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Adjunctive Pain Control Methods Lower Narcotic Use and Pain Scores for Patients With Adolescent Idiopathic Scoliosis Undergoing Posterior Spinal Fusion

M. Wade Shrader, MD*, Sean J. Nabar, MD, John S. Jones, MD, Miranda Falk, PA-C, Richard Cotugno, MHSM, Greg R. White, MD, Lee S. Segal, MD

Division of Pediatric Orthopaedic Surgery, Phoenix Children's Hospital, 1919 East Thomas Road, Phoenix, AZ 85016, USA

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Abstract

Study Design: This was a retrospective review of patients with adolescent idiopathic scoliosis (AIS) undergoing posterior spinal fusion (PSF).

Objectives: To determine whether the use of adjunctive pain medications (bupivacaine pump, dexmedetomidine, and ketorolac) will reduce the need for opioids, reduce postoperative pain, and shorten length of hospital stay in patients with AIS undergoing PSF.

Summary of Background Data: Posterior spinal fusion and instrumentation for AIS can cause significant postoperative pain. Adjunctive pain control modalities, including the use of ketorolac, dexmedetomidine, and subcutaneous bupivacaine pumps, all can lessen the effects of postoperative pain.

Methods: Retrospective review of adolescents aged 10–18 years with AIS receiving PSF surgery over the past 10 years at a tertiary care children's hospital. All patients with AIS undergoing PSF were included in the study. Patients older than 18 or younger than 10 years and those undergoing PSF for other diagnoses, including neuromuscular scoliosis, congenital scoliosis, and kyphosis, were excluded from the study. Patients' pain was managed postoperatively with adjunctive medications in addition to intravenous and oral opioids. Variables of interest were local anesthetic bupivacaine delivered through a subcutaneous pump, sedative/analgesic dexmedetomidine, and ketorolac. Primary outcomes analyzed were normalized opioid requirement after surgery, visual analog scale (VAS) pain scores, and length of stay in the hospital.

Results: A total of 196 children were analyzed with no significant differences in demographics. Univariate analysis showed that all 3 adjunct medications improved outcomes. A multivariate regression model of the outcomes with respect to the 3 medication variables of interest was built, showing that the bupivacaine pump significantly reduced normalized opioid requirement by 0.98 mg/kg ($p = .001$) and reduced VAS pain scores by 0.67 points ($p = .004$). Dexmedetomidine significantly reduced the average VAS pain scores in the first 24 hours by 0.62 points ($p = .005$).

Conclusions: Use of the bupivacaine pump provided improved analgesia with lower pain scores, lower opioid requirements, and a lower length of stay.

Keywords: Idiopathic scoliosis; Posterior spinal fusion; Pain

Introduction

Posterior spinal fusion (PSF) is considered the standard treatment for patients with progressive, adolescent idiopathic scoliosis (AIS), with the goals being to improve spinal balance, prevent progression, and improve quality of life [1]. However, PSF can lead to significant pain postoperatively, and poor pain control can lead to family stress and anxiety, inability to participate fully with prescribed therapies, and longer hospital stays [2-6]. Several alternative pain control

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*Corresponding author. Division of Pediatric Orthopaedic Surgery, Phoenix Children's Hospital, 1919 East Thomas Road, Phoenix, AZ 85016, USA. Tel.: (602) 933-3033; fax: (602) 241-0292.

E-mail address: mwshrader@phoenixchildrens.com (M. Wade Shrader).

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strategies have been developed to improve outcomes, including on-demand patient controlled analgesia (PCA) pumps, intrathecal and epidural analgesia, intravenous ketorolac, local anesthetic infusions via indwelling catheters, and dexmedetomidine (DEX) (a centrally acting α2-adrenergic agonist similar to clonidine) infusions [7-10]. Anecdotally, providers observed improvement in pain control with the implementation of these adjunct therapies [11,12]. However, few studies are available that corroborate these observations.

