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Clinical Study

Perioperative characteristics and complications in obese patients undergoing anterior cervical fusion surgery

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ABSTRACT

In the USA, obesity rates have significantly increased in the last 15 years. Mirroring this trend, a large proportion of patients undergoing spinal surgery are obese. Concern exists for increased complications due to surgical challenges posed by obese patients and their often-prevalent comorbidities. Studies have shown associations between body mass index (BMI) and perioperative complications in lumbar and thoracolumbar fusion surgeries; however, few studies have evaluated the impact of obesity on anterior cervical fusion surgery. As such, this study aimed to evaluate complications and perioperative characteristics in obese patients undergoing anterior cervical fusion. We queried medical records to identify patients with BMI >30 who underwent anterior cervical fusion surgery. A total of 69 patients were included and subdivided based on obesity class: Class 1 (BMI 30–35), Class 2 (BMI 35–40), and Class 3 (BMI >40). Subgroup analysis included comorbidities, diagnosis, procedure, levels treated, and length of hospital stay. Overall mean BMI was 35.1, mean age was 54.3 years, and 43 (63.3%) were men. Disc herniation was the most common diagnosis. Length of stay differed significantly among obesity subgroups ($p = 0.02$). Mean length of stay was 2.8, 3.5, and 4.0 days for Classes 1, 2, and 3, respectively. Three (4.3%) complications were observed, comprising of urinary tract infection, wound dehiscence, and neck hematoma. Complication rates by class were 5.5%, 0%, and 16.6% for Classes 1, 2, and 3, respectively ($p = 0.17$). We found that obese patients undergoing anterior cervical spine surgery experience relatively few complications. Hospital stay, however, appears to lengthen with increased BMI.

1. Introduction

In the USA, obesity has increased at a substantial rate in the last 15 years. Flegal et al. recently determined that the age-adjusted prevalence of obesity is 33.8% overall, with rates of 32.2% among men and 35.5% among women, and it continues to rise [1]. Mirroring this sizeable prevalence of obesity in the population are the large numbers of obese patients who undergo spinal surgery. There is a concern, however, for an increase in complications due to the greater number of comorbidities and technical challenges often encountered during spinal surgery in the obese. Previous studies have shown an association between increased body mass index (BMI) and perioperative complication rates [2,3]. These investigations, however, have focused on lumbar and thoracolumbar fusion procedures. There is a paucity of studies evaluating the impact of obesity in cervical fusion surgery.

A cohort of obese patients who underwent anterior cervical fusion surgery was analyzed in this study. Overall perioperative characteristics, outcomes, and complications are reported in addition to a subgroup analysis based on obesity class.

2. Methods

We queried the University of Michigan Health System electronic medical records for patients treated between 2006 and 2012, to identify patients with BMI >30 who underwent anterior cervical fusion surgery. BMI was calculated as body weight in kilograms divided by height in meters squared [4]. A total of 69 patients were identified and included in the analysis. These patients were further subdivided into groups based on obesity class: Class 1 (BMI 30–35), Class 2 (BMI 35–40), and Class 3 (BMI >40). There were 36, 27, and six patients in Classes 1, 2, and 3, respectively.

For the subgroup analysis among obesity classes, demographic covariates analyzed included age, sex, and BMI. Comorbidity covariates assessed included hypertension, diabetes mellitus, coronary artery disease, chronic obstructive pulmonary disorder, congestive heart failure, hypothyroidism, and high creatinine levels indicative of abnormal renal function. High creatinine levels were defined as

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>1.3 mg/dL. Diagnosis, procedure, number of levels treated, and length of hospital stay were also assessed.

This study was reviewed and approved by the Medical Sciences Institutional Review Board of the University of Michigan, USA.

2.1. Complications

All events occurring intraoperatively and within 30 days of surgery were considered relevant. We specifically assessed the following complications: infection, hematoma, instrumentation malposition/migration, new neurologic deficit, pulmonary embolism, death, thromboembolism, cardiopulmonary abnormalities, dysphagia, altered mental status, stroke, and urinary/renal complications.

2.2. Statistical analysis

Statistical analysis assessing the obesity subgroups was performed. Pearson's chi-squared test was used to determine associations for categorical variables, while one-way analysis of variance was used to determine differences in continuous variables. A p value <.05 was considered statistically significant. All statistical analyses were performed using Stata 13 software (StataCorp, College Station, TX, USA).

3. Results

Overall mean BMI was 35.1, mean age was 54.3 years, and 43 (63.3%) patients were men (Table 1). Average BMI was 31.9, 37.3, and 44.3, and average age was 52.3, 55.1, and 57.2 years for Classes 1, 2, and 3, respectively (Table 2). The highest frequency comorbidities included hypertension and diabetes mellitus. Frequencies for these two comorbidities were 23.2%, 21.7%, and 7.3% for hypertension, and 8.7%, 11.6%, and 2.9% for diabetes mellitus in Classes 1, 2, and 3, respectively.

