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Thirty day postoperative outcomes following anterior lumbar interbody fusion using the national surgical quality improvement program database

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ABSTRACT

Objective: Anterior lumbar interbody fusion (ALIF) is a common procedure used to treat various lumbar degenerative pathologies. The purpose of this study is to describe 30-day postoperative outcomes following ALIF on a national scale.Methods The American College of Surgeons National Surgery Quality Improvement Program (ACS NSQIP) was searched for ALIF patients between 2005 and 2011. The top preoperative diagnoses were determined using ICD-9 codes. All available 30-day complications were grouped as overall composite morbidity and were compared between preoperative diagnosis groups by univariable and multivariable analyses.Results There were a total of 1352 ALIF patients. Overall, 6.73% of patients experienced a postoperative complication. Unplanned reoperations (2.48%), urinary tract infection (1.55%), superficial surgical site infection (1.41%), and sepsis (1.11%) were the most common morbidity events. The morbidity rates for each sub-group were: intervertebral disc degeneration (4.41%), spondylosis (6.72%), lumbosacral spinal stenosis(8.21%), and spondylolisthesis (8.41%). After extensive adjustment for patient characteristics and preoperative morbidities, multivariable analysis revealed spondylolisthesis (OR=3.29; 95% CI:1.04–10.46) and spinal stenosis (OR=3.76; 95% CI:1.33–10.63) to be associated with significantly higher overall morbidity odds when compared with lumbar disc degeneration. Lumbosacral spondylosis was associated with similar outcomes as degenerative disc disease (OR =1.70; 95% CI:0.48–6.06).Conclusions Diverse postoperative complications need to be managed following ALIF. Patients with spondylolisthesis and spinal stenosis may carry increased 30-day postoperative morbidity profiles in ALIF when compared to those with degenerative disc disease. Prospective studies are needed to better delineate the outcomes of ALIF procedures, particularly in the spondylolisthesis and spinal stenosis patient populations.

1. Introduction

Anterior spinal fusion offers a multitude of benefits in the treatment of lumbar degenerative disorders. The extraperitoneal anterior approach allows for excellent spinal exposure and a sizeable operating field. The anterior lumbar interbody fusion (ALIF) was first described by Burns [1] and is currently one of the most common anterior spinal procedures in the lumbar region. While the anterior approach requires manipulation of the abdominal viscera, ALIFs preserve paravertebral muscles, ligaments, spinal cord, and nerve roots [2]. The implanted bone graft provides for a greater angle of lumbar lordosis and thus increased spinal height. The restored anatomy of the spinal column not only corrects the osseous and ligamentous deformities, but also decompresses the spinal neural tissue [3].

Although ALIFs may correct for a degenerative lumbar spine, the invasive procedure leads to substantial postoperative morbidity. Overall complication rates for ALIF procedures range from 13.8

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to 26.6% [2,4–7]. Vascular complications are strongly associated with the anterior approach, as the great vessels lay directly on the ventral aspect of the spine [8]. Additional complications including incisional hernia, wound infection, retrograde ejaculation due to hypogastric nerve plexus disruption, cerebrospinal fluid leak, and nonfusion have been reported [5,9].

While single institution series have described the complications and clinical outcomes of ALIFs well, large, national, diverse databases have not explored ALIF complications and specific prognostic variables that affect morbidity rates and/or surgical outcomes [9]. The purpose of this study is to determine complication rates amongst a national consortium of patients undergoing anterior lumbar interbody fusion procedures using the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database.

2. Methods

2.1. Data source and inclusion criteria

First instituted by the Department of Veterans Affairs in the early 1990s, the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database is a prospective collection of over 1.7 million patients from 250+ hospitals around the world. Now with the participation of the private sector, NSQIP is a nationally validated, risk-adjusted, outcome-based database, which provides perioperative prognostic variables across multiple surgical disciplines [10]. The national database collects 30-day postoperative outcomes for over 250 clinical and operative variables.

All patients undergoing ALIF from 2005 to 2011 were identified using the following American Medical Association Current Procedural Terminology (CPT) codes: 22558 for fusion within one interspace and 22585 for additional interspace fusions.

The primary outcome was overall postoperative morbidity, which was an aggregation of available 30-day complications in the NSQIP database. These complications include wound infection, systemic infection, cardiac, respiratory, renal, neurologic, thromboembolic events, and unplanned returns to the operating room.

2.2. Statistical analysis

Comparisons between groups were made using the chi-squared test for categorical variables and the *t*-test/Wilcoxon rank-sum test for continuous variables, as appropriate. Results were considered significant if the observed *P*-value was less than 0.05.

