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Case study

Preoperative functional status as a predictor of short-term outcome in adult spinal deformity surgery ☆

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ABSTRACT

Adult spinal deformity (ASD) may cause severe disability and difficulty with daily activities. The purpose of this study was to investigate the impact of preoperative functional status on 30-day major complication occurrence in ASD surgery. A review of the prospectively-collected American College of Surgeons National Surgical Quality Improvement database was performed for the years 2007–2013. Inclusion criteria were adult patients (over 21 years of age) who underwent spinal fusion for ASD. Functional status was defined as "independent" or "dependent" (requiring assistance from another person) for activities of daily living such as bathing, dressing, feeding, toileting, or mobility. The association between functional status and complications (overall and major) was investigated via multivariate analysis. Results are presented as odds ratios (OR) with 95% confidence intervals (CI). A total of 1247 patients met inclusion criteria (94.4% independent and 5.6% dependent patients). The overall 30-day complication rate was 16.0% (15.6% for independent patients and 22.9% for dependent patients, $p = 0.10$); major complications occurred in 9.2% of independent patients and 17.1% for dependent patients ($p = 0.02$). After controlling for patient age, smoking status, preoperative hematocrit, revision status, use of osteotomy, number of levels fused, and operative time, being dependent on another person for activities of daily living was found to be a significant predictor of major complication development (OR 2.09; 95% CI, 1.04–4.20; $p = 0.03$). Depending on others for activities of daily living before undergoing ASD surgery may predict the development of major perioperative complications, increasing the risk by 2-fold compared to independent patients.

1. Introduction

Corrective surgery for adult spinal deformity (ASD) has shown superior outcomes in terms of pain and disability when compared to non-operative treatment in multiple studies [1–4]. Nonetheless, a subset of patients unfortunately do not achieve good long-term outcomes, with studies suggesting that depression/anxiety, preoperative narcotic usage, smoking, older age, obesity, and severe preoperative pain, among others, are risk factors for poor results [5]. Furthermore, operative treatment of ASD carries the risk of perioperative adverse events such as implant-related complications, cardiopulmonary complications, neurological complications, and wound infection, among others [6].

One of the manifestations of ASD is impairment in activities of daily living such as eating, toileting, and mobility, most often secondary to severe pain [7]. Some of the tools for measuring disability in spine surgery patients include the Oswestry Disability Index (ODI), Scoliosis Research Society-22 (SRS-22) instrument, and Short-Form 36 (SF-36) [8,9], and it has been suggested that baseline scores are important predictors of long-term outcome [4].

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However, there is a paucity of literature regarding the impact of preoperative functional status/disability on short-term outcome, specifically on perioperative complications after ASD surgery.

Recently, frailty has been shown to be strongly associated with major complication rates in general surgery, and preliminary results suggest a similar association following spine surgery [10]. The purpose of this study was to investigate if preoperative dependency, as a single variable, may predict short-term outcomes in ASD surgery, particularly the development of major 30-day complications.

2. Methods

2.1. Data source and participants

This is a cohort study that utilized the American College of Surgeons National Quality Improvement Program (ACS-NSQIP) databases from 2007 to 2013. ACS-NSQIP is a prospectively-collected surgical database that contains data on preoperative risk factors, intraoperative variables, and 30-day outcomes for patients undergoing major surgery (mostly general surgery). Participating hospitals have a trained "Surgical Clinical Reviewer" that captures data via medical chart reviews, phone calls, and letters. Currently, there is a 95% success rate in data capture and over 95% inter-rater reliability in all variables [11]. Given that the database contains only de-identified information, this study was exempt from review by the local institutional review board.

Inclusion criteria were adult patients over 21 years of age who underwent spinal fixation for ASD. ASD was identified via the following International Classification of Disease 9th Edition codes: acquired postural kyphosis (737.10), postlaminectomy kyphosis (737.12), other acquired kyphosis (737.19), idiopathic kyphoscoliosis (737.30), thoracogenic scoliosis (737.34), and other kyphoscoliosis (737.39). The initial search yielded 1674 patients. Patients that did not undergo spinal fusion procedures were excluded ($n = 307$), and so were patients younger than 21 years of age ($n = 91$), patients without data on functional status ($n = 8$), patients with a diagnosis of disseminated cancer ($n = 3$), preoperative sepsis ($n = 3$), quadriplegia ($n = 2$), preoperative ventilator dependency ($n = 6$), and with history of cerebrovascular accident with neurological deficit ($n = 7$). The final analytic sample consisted of 1247 patients.

