve patients were included in the study (nine females) with a mean age of 50 years. Cervical (two cases), thoracic (four cases), and lumbar (six cases) surgeries were performed. The follow-up period ranged from 6 months to 2 years. Tables 1 and 2 provide summaries of the presentation, treatment, and outcome for each patient.

Results

Characteristics of Presentation

Five patients presented with myelopathy, four with...
TABLE 1
Summary of characteristics in 12 morbidly obese patients

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Diagnosis</th>
<th>Weight (kg), BMI (kg/m²)</th>
<th>Presentation</th>
<th>Duration of Symptoms (mos)</th>
<th>Diagnostic Modality</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C5–7 spondylolisthesis</td>
<td>145, 48.8</td>
<td>severe myelopathy</td>
<td>36</td>
<td>MR, intraop radiography</td>
</tr>
<tr>
<td>2</td>
<td>C5–7 compression</td>
<td>151, 61.0</td>
<td>quadriparesis</td>
<td>36</td>
<td>CT myelography, intraop radiography</td>
</tr>
<tr>
<td>3</td>
<td>T8–8 compression</td>
<td>129, 48.9</td>
<td>paraparesis</td>
<td>7.5</td>
<td>MR, intraop radiography</td>
</tr>
<tr>
<td>4</td>
<td>thoracic epidural abscess</td>
<td>147, 63.2</td>
<td>paraparesis</td>
<td>0.5</td>
<td>MR w/ marker</td>
</tr>
<tr>
<td>5</td>
<td>thoracic herniated disc</td>
<td>211, 65.0</td>
<td>paraparesis</td>
<td>2</td>
<td>intraop fluoroscopy, myelography, microventriculography</td>
</tr>
<tr>
<td>6</td>
<td>thoracic metastases</td>
<td>175, 52.3</td>
<td>paraparesis, severe pain</td>
<td>4</td>
<td>CT, intraop radiography</td>
</tr>
<tr>
<td>7</td>
<td>lumbar stenosis</td>
<td>109, 44.0</td>
<td>cauda equina syndrome</td>
<td>0.5</td>
<td>MR, intraop myelography &amp; fluoroscopy</td>
</tr>
<tr>
<td>8</td>
<td>L3–4 spondylolisthesis</td>
<td>143, 45.3</td>
<td>back &amp; leg pain</td>
<td>36</td>
<td>MR, CT, intraop fluoroscopy</td>
</tr>
<tr>
<td>9</td>
<td>L3–4 spondylolisthesis</td>
<td>115, 46.4</td>
<td>back &amp; leg pain</td>
<td>12</td>
<td>MR, CT myelography, intraop fluoroscopy</td>
</tr>
<tr>
<td>10</td>
<td>L3–4 spondylolisthesis</td>
<td>123, 46.4</td>
<td>back &amp; leg pain, leg weakness</td>
<td>0.25</td>
<td>MR, CT, bone scanning, discography</td>
</tr>
<tr>
<td>11</td>
<td>L4–5 herniated disc</td>
<td>130, 47.5</td>
<td>leg pain &amp; weakness</td>
<td>12</td>
<td>MR, CT myelography, intraop fluoroscopy</td>
</tr>
<tr>
<td>12</td>
<td>L4–5 herniated disc</td>
<td>159, 54.9</td>
<td>leg pain &amp; weakness</td>
<td>3</td>
<td>MR, intraop radiography</td>
</tr>
</tbody>
</table>

**Radicular Pain and Weakness**

Radicular pain and weakness, two with radicular and back pain, and one with cauda equina syndrome. The mean preoperative duration of symptoms was 12.5 ± 14.7 months. Of the 12 patients, nine had not previously undergone neuroimaging or had their conditions diagnosed, and at the time of presentation they required urgent treatment due to the acute progression of a neurological deficit. Seventy-five percent of our morbidly obese patients sought treatment only after the onset of a progressive deficit, even though they experienced symptoms on average for greater than 1 year. Of the three patients who underwent elective surgery, two with lumbar spondylolisthesis required spinal fixation and fusion and one harboring a known thoracic metastasis required decompressive surgery to treat progressive paraparesis.

