Spine Deformity
www.spine-deformity.org

Spine Deformity 4 (2016) 288–295

A Rapid Recovery Pathway for Adolescent Idiopathic Scoliosis That Improves Pain Control and Reduces Time to Inpatient Recovery After Posterior Spinal Fusion

Alex L. Gornitzky, BS[a], John M. Flynn, MD[a,*], Wallis T. Muhly, MD[b], Wudbhav N. Sankar, MD[a]

[a]*Division of Orthopaedic Surgery, The Children's Hospital of Philadelphia, 34th Street and Civic Center Boulevard, Philadelphia, PA, 19104, USA*
[b]*Department of Anesthesiology and Critical Care Medicine, The Children's Hospital of Philadelphia, 34th Street and Civic Center Boulevard, Philadelphia, PA, 19104, USA*

Received 24 July 2015; revised 5 January 2016; accepted 9 January 2016

Abstract

Study Design: Retrospective comparative cohort.
Objectives: To determine if a standardized multimodal analgesic and rehabilitation protocol (rapid recovery pathway [RRP]) in adolescent idiopathic scoliosis (AIS) patients undergoing posterior spinal fusion (PSF) could improve pain control, reduce opioid-related complications, and expedite early mobilization.
Background: Several reports have described postoperative recovery pathways for AIS patients undergoing PSF that shorten length of stay (LOS) without reporting the impact such pathways might have on patients' pain or quality of recovery.
Methods: We compared two high-volume surgeons' patients managed on our conventional pathway (CP) or our RRP. The CP analgesia consisted of intraoperative methadone and postoperative patient-controlled analgesia (PCA) until tolerating oral analgesics, with adjunctive diazepam. Analgesia on the RRP includes intraoperative methadone and postoperative PCA; patients also receive preoperative gabapentin and acetaminophen, intraoperative intravenous acetaminophen, and postoperative diazepam, gabapentin, acetaminophen, and ketorolac. Ambulation and full diet are permitted beginning postoperative day 1. The primary outcome was mean daily pain scores. Secondary outcomes were LOS, time to pathway milestone completions, and frequency of opioid-related side effects requiring treatment.
Results: There were 58 patients in the RRP group and 80 patients in the CP group. Patients on RRP had improved mean daily pain scores on postoperative days 0 ($p = .027$), 1 ($p < .001$) and 2 ($p = .004$). RRP patients were discharged home 31% earlier, discontinued from PCA 34% earlier and had their urinary catheters removed 26% earlier. Total opioid consumption decreased on postoperative day 0 ($p < .001$), but not postoperative day 1 ($p = .773$) or 2 ($p = .343$). Fewer patients on the RRP required medication for opioid-induced pruritus ($p = .001$), but there was no difference in the frequency of odansetron administration ($p = .566$). There were no differences in 30-day rates of readmission ($p = .407$).
Conclusion: Implementation of standardized RRP resulted in reduced pain, faster mobilization, reduced frequency of opioid-related side-effects, and earlier discharge.

Keywords: Orthopedic surgery; Scoliosis; Posterior spinal fusion; Analgesia; Postoperative recovery

Introduction

Adolescent idiopathic scoliosis (AIS) affects approximately 3% of children and is the most common pediatric spinal disorder in North America, with more than 5,000 AIS spinal fusions performed in 2011 [1,2]. At its inception, spinal fusion often required a prolonged hospitalization of up to 3 weeks [3]. More recently, mean length of hospitalization has been approximately 5–6 days [2,4-7].

Author disclosures: ALG (none), JMF (personal fees from Biomet, outside the submitted work), WTM (none), WNS (none).

*Corresponding author. Division of Orthopaedic Surgery, The Children's Hospital of Philadelphia, 34th Street and Civic Center Boulevard, Philadelphia, PA, 19104, USA. Tel.: (215) 590-1527; fax: (215) 590-1527.
E-mail address: flynnj@email.chop.edu (J.M. Flynn).

2212-134X/$ - see front matter © 2016 Scoliosis Research Society.
http://dx.doi.org/10.1016/j.jspd.2016.01.001

Historically, major challenges in postoperative care after posterior spinal fusion (PSF) for AIS have included adequate pain control, effective management of opioid-related side effects, and delayed mobilization [8]. Other barriers to patient discharge may include adverse in-hospital outcomes such as postoperative hemorrhage, infection, or procedure-related complications, with overall complication rates averaging approximately 9% to 15% [5-7,9].

