Interdisciplinary Optimization Clinic Decreases Infection in Neuromuscular/Syndromic Scoliosis Patients

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Abstract: Spinal surgery in pediatric neuromuscular and syndromic (NMS) patients is associated with numerous perioperative adverse events, unplanned reoperations, and suboptimal outcomes. This quality initiative (QI) focused on the development of a patient-centered interdisciplinary medical optimization clinic and implementation of a standardized care pathway for NMS spinal fusion patients.

In 2017, an interdisciplinary committee was formed with the purpose of creating a patient-centered medical optimization clinic (NSP) for surgical patients with neuromuscular and syndromic scoliosis. The aims of the initiative were to 1) measure compliance to the implemented NSP clinical pathway, 2) create a mobile App to coordinate care 3) to reduce infections (SSI) in NMS spinal fusion patients to a target goal of zero.

Over two years, 160 NMS patients underwent spinal fusion. Twenty-nine (18%) of those were medically optimized in the NSP clinic. The average age was 12.8 years, preop cobb angle was 85.4 degrees, the preoperative kyphosis was 76.1 degrees, and the average preoperative BMI was 17.4. The average preoperative SSI RSS was calculated to be 19.69%. None of the 29 NSP patients developed an SSI, whereas 6.9% of the remaining 131 NMS scoliosis fusion patients that were not evaluated in the NSP clinic developed an SSI. ($p = 0.015$)

In summary, the NSP clinic cohort had a 20% predicted risk of developing a HAI SSI, and the actual rate was 0%. In contrast, 6.9% of the NMS scoliosis fusion patients that were not evaluated in the NSP clinic developed an SSI. As a result of this QI study, **ALL** NMS spinal fusion patients at our institution are medically optimized through the NSP clinic.

Introduction

Surgical site infection (SSI) is a well-studied postoperative complication for pediatric patients undergoing spinal fusion. Neuromuscular and syndromic scoliosis (NMS) patients have high complication rates and greater risk of infection after surgical correction of their deformity.[1,2,3,4] SSIs are hospital-acquired infections (HAIs), they contribute to substantial morbidity, and represent a common cause of unplanned reoperation.[5,6]

Preoperative infection prevention strategies implemented in recent years have been shown to improve surgical outcomes and reduce costs after spine surgery.[7,8] Over a 30-year period (1980-2009), the overall infection rate after posterior spinal fusion in children with neuromuscular scoliosis was 10.3% at our institution.[10] A report from the Scoliosis Research Society (SRS) Morbidity and Mortality database demonstrated a decrease in NMS SSI rates in recent years.[9] Similarly,

over a 3-year period (2015-2017), our institution's NMS spinal fusion SSI rate dropped to 7/175 (4.0%) with the establishment of a standardized preoperative and intraoperative infection prevention bundle. This bundle included: daily CHG baths for 3 days prior to the operative date, intraoperative CHG for sterile site prep, weight-based pre-incisional IV antibiotic piperacillin-tazobactam (Zosyn), re-dosing of Zosyn every 6 hours during the case, continuing IV Zosyn every 8 hours postoperatively (x 48 hours), antibiotic addition to the bone graft (vancomycin, gentamycin/tobramycin), drain placement, layered closure, non-dissolvable sutures in the superficial layer, and placement of an incisional wound vacuum closure dressing. We were pleased with the decreased SSI rate, but our target goal for SSI in NMS spinal fusion patients was 0%. To further our journey towards the target of "zero" SSI, this quality initiative (QI) focused on the development of a patient-centered interdisciplinary medical optimization clinic and implementation of a standardized care pathway for NMS spinal fusion patients. The aims of the initiative were to 1) develop and implement a standardized preoperative medical optimization clinic (Neuromuscular and Syndromic Spine Pathway (NSP)), 2) measure compliance to the implemented NSP clinical pathway by creating standardized order sets in the electronic medical record (EMR) (EPIC), and 3) create a free patient mobile App to address the following:

1. Coordination of necessary preoperative appointments/consults
2. Pre and postoperative education (video links, hospital tour, provider contact information)
3. Reduced HAI SSI in NMS spinal fusion patients with a target goal of zero