Sucato et al. [13] compared continuous epidural analgesia with opioid PCA and found that epidural analgesia resulted in lower and less fluctuation of pain scores; however, that study included both anterior and posterior spinal procedures. Milbrandt et al. [14] compared PCA with and without intrathecal morphine and epidural analgesia. They found no difference in pain control but showed that epidural analgesia resulted in quicker return to normal diet and that intrathecal morphine injection reduced opioid side effects, requiring less nursing and physician intervention [14]. A study by Ross et al. [15] showed that continuous infusion of bupivacaine (BP) reduced postoperative morphine use in AIS after PSF. However, that study had 4 different placement locations for the local anesthetic catheter and only looked at continuous infusion opioid without considering subsequent oral opioids through the entire hospital stay.

In this retrospective study, the effects of 3 adjunctive medications (BP, DEX, and ketorolac) on postoperative pain scores, opioid use, and hospital length of stay (LOS) were analyzed for patients with AIS undergoing PSF at a single institution.

Materials and Methods

The researchers obtained institutional review board approval for this retrospective study. Inclusion criteria were all adolescents with *International Classification of Diseases, Ninth Revision* diagnosis codes for AIS who received PSF over the past 10 years at the authors' institution. Patients older than age 18 or younger than age 10 and those with congenital or neuromuscular scoliosis or kyphosis were excluded.

The study design was a retrospective chart review. Key variables in the data collection included patient age, gender, weight, American Society of Anesthesiologists physical status, levels of spinal fusion, estimated blood loss, length of stay in the intensive care unit and hospital, visual analog scale (VAS) pain scores, postoperative opioid requirement, presence of the 3 adjunctive medications (BP subcutaneous pump, DEX, and ketorolac), length of surgery, length of time until ambulation, and side effects such as nausea, excess sedation, oxygen desaturation events, and urinary retention.

All patients with AIS undergoing PSF at the authors' institution between 2000 and 2009 were identified. A total of 196 patients were available for analysis; 148 of these were female (76%). Mean age of patients was 14.4 years (range, 11–18 years). Table 1 shows the demographics of all subjects. The mean number of levels fused was 10.48, with a range of 7–14. No patients were excluded from the analysis because of lack of recorded data in their inpatient medical records.

Table 1
Demographics of patients with adolescent idiopathic scoliosis undergoing posterior spinal fusion.

	Average	Standard deviation	Range
Age, years	14.38	1.65	11–18
Gender			
Female	148 (76%)	NA	NA
Male	51 (24%)	NA	NA
Weight, kg	57.40	14.83	27–111
Height, cm	163.38	9.83	112–188
Levels fused	10.48	1.49	7–14

NA, not applicable.

All patients had access to opioid patient-controlled analgesia (PCA) for pain management. Patients were started with intravenous morphine at 10 μg/kg/demand dose every 10 minutes with a continuous infusion of 10 μg/kg/h. If the patient was allergic to morphine, PCA with an equivalent dose of hydromorphone or fentanyl was used. Using an opioid conversion calculator, the PCA opioid (scheduled and demand doses) and subsequent oral opioids were converted to morphine equivalents for each patient over the duration of hospital stay. This method allowed for a determination of the total opioid used (TOU) in milligrams of morphine equivalents for each patient.

The 3 adjunctive medications analyzed were BP, DEX, and ketorolac. The subcutaneous pain pump device is an elastomeric ball holding 400 mL BP, which delivers the medication via 2 5-inch catheters. The catheters were placed subcutaneously in the wound before closure. The infusion of 0.25% BP was delivered at 4 mL/h and continued for approximately 72 hours after surgery.

Dexmedetomidine infusion is normally dosed at 0.4 μg/kg/h on the day of surgery and through the first 24 hours postoperatively. At the authors' institution, operating room anesthesiologists started the infusion in the operating room, and the medication was continued in the intensive care unit. Intravenous ketorolac was administered at 0.5 mg/kg every 6 hours for 72 hours. Valium was given to all patients with a standard dosing protocol as adjunctive pain control.

Of the 196 patients, 74 (38%) received BP, 139 (71%) received DEX, and 117 (60%) received ketorolac. There were no significant differences between the groups receiving BP, DEX, or ketorolac, or not regarding age, gender, weight, height, or levels fused.

For the purposes of this study, pain scores were collected every 2 hours over the first 24 hours, and then at the same time of day on postoperative days 2 until the date of discharge. To assess postoperative pain, a standard 10-point pain scale was used (VAS).

The TOU was determined by the total summation of all opioid medications given during the hospital stay, including both parenteral and oral medications. Opioid medications