**Neurodiagnostic Imaging**

Modifications required to undertake preoperative imaging were necessary for six of the patients. All but three of our patients were able to fit in an MR imager or on an MR imaging table. In two of these three patients who could not undergo MR imaging, CT myelograms were obtained and in the third an intraoperative plain myelogram was acquired. Two patients in whom symptoms were consistent with severe lumbar compression presented with MR imaging studies that had been obtained at open-imager imaging centers. These studies were of poor quality because of the patients’ size and suggested only minimal disease. Myelography subsequently performed in these patients revealed severe neural compression.

**Intraoperative Modifications**

Only the 211-kg patient was unable to be positioned on a standard operating table because of his girth. Surgery was performed with the patient in a supine position while lying in his hospital bed. In all cases requiring lumbar surgery and in one requiring thoracic surgery, the patients were positioned prone on the Wilson frame. Figure 1 illustrates the size of one patient with respect to a standard operating table and Wilson frame. In two of the four cases in which thoracic surgery was performed the lateral decubitus position was used and in one case the patient was positioned on a hospital bed as described earlier. In cases requiring cervical surgery the patients were positioned supine. Additional staff was available for positioning in all cases.

Longer incisions were necessary to improve exposure, and retraction was difficult in all cases. Modifications of standard retractors were only necessary in patients undergoing cervical surgery in which the standard Caspar set was insufficient. In these cases Scoville retractors were used and an additional assistant was necessary.

Intraoperative neuroimaging–related modifications were required in three of the 12 cases. In all three cases intraoperative fluoroscopy was performed instead of plain radiography. In those patients with an especially large girth, fluoroscopy allowed better control of the x-ray-beam intensity and enabled an immediate determination of the image quality. In two of these cases intraoperative myelography was necessary. In one of these cases, a patient in whom neither preoperative MR imaging nor CT scanning was possible, a flexible neuroendoscope of 1-mm diameter (Clarus Medical L.L.C., Minneapolis, MN) was used to explore the region in which neural compression was present.

**Postoperative Results**

In 11 of the 12 patients significant improvement of preoperative symptoms occurred. One patient suffered progression of his neurological deficit. There were no perioperative deaths. The one patient who did not improve postoperatively was the heaviest patient, a 211-kg (465-lb) man who was 40 years of age and presented with symptoms of thoracic myelopathy. Attempts at obtaining MR images, CT scans, and nuclear medicine scans as well as a preoperative myelogram were unsuccessful. Intraoperative myelography was able to localize the point of compression, and three-level thoracic laminectomy was performed to treat a central disc herniation. Postlaminectomy, exploration was attempted using a flexible neuroendoscope. This 1-mm endoscope was passed in the epidural space approximately 15 cm above and below the superior and inferior limits of the laminectomy exposure; no additional disease was identified. Preoperatively, he was unable to walk, he...
Mortality. There is also a clear association between obesity and morbidity and surgery-related complications, mortality risk, and increasing operative time.1,7,9,10 There have been two published studies in which the authors undertook lumbar surgery in the obese patient2,7 and in which poor outcomes were found in obese patients compared with their non-obese counterparts. These authors did not examine morbidity, abdominal girth, which may also hinder access.12 With the open MR imaging units, the signal-to-noise ratio is low because a large receiver coil is required, and this degrades the quality of the image, especially in an obese patient.12

The mean inpatient LOS was 14 ± 6 days, and in all but two cases the patients required transfer to inpatient rehabilitation facilities before returning home. The mean LOS in a rehabilitation facility was 1.4 ± 0.9 months.

Discussion

In studies of obese patients a direct correlation has been shown between the degree of obesity and morbidity and mortality.4 There is also a clear association between obesity and surgery-related complications, mortality risk, and increasing operative time.1,7,9,10 There have been two published studies in which the authors undertook lumbar surgery in the obese patient2,7 and in which poor outcomes were found in obese patients compared with their non-obese counterparts. These authors did not examine morbidity, obese patients, a group that presents unique challenges with respect to diagnosis, surgical treatment, and postoperative care.