Disc herniation was the most common diagnosis among our patient population. Relative frequencies were 30.4%, 21.7%, and 5.8% respectively for Classes 1, 2, and 3. Similar proportions were seen for spondylosis and stenosis, as shown in Table 2. Length of hospital stay was significantly different between obesity subgroups, with Class 3 patients staying longer (p = 0.02). Mean length of stay (LOS) was 2.8, 3.5, and 4.0 days for Classes 1, 2, and 3, respectively.

Table 1
Characteristics, comorbidities, and diagnoses of patients with a body mass index >30 undergoing anterior cervical spine surgery (n = 69)

	All patients
Mean BMI (SD)	35.1 (4.2)
Mean age, years (SD)	54.3 (10.8)
Mean hospital stay, days (SD)	3.2 (6.1)
Male (n)	63.3% (43)
Female (n)	37.7% (26)
Alcohol use (n)	5.8% (4)
Smoker (n)	28.9% (20)
Hypertension (n)	52.2% (36)
Diabetes mellitus (n)	23.2% (16)
Coronary artery disease (n)	5.8% (4)
Chronic obstructive pulmonary disease (n)	4.4% (3)
Congestive heart failure (n)	4.4% (3)
Hypothyroidism (n)	5.8% (4)
High creatinine (n)	10.2% (7)
Diagnosis	
Disc herniation (n)	57.8% (40)
Spondylosis (n)	36.2% (25)
Stenosis (n)	52.2% (36)

BMI = body mass index, SD = standard deviation.

In terms of surgical procedure, the most common operation was anterior cervical discectomy and fusion (ACDF) involving 49 patients (Table 3). Nineteen patients underwent corpectomy and just one patient underwent corpectomy in addition to ACDF. Two-level fusions were most prevalent at 37 total patients, followed by 25 patients who underwent single-level fusion, and seven patients who had three levels fused. Table 3 displays the breakdown by obesity class.

3.1. Complication rates

Overall, three complications were seen in 69 patients, resulting in a total complication rate of 4.3%. Complications noted were urinary tract infection, wound dehiscence, and neck hematoma. Wound dehiscence and neck hematoma required reoperation. Table 4 displays complications by obesity class. Not surprisingly, the rate of 16.6% in the Class 3 group is high due to the small number of patients. No complications were seen in Class 2 obesity patients.

4. Discussion

The varying definition of a complication has made the assessment of complication rates in patients with surgical intervention problematic and inconsistent [5]. Consequently, this study *a priori* determined a list of complications based on previously reported complications associated with cervical surgery [6,7]. These potential complications were specifically assessed in addition to any other adverse events that occurred.

Overall, complications associated with anterior cervical fusion surgery are relatively few, with reported rates ranging from 3.3% to 19.3%. Boakye et al. evaluated the USA National Inpatient Sample database of 58,115 patients who underwent spinal fusion for cervical spondylotic myelopathy [6]. Overall inpatient complication rate was 13.4%. For the 46,562 patients who underwent anterior cervical fusion surgery, the complication rate was 11.35%, with 0.5% mortality. Dysphagia, pulmonary complications, and hematoma were the three most common adverse events. Older age and three or more comorbidities were among the factors associated with an increased rate of complications. Marawar et al. also utilized a large database, the USA National Hospital Discharge Survey, to evaluate trends in ACDF procedures from 1990 to 2004 [8]. A total of 771,932 patients were identified. Interestingly, complication rates decreased from 4.6% to 3.03% during the time periods evaluated. The most common complications were device-related and gastrointestinal. Of note, delayed complications were not identified in this study of inpatient data, and as a consequence, the 30 day complication rate was likely higher. In a large single-institution study of 1576 patients who underwent ACDF by a single surgeon, the overall complication rate was 8.4% [9]. Dysphagia, dural tear, and hoarseness were the three most common complications noted. In another retrospective study of 1015 patients who underwent ACDF, a 19.3% complication rate was observed [10]. Dysphagia (9%), hematoma (5.6%), and recurrent laryngeal nerve palsy (3.1%) were the most frequent conditions recorded. Lied et al. prospectively evaluated 390 patients who underwent ACDF and found an overall complication rate of 9% [11]. The most common adverse events were anterior graft dislocation (1.8%), neurological deterioration (1.2%), urinary tract infection (1.2%), and hematoma (1.2%). Although these were large studies, the impact of obesity was not specifically investigated.

In a study involving the USA Healthcare Cost and Utilization Project's California State Inpatient Databases (CA-SID), a higher rate of inpatient complications was found in the morbidly obese [12]. Of the 40,109 patients who underwent anterior cervical