2.2. Collected data and definition of functional status

Recorded data for each patient included age at surgery, sex, body mass index (BMI), comorbidities, preoperative albumin level, preoperative hematocrit, smoking status, revision status (revision/exploration of previous spinal fusion only), use of osteotomy, number of instrumented levels, operative time, length of stay, use of blood transfusion, and functional status.

Functional status prior to surgery (as defined by ACS-NSQIP) focuses on a patient's ability to perform activities of daily living in the 30 days prior to surgery. These activities include bathing, feeding, dressing, toileting, and mobility (https://www.facs.org/~/media/files/quality%20programs/nsqip/acs_nsqip_puf_user_guide_2013.ashx). The level of functional status is defined as follows:

(1) Independent: Patient does not require assistance from another person for any activities. Patient may require prosthetics, equipment, or devices but is independent.
(2) Dependent: The patient requires some degree of assistance or total assistance from another person for any activities of daily living.

2.3. Outcome measures

The primary outcome measure was development of at least one major complication in the 30-day follow-up period. Major complications included 30-day mortality, intraoperative occurrence (cardiac arrest or myocardial infarction), mechanical implant failure requiring reoperation, postoperative coma, unplanned intubation, stroke, pulmonary embolism, cardiac arrest, myocardial infarction, acute renal failure, sepsis, septic shock, deep/organ-space surgical site infection, and ventilator dependence for over 48 h. Secondary outcome measures included development of any complication, length of stay, unplanned return to the operating room, and discharge disposition (home, rehab, acute care facility, or skilled care facility). Other complications (not major) examined included wound dehiscence, superficial wound infection, pneumonia, urinary tract infection, progressive renal insufficiency, and deep vein thrombosis.

2.4. Statistical analysis

Baseline and operative parameters were compared between the two functional groups – independent and dependent patients. This was done via two-tailed student's *t*-test with unequal variance for continuous variables and via chi-squared test for frequencies. Parameters with a *p*-value less than 0.200 on univariate analysis were included in a multivariate model to assess the independent effect of functional status on major complication development. Results of the multivariate logistic regression analysis are presented as odds ratios (OR) with 95% confidence intervals (CI). The alpha level was set at 0.05, and all analyses were done in Stata SE 12 (StataCorp LP, College Station, Texas).

3. Results

3.1. General patient characteristics

There were 1247 patients from the ACS-NSQIP database who met inclusion criteria and were included in this study. Stratified by functional status, 94.4% of patients were independent ($n = 1,177$) and 5.6% were dependent ($n = 70$) for activities of daily living. Baseline and operative characteristics of patients are summarized and compared in Table 1. Age at surgery was similar between groups, with an average age of 61.1 ± 13.9 years for independent patients and 57.9 ± 17.4 years for dependent patients ($p = 0.14$); the proportion of males in each group was also not significantly different ($p = 0.22$). Average BMI was 28.3 ± 6.1 kg/m^2 for independent patients and 27.4 ± 7.1 kg/m^2 for dependent patients ($p = 0.28$). The proportion of patients with specific comorbidities such as diabetes ($p = 0.92$), congestive heart failure ($p = 0.59$), and chronic steroid use ($p = 0.21$) was not different between groups. Similarly, there were no differences in preoperative diagnoses ($p = 0.29$). The percentage of patients who were current smokers in the independent group was 17.2% versus 2.9% in the dependent group ($p = 0.002$). The mean preoperative albumin level was 4.0 ± 0.5 g/dL for independent patients and 3.9 ± 0.7 g/dL for dependent patients ($p = 0.37$). Lastly, the average preoperative hematocrit was 38.6 ± 4.8% for independent patients and 36.5 ± 6.6% for dependent patients ($p = 0.02$).

Operative parameters are summarized in Table 2. The proportion of patients who underwent a revision procedure (8.1% of independent patients and 11.3% of dependent patients, $p = 0.32$) or osteotomy (27.8% of independent patients and 27.1% of dependent patients, $p = 0.90$) was not significantly different between functional groups. Likewise, the proportion of patients who underwent 3-column osteotomy was similar between groups (6.1% vs. 5.7%,