Methods

In late 2017, an interdisciplinary committee was formed with the purpose of creating a patient-centered medical optimization clinic for NMS scoliosis patients scheduled to undergo spinal fusion surgery. A standardized clinic pathway was created in the electronic medical record (EMR) (EPIC) and titled the Neuromuscular and Syndromic Spine Pathway (NSP) clinic. A "pilot" group of patients had standardized pre-surgical assessment that included: baseline nutritional labs, pulmonary function tests and 6-minute walk test (if possible), sleep studies to assess overnight apnea, swallow studies to assess aspiration risk, sitting or standing P/A and lateral spine x-rays, manipulative films (bolster, traction, or bending) to determine curve flexibility. In addition, we included evaluation by pulmonology, respiratory therapy, anesthesiology, dietary/nutrition, child psychology, developmental pediatricians, neurology, physical and occupational therapy, and child life. Based on this assessment, interventions were performed to reduce complications preoperatively (ex: initiation of CPAP/BIPAP to treat apnea, G/J tube placement with elimination of oral intake for high aspiration risk, nutritional optimization). The committee retrospectively reviewed the prospectively collected data for all NMS spine infections from Jan 1, 2018 to Dec 31, 2019. All infections were reviewed using Root Cause Analysis (RCA) methodology. Infection rates were calculated using rolling 6-month averages. The NSP patient's SSI risk was calculated using the Risk Severity Scale (RSS) preoperatively.[16] This was compared to the actual HAI SSI rate to determine if the SSI risk could be positively modified through preoperative medical optimization. Statistical analysis was performed to compare the control (calculated RSS SSI rate) and (2018-2019) NSP intervention group using a one-tailed T test. Significance was defined as $p < 0.05$. The HAI SSI rate in the 2018-2019 NSP cohort was also compared to 2018-2019 NMS scoliosis fusion patients that were "not cleared" (NC) through the NSP clinic. IRB approval was not necessary for this QI.

Results

We identified 160 patients with neuromuscular and syndromic scoliosis who underwent spinal fusion at our

institution from Jan 1, 2018 through Dec 31, 2019. Twenty-nine (18%) of those NMS patients were seen and cleared through the NSP clinic. There were 13 male and 16 female patients. The average age was 12.8 years, the average preoperative cobb angle was 85.4 degrees, the average preoperative kyphosis was 76.1 degrees, and the average preoperative BMI was 17.4. The average preoperative SSI RSS was calculated to be 19.69%. None of the NSP patients developed a SSI. In comparison, 9/131 (6.9%) of the NMS scoliosis fusion patients that were "not cleared" (NC) through the NSP clinic developed a HAI SSI. ($p = 0.015$)

Discussion

Our project focused on a patient-centered interdisciplinary preoperative medical evaluation. In one clinic visit, the patient was evaluated by pulmonology, respiratory therapy, anesthesiology, dietary/nutrition, child psychology, developmental pediatricians, neurology, physical and occupational therapy, and child life. Following these evaluations, a care huddle was conducted, and a nurse (RN) coordinator created an individualized medical optimization plan for each patient. Based on the recommendations from the care huddle, interventions were performed to reduce complications preoperatively (ex: initiation of CPAP/BIPAP to treat apnea, G/J tube placement with elimination of oral intake for high aspiration risk, nutritional optimization).

A consistent best practice guideline for SSI prevention in high-risk pediatric spine surgery does not recommend preoperative medical optimization. This is likely due to the conflicting literature that surrounds this topic. Berry et al. demonstrated that multiple preoperative primary care visits were associated with lower hospital costs and shorter hospitalizations in medically complex patients with that underwent spinal fusion surgery,[15] but they did not comment on the preoperative care and its relationship to the development of an SSI. A recent paper by Glotzbecker et al. focused on pediatric neuromuscular and syndromic scoliosis patients that underwent spinal fusion.[14] As part of a multidisciplinary clinical pathway all patients were discussed at a monthly "high risk case conference." The authors demonstrated a significant decrease in SSI in this high-risk group. However, due to the multiple changes that were implemented simultaneously, it was impossible for the authors to attribute the drop in SSI to any specific factor.

Our project is unique because it prospectively evaluated the benefit of a patient-centered interdisciplinary medical optimization clinic. Unlike the Glotzbecker study where multiple changes were made concurrently, these initiatives were initiated sequentially. The Berry study only evaluated the effect of preoperative primary care visits on NMS spinal fusion outcomes.[15]

We calculated the preoperative Risk Severity Score (RSS)[16] for SSI in this high-risk patient population and compare it to the actual 90-day SSI rate. The average preoperative SSI RSS was calculated to be 19.69%. 0/29 (0%) NSP patients developed a SSI. ($p = 0.015$) Also, 9/131 (6.9%) NMS scoliosis fusion patients that were NC through the NSP clinic developed a HAI SSI.

In summary, surgical site infections (SSI) that occur within 90 days of spinal fusion surgery in pediatric patients with underlying neuromuscular and syndromic (NMS) conditions are considered hospital acquired infections (HAI) and lead to high morbidity and cost. Interdisciplinary patient-centered preoperative medical optimization modified the SSI risk in this group of NMS scoliosis patients. This cohort had a 20% predicted risk of developing a HAI SSI, and actual rate was 0%. As a result of this QI, ALL NMS spinal fusion patients at our institution are medically optimized through the NSP clinic.

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