Presentation and Diagnosis

In this study the group as a whole presented with a relatively long course of preoperative symptoms prior to diagnosis. The mean duration of symptoms was greater than 1 year (range 1 week–3 years) with 75% having never undergone imaging or had their condition diagnosed. Many required urgent surgery for an acute progressive neurological deficit. Patient history and results of physical examination in each case indicated the approximate location of the lesion in those with thoracolumbar disease. Neurodiagnostic imaging was problematic in some patients. An attempt at obtaining an MR image was made in all cases. Weight or girth in three patients, however, prevented our being able to obtain an MR image. Two other patients underwent open imaging studies, the resolution of which was very limited and prevented clear definition of the compressive pathological entities. The weight limitation for most MR imaging and CT tables is 159 kg (350 lb). In addition to weight, another limitation in such patients is the shoulder and abdominal girth, which may also hinder access.12 With the open MR imaging units, the signal-to-noise ratio is low because a large receiver coil is required, and this degrades the quality of the image, especially in an obese patient.12

In the absence of an adequate MR imaging study, an attempt at myelography was undertaken to visualize the spinal canal. Placement of the spinal needle was difficult in two of the cases, but visualization of a dye column was obtained. In one of the cases, however, the dye column could not be clearly visualized up to the thoracolumbar junction, the region in which clinical examination predicted the disease. In another patient the level of obstruction could not be seen in the lower lumbar spine.

Open myelography was conducted intraoperatively in two patients. One patient required a diagnostic myelogram to determine the source of his lower thoracic myelopathy. After exposing the lower thoracic spine, the laminotomy was performed and dye was inserted into the thecal sac by using a butterfly needle under direct visualization. Fluoroscopy was used to follow the dye column caudad until the focus of obstruction was observed. The decompressive laminectomy was performed once the obstruction was found.

Intraoperative myelography was performed in one case to confirm that adequate decompression had been achieved. The advantages of intraoperative myelography include: 1) performance of the test after induction of general anesthesia; 2) the ability to cannulate the subarachnoid space under direct vision; and 3) patient positioning allowing displacement of adipose tissue to enable fluoroscopic visualization (Fig. 2).
Surgery-Related Considerations

There are several aspects of operative procedure and technique that require modification when treating the obese patient. Operative positioning poses several difficulties. The weight limitation for most operating tables is less than 205 kg and for stretchers can be up to 227 kg. In a study in which the authors reviewed the needs of patients weighing in excess of 270 kg, who required abdominal surgery, it was recommended that two operating room tables be clamped together side-by-side, to allow the patient’s weight to be distributed over two tables. The safety of the patient and the operating room staff must be considered when moving and positioning such patients.

Prone positioning on the table remains optimum for patients undergoing posterior lumbar surgery. The physiological effect of this position on venous return and ventilation in the morbidly obese patient is of concern. In the 11 patients in our study who were ultimately placed prone, however, the anesthesiologist did not have to take extraordinary measures to maintain reasonable oxygenation, ventilatory pressures, or blood pressure control.

Nine of the 10 patients undergoing thoracolumbar surgery were positioned prone; many advocate the use of the Andrews frame to prevent abdominal compression, which can impair ventilation and increase epidural venous return. In the morbidly obese patient, this frame was found to be cumbersome. The turning, balancing, and positioning of the patient on the frame was somewhat precarious, given the patient’s size and the number of assistants required to stabilize him/her while the hip and buttock clamps were inserted. Additionally, abdominal girth did not allow the abdomen to hang freely. Therefore, reduction of abdominal compression could not be achieved on this frame. Conventional bolsters were also very difficult to position beneath the patient. They did not provide much support for the chest or over the iliac crest sites because of the large volume of fat. The patients tended to rest predominantly on their abdominal fat. The bolsters were also unstable because they were not attached directly to the table or an underlying frame. Taking into consideration the drawbacks of these different positioning devices, and the fact that regardless of the devices the patients generally had to lie on their abdomens, the Wilson frame was used in nine of the 10 patients. This device appeared to be the best of the three to prevent the patient from rolling from side to side, because the lateral cushions are angled medially to create a central wedge in the frame and the lateral cushions are attached to the frame, which prevents them from being dislodged laterally.

