

Inpatient Opioid Consumption Since the Implementation of a Rapid Recovery Protocol for Posterior Spinal Fusion of Adolescent Idiopathic Scoliosis

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INTRODUCTION: With the introduction of a rapid recovery pathway following posterior spinal fusion (PSF) for adolescent idiopathic scoliosis (AIS), a more standardized approach to pain management has been adopted. However, variability still exists in the inpatient consumption of opioids with the incorporation of a patient-controlled analgesia (PCA) pump and medications given on a *pro re nata* (PRN) basis. In the setting of a rapid recovery protocol, we do not yet know which factors correlate with increased hospital opioid consumption and the relationship between inpatient opioid consumption and postoperative pain control.

METHODS: This retrospective cohort study was conducted among AIS patients who underwent PSF from 2017-2022 at a large, urban children's hospital following the implementation of a rapid recovery pathway. We measured the total amount of opioids consumed during hospitalization, including the number of PCA doses administered per hour of use and the number of PRN opioids requested per postoperative day (POD). Total consumption was compared in oral morphine equivalents (OME) per kilogram (kg) of bodyweight. Additionally, we looked at opioid prescription refills and pain scores at six-week and six-month follow up.

RESULTS: Among 160 patients in our cohort, patients, on average, consumed 2.81 OME per kg, consisting of 2.05 OME per kg from PCA and 0.76 OME per kg from PRN opioids. Further, patients, on average, self-administered 0.92 doses of PCA per hour of use and requested 2.51 PRN opioids per POD. On univariate analyses, age, preoperative pain, and the number of vertebral levels fused were significantly associated with total OME per kg consumed (Table 1). Meanwhile, preoperative pain and number of vertebral levels fused were associated with PCA pushes per hour and age and surgery length were associated with PRN opioids per POD (Table 1). Further, higher values of OME per kg consumed, PCA push per hour, and opioid PRN requested per POD were associated with higher likelihoods of requesting refills for post-discharge opioid prescriptions, as well as significant pain at follow-up visits (Table 2).

DISCUSSION AND CONCLUSION: Predicting which patients will require more opioid medications following PSF remains a challenge for healthcare teams, particularly as we shift towards more multimodal approaches to pain management. Our study demonstrates that older age, preoperative pain, more levels of fusion, and surgery length all correlate with increased hospital opioid use. Awareness of these factors is important for optimizing pain control for AIS-PSF patients because we also show there are strong relationships between use of pain medications in the hospital and pain levels and medication needs after discharge. Future studies should continue to explore the relationship between inpatient opioid use and postoperative outcomes, such as long-term pain, function, and other quality-of-life metrics.

Table 1. Association between Pre-Operative Factors and Pain Medication Usage Post-Operatively

	Total OME/kg Consumed		PCA Pushes per Hour of Use		Opioid PRNs Requested per POD	
	Median (IQR)	P-value	Median (IQR)	P-value	Median (IQR)	P-value
Age		0.05		0.24		0.03
<15 years	2.11 (1.43, 3.76)		0.76 (0.51, 1.14)		1.95 (0.98, 3.46)	
≥15 years	2.73 (1.84, 4.03)		0.90 (0.51, 1.42)		2.93 (1.73, 3.46)	
Gender		0.67		0.40		0.29
Male	2.52 (1.76, 3.74)		0.92 (0.51, 1.24)		2.95 (1.29, 3.87)	
Female	2.53 (1.48, 3.85)		0.77 (0.51, 1.21)		2.42 (1.21, 3.37)	
Primary Payer		0.35		0.23		0.40
Private	2.13 (1.42, 3.82)		0.72 (0.44, 1.15)		2.51 (1.59, 3.46)	
Public	2.59 (1.77, 3.88)		0.85 (0.59, 1.24)		2.48 (1.02, 3.50)	
BMI		0.42		0.96		0.14
Underweight	2.67 (1.92, 4.79)		0.71 (0.51, 1.92)		0.92 (0.52, 3.74)	
Normal	2.54 (1.48, 3.99)		0.78 (0.49, 1.26)		2.65 (1.28, 3.46)	
Overweight	2.82 (1.90, 3.79)		0.86 (0.57, 1.19)		1.89 (1.20, 3.13)	
Obese	2.10 (1.27, 2.76)		0.74 (0.51, 1.23)		2.59 (1.82, 4.66)	
Pre-Op Pain		0.05		0.009		0.12
Yes	2.94 (1.94, 4.12)		1.08 (0.67, 1.52)		3.11 (1.69, 3.83)	
No	2.19 (1.47, 3.72)		0.75 (0.47, 1.17)		2.48 (1.13, 3.33)	
ASA		0.98		0.70		0.33
I	2.40 (1.76, 3.41)		0.77 (0.54, 1.11)		2.51 (1.20, 3.30)	
II	2.55 (1.44, 3.85)		0.81 (0.49, 1.27)		2.42 (1.26, 3.42)	
III	2.25 (1.63, 3.47)		1.14 (0.43, 1.80)		3.86 (2.82, 4.51)	
# Levels Fused		0.02		0.008		0.08
<12	2.08 (1.45, 3.58)		0.73 (0.43, 1.11)		2.20 (1.04, 3.20)	
≥12	2.78 (1.87, 4.17)		0.92 (0.65, 1.42)		2.63 (1.69, 3.64)	
Surgery Length		0.61		0.86		0.04
<6 hours	2.41 (1.56, 3.67)		0.79 (0.55, 1.22)		2.31 (1.20, 3.13)	
≥6 hours	2.53 (1.54, 3.85)		0.77 (0.47, 1.24)		2.67 (1.32, 3.88)	
Est. Blood Loss		0.24		0.17		0.06
<600 cc	2.26 (1.41, 3.95)		0.75 (0.48, 1.20)		2.40 (0.98, 3.20)	
≥600 cc	2.80 (1.79, 3.79)		0.91 (0.61, 1.24)		2.52 (1.73, 3.88)	

OME: oral morphine equivalents, kg: kilogram, PCA: patient-controlled analgesia, PRN: pro re nata, POD: post-operative day, IQR: interquartile range, ASA: American Society of Anesthesiologists, cc: cubic centimeter

Table 2. The Association between Inpatient Opioid Use and Post-Discharge Pain Metrics

	Opioid Refill Post-Discharge	Pain at 6 Weeks Follow-up	Pain at 6 Months Follow-up
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Total OME per kg	1.33 (1.08, 1.64)	1.24 (0.99, 1.55)	1.66 (1.19, 2.32)
PCA Pushes per Hour	2.11 (1.10, 4.05)	1.44 (0.72, 2.92)	3.82 (1.60, 9.13)
Opioid PRNs per POD	1.49 (1.16, 1.92)	1.37 (1.05, 1.79)	1.12 (0.80, 1.57)

OR: odds ratio, CI: confidence interval, OME: oral morphine equivalents, PCA: patient-controlled analgesia, PRN: pro re nata, POD: post-operative day