Recent work across the medical and orthopedic literature has focused on value-based health care delivery. Driven primarily by implant expense, followed by length of stay (LOS), the mean cost of AIS spinal fusions has more than doubled since 2001 to more than $150,000 in 2011 [2,10]. Fletcher [11,12] described an accelerated discharge pathway for AIS patients that expedited mobilization and resulted in early discharge. However, the authors did not document pain control or other patient-reported outcomes. Recently, the use of multimodal pain management strategies has been shown to reduce opioid consumption and time to mobilization, but not length of stay, after multi-level spinal fusion in adults [13]. To our knowledge, no group has reported on the use of a comprehensive multimodal analgesic protocol for postoperative management of pediatric spinal fusion patients. In the setting of a large, hospital-wide quality-improvement initiative studying the implementation of a standardized rapid recovery pathway (RRP) for all AIS patients undergoing PSF at our institution, the aim of this study was to perform a rigorous comparison between a population of pre- and post-pathway patients managed by two high-volume surgeons with a focus on both value-based outcomes such as length of stay and quality-based, patient-oriented outcomes, including patient-reported pain and opioid-induced side effects.

Methods

This was a non-matched retrospective comparative study at a regional, tertiary-care pediatric hospital comparing two high-volume pediatric spinal surgeons (JMF and WNS) pre- and [...] postimplementation of the RRP. Our institutional review board approved this study. Potential cases were ascertained using a quality improvement tracking tool (Qlikview, Radnor, PA) that utilized diagnosis and procedure codes to identify a convenience sample of all otherwise healthy adolescent patients undergoing PSF for AIS. Cases were then cross-checked against surgeon case logs to ensure complete identification of all eligible patients. Exclusion criteria were neuromuscular, congenital, or otherwise nonidiopathic scoliosis, anterior spinal fusion, or any intraoperative complication, including hemorrhage, coagulopathy, or loss of motor signals, that required a postoperative intensive care monitoring period for greater than 24 hours.

In all, 58 consecutive patients treated surgically from March 2014 through January 2015 on the RRP were compared to 80 consecutive historical controls treated on the Conventional Pathway (CP) between January 2012 and August 2013. A 6-month washout period was utilized to account for the time period during pathway development, informal testing, and optimization. Given the continually evolving nature of surgical techniques and implant usage [2], as well as the current emphasis on value-based care that has led to a decline in mean lengths of hospitalization nationwide [6], a more recent historical control was emphasized in order to minimize any potential influences introduced by these non−pathway-related factors. Additionally, these two surgeons have similar intraoperative techniques and shared nurse practitioners coordinating care, which minimized any potential disparities in RRP implementation due to intra-surgeon differences, inconsistent patient instructions, or variations in pre- or postoperative care.

Conventional pathway

Prior to development of the RRP, pain management on the CP consisted of intraoperative methadone and postoperative intravenous morphine or hydromorphone patient-controlled analgesia (PCA). Patients were transitioned to oral medication (oxycodone and acetaminophen) as tolerated, beginning around postoperative day (POD) 3 to 4, and supplemented throughout with diazepam, as needed, for muscle spasm. Additionally, patients were prescribed bed rest with limited movement for the first 24 hours, after which physical therapy (PT) and dietary advancement were initiated beginning on POD 2. Discharge criteria included physical therapy clearance, ability to tolerate oral nutrition, adequate pain control on oral analgesics, and no medical problems (fever, ileus, etc). Patients were discharged home with oral oxycodone and acetaminophen (every 4 hours as needed), oral diazepam (every 6 hours as needed), and a bowel regimen for use while taking narcotics.

Rapid recovery pathway

Predicated on a novel multimodal analgesic platform and accelerated physical activity, the RRP includes preoperative gabapentin and acetaminophen, intraoperative intravenous (IV) methadone and acetaminophen, and postoperative hydromorphone PCA and diazepam supplemented with 3 additional doses of IV acetaminophen, gabapentin, and ketorolac initiation on POD 1. Ambulation and full diet were permitted beginning POD 1, and accelerated PT goals included early log-rolling the day of surgery, three times a day out of bed to chair, and walking the halls by POD 1. A formalized clinical pathway for the entire treatment team (nursing, physical therapy, acute pain service, orthopedics, etc) was implemented in order to standardize care and ensure consistent treatment. Discharge criteria was similar to the CP. Consistent with a previously reported pathway [11], a bowel movement was not a prerequisite for discharge, and any drains in place at discharge were subsequently removed in clinic. Patients were