The pathological level was primarily identified intraoperatively using radiography or fluoroscopy. In the cervical spine cases, the cervical exposures were extended cephalad and a manual count was performed from the high cervical levels caudad when the mid and inferior cervical vertebrae had to be identified. In the thoracolumbar cases, visualization of the lumbosacral junction was required to identify the vertebral levels. Maximal radiographic exposure was initially used in an attempt to visualize the lumbosacral vertebrae. The subcutaneous fat over the flanks and the lateral hip regions appeared to be the impediment to x-ray beam penetration. If the initial x-ray beam underestimated, manual traction was placed on the fat of the hips by grasping the subcutaneous fat of the lateral hips and pulling the fat in an inferior direction at the time of the exposure. This technique significantly augmented the ability to visualize the lumbosacral spine on a conventional radiography. If this, too, was unsuccessful, the fluoroscopy unit, with or without manual traction of the subcutaneous fat, provided an adequate image. Later in the series, prior to preparing and draping the patient, the lateral flank and buttock pannus was pulled inferiorly and held in position with tape (Fig. 2).

All patients required a long incision to enhance the exposure and the ability to illuminate the wound. Additionally, if a manual count from the cranium caudad or the lumbosacral junction cephalad had to be undertaken, further exposure was required. The depth required to reach the fascia and the spine necessitated the use of a

FIG. 1. The senior author is shown palpating the anatomical landmarks before intraoperative myelography is performed on a morbidly obese patient positioned prone on the Wilson frame for posterior thoracic surgery.

FIG. 2. The same patient shown in Fig. 1, positioned prone on the Wilson frame for myelography and thoracic decompression after manual traction and taping of the lateral flank and buttock pannus away from the fluoroscope’s beam pathway.
longer muscle and fascial opening to obtain access to these structures for retraction. Large, jointed, self-retaining retractors were used to retract the paraspinal musculature and fascia.

Postoperative Care

Inpatient stays were long, and all but two of the patients required inpatient rehabilitation. In our experience, a patient with an L4–5 herniated disc and foot drop would be discharged to home with outpatient physical therapy 1 day postoperatively, but when that patient weighs 159 kg, safety issues require inpatient rehabilitation. With the majority of morbidly obese patients requiring inpatient rehabilitation, we learned to have these patients evaluated for rehabilitation stays very early during their postoperative courses.

The incidence of wound infections in obese patients has been reported to be 40.5% among clean contaminated general surgical procedures,3,8,9 3 to 13% after gynecological procedures,4 and 5 to 15% after vertical banded gastroplasty.5 In our series, wound closure followed liberal irrigation of the wound. A multilayer subcutaneous fat closure was performed to attempt to obliterate the dead space in this tissue layer. A delayed wound closure or superficial wound infection was observed in one third of the patients. All patients were treated with superficial wound care and antibiotic medication. All the wound-related problems resolved after provision of these treatment measures. The probable sources of many superficial wound healing problems include infection, subcutaneous fat necrosis, and inversion of the skin edges during closure. The presence of a large volume of subcutaneous fat likely predisposes to wound problems if one of these aforementioned conditions exists, given the volume of subcutaneous fat and potential space available in these wounds.

Conclusions

The results obtained in our small series of morbidly obese patients undergoing spine surgery indicate that their clinical symptomatology often persists for a protracted interval prior to diagnosis. Many of the patients experience an associated neurological deficit and present with progressive symptomatology at the time of diagnosis. The patient’s body habitus can impair the physician’s ability to visualize compressive lesions preoperatively and impede intraoperative radiography for localization. The logistics of patient positioning can be difficult. Prone positioning was well tolerated after induction of general anesthesia. Extending the skin openings was required to enable adequate visualization, to illuminate the wound, and, in some cases, to enable verification of the operative level. With adequate visualization of the compressive lesion, the results of the procedure should be comparable with those obtained in the nonobese patient. Wound healing problems and/or superficial infections were observed in 33% of our patients. Inpatient rehabilitation is frequently required in such patients because many of them present with progressive neurological deficit that, when combined with their large size, significantly impair safe postoperative ambulation.

As in other disciplines, the management of morbidly obese patients is associated with a high rate of perioperative morbidity. Limited modifications of general patient care and operative techniques, however, can yield satisfactory results in most of these patients.

References


Manuscript received August 20, 2001. Accepted in final form February 25, 2002.

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