Adjusted odds ratios were estimated using a multivariable forward stepwise logistic regression model (Table 4) controlling for the following variables: preoperative diagnosis, age, sex, body mass index (BMI), smoking status, operation year, inpatient status, wound classification, previous cardiovascular morbidity, previous neurological morbidity, diabetic status, alcohol consumption >2 drinks/day in 2 weeks before admission, steroid use for chronic condition, length of operation, and history of previous operation within 30 days of the surgery. American Society of Anesthesiologists classification, composite hepatobiliary morbidity, previous wound infection, and type of anesthetic method variables were not included in multivariable analysis due to high collinearity with other characteristics. All morbidity events were included for analysis regardless of etiology.

All statistical analyses were done using STATA/SE 12. In accordance with Johns Hopkins guidelines (which follow the US Code of Federal Regulations for the Protection of Human Subjects), institutional review board approval was not needed or sought for the present study as only de-identified data was received.

3. Results

We identified 1352 patients who underwent anterior lumbar interbody fusion (ALIF) in the ACS-NSQIP database. Of this population, 1236 (91.4%) patients had a single level ALIF and 116 (8.6%) patients had multiple level ALIF. Females were slightly more common at 56.1%, and the mean age was 52.2 years. Characteristics of the total ALIF population are presented in Table 1.

The four most common preoperative diagnoses were degeneration of lumbar or lumbosacral intervertebral disc ($n = 454$, 33.58%), lumbosacral spondylosis without myelopathy ($n = 134$, 9.91%), lumbar spinal stenosis without neurogenic claudication ($n = 134$, 9.91%), and spondylolisthesis ($n = 107$, 7.91%). The preoperative characteristics for these diagnostic cohorts can be found in Table 2.

Postoperative complications of all ALIF patients are displayed in Table 3. Of 1352 patients, 91 patients (6.73%) experienced at least one morbidity event. The morbidity with the highest rate was unplanned returns to the operating room at 2.48%. Urinary tract infection, superficial surgical site infection (SSI), and sepsis also had high rates at 1.55%, 1.41%, and 1.11% respectively. Other surgical site infection complications included deep incisional SSI (0.59%), organ space SSI (0.22%), and wound dehiscence (0.37%). Pulmonary events included pneumonia (0.96%), unplanned intubation (0.30%), pulmonary embolism (0.59%), and failure to wean ventilatory support within 48 h of surgery (0.07%). Renal complications were progressive renal insufficiency seen in 0.15% and acute renal failure in 0.22%. There were no neurological morbidity events(e.g. stroke with neurological deficit or coma >24 h). Cardiovascular events included cardiac arrest requiring cardiopulmonary resuscitation (0.37%), myocardial infarction (0.37%), and deep venous thrombosis/thrombophlebitis requiring treatment (0.67%). Cage graft failure only occurred in 1 patient (0.07%). Finally, septic shock occurred in 0.22% of patients.

Postoperative complications were compared among the four diagnostic cohorts. Overall 30-day postoperative morbidity rates were 4.41% with degeneration of lumbar or lumbosacral intervertebral discs, 6.72% with lumbosacral spondylosis without myelopathy, 8.21% with lumbar spinal stenosis without neurogenic claudication, and 8.41% with spondylolisthesis ($p < 0.001$). Detailed information regarding complications in the diagnostic subsets analyzed are presented in Table 3.

Following univariable regression analyses, patients with lumbosacral spondylosis (Odds Ratio [OR] = 1.56, 95% Confidence Interval [CI]:0.69–3.52), lumbar spinal stenosis (OR = 1.94, 95% CI:0.91–4.16) and spondylolisthesis (OR = 1.99, 95% CI:0.88–4.51) were not associated with a statistically significant difference in the rate of overall 30-day morbidity relative to patients with degenerative disc disease. Using multivariable regression with adjustment for clinically relevant confounders, spinal stenosis (OR = 3.76; 95% CI:1.33–10.63) and spondylolisthesis (OR = 3.29; 95% CI:1.04–10.46) were associated with a statistically significant increased in the odds of postoperative morbidity. Overall morbidity was similar in patients with lumbosacral spondylosis without myelopathy relative to those with degenerative disc disease (OR = 1.70; 95% CI:0.48–6.06) [Table 4].

The incidence of vascular complications was investigated. Two patients had a recorded abdominal aortic injury (0.15%). The preoperative diagnosis for these 2 patients is unlisted within the database.

4. Discussion

The most common postoperative complications encountered following ALIF included unplanned reoperations, urinary tract