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Are We Undermedicating Patients With Neuromuscular Scoliosis After Posterior Spinal Fusion?

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Abstract

Study Design: Retrospective, matched study of patients with adolescent idiopathic scoliosis (AIS) and patients with cerebral palsy (CP) undergoing (PSF).

Objectives: To compare pain management, through measurement of the amount of narcotic used and pain scores, for patients with neuromuscular (NM) scoliosis undergoing PSF to a cohort of patients with AIS.

Summary of Background Data: Posterior spinal fusion for children with severe NM scoliosis carries a high risk of complications. Appropriate assessment of pain is crucial; undertreatment of pain leads to anxiety whereas overtreatment can lead to respiratory depression and additional complications.

Methods: A series of patients with NM scoliosis was matched for age, gender, and weight with a group of patients with AIS. Data collection included age, curve type and magnitude, and instrumentation type and levels fused. The total opioid used (TOU) was determined by summing all narcotics given during the hospital stay and converting them to morphine equivalent units. The data were then analyzed to determine differences in TOU.

Results: A total of 25 patients with NM scoliosis were included in the study. This group was matched with 25 patients with AIS scoliosis. The TOU for the NM group was 1.2 mg morphine/kg (range, 0.28–4.21 mg morphine/kg) whereas the TOU for the AIS group was 3.52 mg morphine/kg (range, 0.71–15.51 mg morphine/kg) ($p < .0000001$).

Conclusions: In this case-control analysis, patients with AIS undergoing PSF received more than twice the amount of narcotic compared with a matched group of patients with NM scoliosis. These data suggest that NM patients' pain may be undertreated compared with AIS patients. More study is indicated to investigate pain assessment and pain control in this vulnerable patient population to improve care.

Keywords: Cerebral palsy; Idiopathic scoliosis; Scoliosis; Pain control

Introduction

The assessment, impact, and treatment of pain in patients with cerebral palsy (CP), especially those with cognitive impairment and developmental delay, can be difficult. It continues to be an important concern for the practitioner, family, and patient. Appropriate assessment and treatment of both chronic and acute pain in this vulnerable patient population are gaining attention in the medical literature.

Patients with CP often need a variety of orthopedic surgical interventions to improve function, provide pain relief, or prevent deterioration of the musculoskeletal system that could negatively affect their future quality of life [1-5]. Children with severe neuromuscular scoliosis most likely also have other medical comorbidities such as seizure disorders, gastrostomy tubes, reflux and aspiration, and others, which make surgical intervention and appropriate pain management postoperatively treatment especially challenging [6-8].

Further compounding these difficulties are inherent communication and cognitive deficits that are common in many patients in this population [9-11]. Lack of verbal

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skills makes it difficult for caregivers to distinguish pain from other sources of discomfort. Cerebral palsy patients are especially vulnerable if there is a lack of the constant presence of family members or guardians to help staff with communication and emotional support for the patient.

Orthopedic surgery in patients with CP such as posterior spine fusion (PSF) can be especially painful for several reasons. Preexisting spasticity in the CP patient exacerbates postoperative pain [12]. Joint contractures and early degenerative changes can be a source of considerable pain and discomfort. Undertreatment of pain leads to undue suffering, patient and family anxiety, and prolonged hospital stay [13]. Overtreatment can lead to oversedation, respiratory depression, and unexpected intensive care unit admission [14]. Better pain control leads to higher patient and parent satisfaction, better cooperation with prescribed physical therapies, earlier return to normal physical activities, and shorter hospital stays.

The current authors' concern and hypothesis are that patients undergoing PSF for neuromuscular scoliosis may be undermedicated in the postoperative period owing to inaccurate pain assessment and the risk of respiratory distress. The goal of this study was evaluate this hypothesis by comparing pain management for patients with neuromuscular (NM) scoliosis undergoing PSF with a cohort of patients with adolescent idiopathic scoliosis (AIS).

Materials and Methods

This was a retrospective, matched, case-control study of patients undergoing PSF at a tertiary care children's hospital. The subjects were identified by a search of the hospitals' International Classification of Diseases–Ninth Revision and discharge diagnoses. A consecutive series of patients with NM scoliosis was matched for age, gender, and weight with a group of patients with AIS. All the patients with NM scoliosis in this cohort had CP or other similar static encephalopathies. Patients with AIS were also matched by having minimum of 10 vertebral levels instrumented and fused. Additional data collected included length of stay (LOS), daily opioid use, and standard pain scores during the first 24 hours and the entire postoperative period. The researchers obtained institutional review board approval for this retrospective chart review.

All patients received standard pain control postoperatively through on demand, intravenous narcotics, and/or a patient-controlled analgesia pump. In addition, all patients in both groups also received intravenous and oral diazepam, and intravenous ketorolac to assist with adjunctive pain control. The ketorolac regimen was 0.5 mg/kg (up to 30 mg) intravenously every 6 hours for 48 hours for both groups. The diazepam regimen was 0.1 mg/kg (up to 5 mg) intravenously and orally every 6 hours for both groups.

The total opioid used (TOU) was the measure employed to determine relative pain management between the 2 groups. The TOU is determined by summing all of the narcotics given during the hospital stay (oral and intravenous) by converting them to morphine equivalent units (milligrams of morphine-equivalents). A normalized opioid value was then obtained by dividing the total opioid used by the weight of the child (in kilograms) and the number of days of hospitalization. The TOU was also analyzed by taking a normalized version accounting for days length of stay, by dividing the total opioid used by the weight of the child divided by the number of days of hospitalization by LOS days (units of milligrams of MSO_4/kg-days). All of these patients remained on the inpatient unit for at least 3 days postoperatively. Data from these 2 groups were then analyzed to determine differences in TOU.

Two pain assessment tools were used for patients included in the study. These are all standard pain assessment tools used at the authors' institution. Older patients able to communicate verbally used the visual analog scale. For nonverbal children, the Face, Legs, Activity, Cry, and Consolability (FLACC) behavioral tool was used [15].

Student *t* test was used to compare differences in actual pain scores and the TOU between the CP spine group and the matched AIS group, with significance determined at $p < .05$.

Results

A total of 25 patients with NM scoliosis (mean age, 15.4 years) were included in the study. This group was matched with 25 patients with AIS scoliosis (mean age, 15 years). Only AIS patients undergoing PSF for 11 or more vertebral segments were used for comparison, to increase the degree of similarity between matched pairs (Table).

The TOU for the NM group was 1.2 mg morphine/kg (range, 0.28–4.31 mg morphine/kg) whereas the TOU for the AIS group was 3.52 mg morphine/kg (range, 0.71–15.51 mg morphine/kg). This difference was highly significant ($p = .0006$) (Fig. 1).

The normalized TOU for LOS for the NM group was 0.23 mg morphine/kg/day (range, 0.06–0.62 mg morphine/kg/day) and was 0.69 mg morphine/kg/day for the AIS group (range, 0.18–2.22 mg morphine/kg/day) ($p < .00005$). The LOS for the NM group was 5.38 days and was 4.6 days for the AIS group ($p = .043$) (Fig. 2).

Table
Patient demographics.

	Neuromuscular	Adolescent idiopathic scoliosis
Males/females	16/9	9/16
Mean age, years (range)	15.4 (10–22)	14.7 (11–18)
Mean weight, kg (range)	36.4 (16.4–75.2)	46.8 (26.9–73.3)
Levels fused, n (range)	18 (all fused T2–pelvis)	11.5 (11–13)