Complications, Results, and Risk Factors of Spinal Fusion in Patients With Myelomeningocele

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Abstract

Study Design: Retrospective prognostic study.

Objective: The purpose of this study assess was to assess the results of spinal fusion and identify factors associated with the development of post–spinal fusion infections in patients with myelomeningocele.

Background: Surgical correction of neuromuscular scoliosis secondary to myelomeningocele is known to be associated with a high complication rate.

Methods: A retrospective cohort study design was used to collect data on patients with myelomeningocele who underwent spinal fusion between the years of 1997–2013. Only subjects with a minimum of two years of continuous follow-up were included in the study. Demographic, surgical, clinical, and radiographic variables of interest were collected. Univariate and multivariable logistic regression analyses were used to identify factors predictive of an infection. Linear mixed model regression analyses were used to analyze postsurgical changes in radiographic parameters.

Results: Of the 33 subjects included in the study, 33.3% developed a postoperative infection. Overall, 69.0% of patients achieved a >50% correction of primary curvature at the one-month time point. Of the measured variables, lumbar and thoracolumbar kyphosis (odds ratio: 10.9, 95% confidence interval [CI]: 1.2-158.3, $p = .0465$) and a low preoperative hematocrit odds ratio per 1% increase, 0.7 (95% CI: 0.5-0.9, $p = .0145$) were associated with developing a postoperative infection. There was a significant improvement in the proportion of subjects with a pelvic obliquity measurement <5° one month postsurgery ($p = .0339$), kyphosis ($p = .0401$), and Cobb angle of the primary curvature across all time points ($p < .0001$).

Conclusion: Type of procedure, neurosegmental level, transfusion rates, age at surgery, gender, length of operation, preoperative urinary tract infection, estimated blood loss, and the number of levels fused were not modifiable risk factors for future complications for patients with scoliosis secondary to myelomeningocele, whereas lumbar and thoracolumbar kyphosis or low hematocrit levels may lead to an increased risk for developing a postspinal fusion infection.

Level of Evidence: Level II.

Key words: Myelomeningocele; Spinal fusion; Complications; Pediatric

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Introduction

Surgical correction of scoliosis among patients with neuromuscular conditions is associated with a high complication rate [1-4]. The incidence of complications following spinal fusion in patients with myelomeningocele has been reported to be as high as 74% [5]. Complications include pseudoarthrosis, limited correction, pulmonary complications, neurologic complications, instrumentation failure, and deep infection [1,2,4]. Of the many complications, postoperative infections are one of the primary

concerns because of the potential for multiple subsequent operations, increased hospitalizations and cost, and even death [2,4]. In a meta-analysis of complications following neuromuscular scoliosis surgery, Sharma et al. [4] reported the weighted infection rate among patients with myelomeningocele was 186% higher than the overall infection rate among all neuromuscular diagnoses.

The increased risk of postoperative infections in patients with neuromuscular conditions has been attributed to numerous factors including poor hygiene, soiling of the wound, use of allograft bone, level of cognitive impairment, and/or a weakened immune system [1,3]. Based on the increased risk of infection, the necessity of surgical correction of scoliosis or kyphosis among patients with myelomeningocele has been called into question [6]. Despite these risks, observations of decreased quality of life with increasing scoliosis severity [7], improved pulmonary function following surgery [8,9], and improvements in sitting and skin problems following surgery [10] support surgical intervention for the correction of spine deformities in patients with myelomeningocele.

Considering the potential benefits and harms of surgical intervention, there is a strong need to identify modifiable risk factors predictive of postoperative infections. The purpose of this study was to determine the incidence of complications following spine fusion in patients with myelomeningocele and to identify factors that may contribute to the development of postoperative infections.

Materials and Methods

Following IRB approval, the medical records of patients with myelomeningocele who underwent spinal fusion with instrumentation at our institution between 1997 and 2013 were retrospectively reviewed. Only patients younger than 18 years at the time of surgery and with two years of continuous follow-up were included in the cohort. Among patients who underwent both limited and definitive spinal fusion surgery, only information related to the final, definitive surgery was used in the statistical analysis. Patients were determined to have pink, warm, well-perfused skin with no rashes, sores, open wounds, or skin breakdown prior to surgery. All spine fusions were performed by a single surgeon (GG).

After 1999, our institution implemented a high-risk spine pathway perioperative protocol [11]. This involved a preoperative sleep study, nutritional assessment, and pulmonary, physical therapy, and cardiology evaluations. Patients also went through discharge planning to ensure they had all the appropriate equipment at home prior to discharge.

Demographic and clinical variables collected include gender, age at surgery, ambulatory status, preoperative hematocrit levels, number of levels fused, estimated blood loss (expressed as milliliters and percentage estimated blood volume [%EBV]), number of intraoperative transfusion units, neurosurgical region (thoracic, upper lumbar,

mid lumbar, or lower lumbar), primary curve type (kyphosis, lumbar scoliosis, or thoracolumbar scoliosis), surgical approach (anterior, posterior, combined), presence of a urinary tract infection (positive preoperative urine culture). Coronal and sagittal plane Cobb angles were measured preoperatively, one month postsurgery, and at final follow-up. Pelvic obliquity was measured by a single researcher (BO) and defined as the angle of the pelvis with respect to the horizontal. Complication occurrence was the primary outcome variable of interest. Most postoperative complications included wound infections or prominent, painful instrumentation. A wound infection was defined as wound breakdown with purulence, wound dehiscence, or a positive wound culture. A major complication was defined as the development of a complication that resulted in a return to the operating room and/or an additional hospital admission. Information about the management of all complications was also collected.

Statistical Methods

Descriptive statistics were used to summarize the demographics and clinical characteristics of all subjects. Incidence rates and corresponding 95% confidence intervals were estimated for the following events: infection, major complication, $>50\%$ correction in Cobb angle, and $<5°$ of pelvic obliquity. Univariate logistic regression analyses were used to identify factors predictive of a major complication as well as factors predictive of an infection. The following variables were considered as potential risk factors: preoperative hematocrit levels, presence of a preoperative urinary tract infection ($>100,000$ colonies per cubic meter) [8], gender, number of levels fused, need for a blood transfusion, procedure type, operative time, estimated blood loss (in milliliters and %EBV), number of intraoperative transfusion units, and primary curve type.

Among patients who underwent separate anterior and posterior staged procedures, the lesser of the two hematocrit level measurements was used in the analysis. A backwards selection strategy was used to eliminate all nonsignificant variables. Only variables that were significant and the 0.05 alpha level were included in the final models. A linear mixed model regression analysis was used to analyze changes in pelvic obliquity, kyphosis, and the Cobb angle of the primary curvature preoperatively, one month postsurgery, and at final follow-up. The unstructured covariance structure was used to model the repeated measures. McNemar's test was also used to compare the proportion of subjects with a pelvic obliquity measurement $<5°$ presurgery versus one month postsurgery, as well as presurgery versus final follow-up.

Results

A total of 33 subjects were included in the analysis (Table 1). The majority of subjects, n = 26 (78.8%), were