ORIGINAL CLINICAL RESEARCH

TRACKING POST-SURGICAL PAIN AND OPIOID USE IN PEDIATRIC PRIMARY CARE

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Abstract

Background: Chronic post-surgical pain (CPSP) is defined as pain after surgical procedures, lasting at least 2 months, and with other causes of pain excluded. The variable etiologies of CPSP contribute to the challenges of managing it and tracking its incidence. Data are especially sparse on epidemiology of CPSP in pediatric populations, due to lower surgical case volume and lower prevalence of pain in general. We aimed to characterize prevalence of CPSP among children followed by primary care pediatricians after surgery performed in the same academic health system.

Methods: Patients of age 5-18 years undergoing abdominal or orthopedic surgery at our children's hospital in 2015-2018 were retrospectively identified. Among patients seen in affiliated pediatric primary care clinics 2-12 months after surgery, we queried presence of chronic pain plausibly related to surgery, and current opioid prescription.

Results: Among 998 children undergoing qualifying procedures, 59 were subsequently seen in pediatric primary care clinics, of whom 12 (20%) had pain complaints likely related to surgery, or a current opioid prescription.

Conclusion: Patients seen by primary care pediatricians after abdominal or orthopedic surgery often present with pain or opioid use potentially related to their surgery. Surgical services should plan for the possibility of transitioning care of pediatric patients who develop CPSP to pediatric primary care clinics.

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Introduction

Chronic post-surgical pain (CPSP) is defined as pain after surgical procedures, lasting at least 2 months, and with other causes of pain excluded.[1] The etiology of CPSP is multifaceted, with central nervous system sensitization playing a prominent role. Inflammation and immune system reactions drive damaged axons to produce ectopic activity. Repetitive ectopic neural activity causes altered dorsal horn activity, and persistent activity can drive death of inhibitory neurons and replacement with excitatory afferent neurons, leading to a persistent excitatory state. In chronic pain conditions, comorbid psychological conditions (e.g., depression) can also contribute to worsening perceptions of pain.[1] The variable etiologies contribute to the challenges of managing CPSP and tracking its incidence. Data are especially sparse on the epidemiology of CPSP in pediatric populations, due to lower surgical case volume and lower prevalence of pain problems in general.[2] CPSP in children is linked to prolonged opioid use after surgery,[3] and one recent study estimates that CPSP occurs in approximately 20% of children ages 6-18 years.[4] Factors associated with increased risk of CPSP or post-surgical chronic opioid use in children include pre-surgical pain intensity, anxiety, pain coping efficacy, and parental pain catastrophizing.[4]

Despite alarming data on the rates of pain problems and opioid use after surgery, attributing these data to CPSP is controversial. The incidence of CPSP and chronic opioid use vary widely by type of procedure,[5] and while approximately 5% of children have an opioid prescription filled 90-180 days after surgery,[6] specific reasons for opioid prescription filled in this time frame are unknown. Additionally, a recent report found that the majority of pediatricians would not refill opioid prescriptions,[7] suggesting that after the initial post-surgical period, pain may no longer be treated with opioid medications.[8] Whereas available evidence on long-term opioid use after pediatric surgery has relied primarily on administrative databases lacking clinical detail, evidence from studies in clinical settings have generally been limited to short-term follow-up, corresponding to the duration of time patients are followed after surgery in a surgical specialty clinic (e.g., 3 months).[9–12] After this period, children who continue to experience pain are likely to be treated primarily by primary care clinics, and the clinical literature currently lacks longitudinal data on pediatric post-surgical pain among patients who are no longer being seen in a surgical clinic. In this study, we aimed to analyze how frequently pediatric CPSP is encountered by primary care pediatricians (PCPs) and whether it is accompanied by prescription opioid use. Specifically, we sought to estimate the prevalence of post-surgical CPSP and opioid use among children seen by PCPs in one academic health system, following a surgery performed in the affiliated children's hospital.

Materials and Methods

The study was approved by the Institutional Review Board at East Carolina University (ECU). The ECU Health academic health system serves as a referral center for a 29-county region in eastern North Carolina, and includes the only children's hospital in the region.[13] Patients were retrospectively evaluated for inclusion in the study if they underwent abdominal or orthopedic surgery (including orthopedic trauma surgery), which are the 2 most common pediatric surgery types performed at our institution and have been previously described in the literature to be associated with significant risk of CPSP.[14] We retrospectively identified surgeries performed in patients ages 5-18 years at ECU Health Medical Center between January 2015 and June 2018, and limited the cohort to patients who were seen at one of ECU's pediatric primary care clinics (general pediatrics clinic, adolescent medicine clinic, or Internal Medicine-Pediatrics clinic) within 2-12 months after surgery. The lower limit of our age range was selected because pain is difficult to accurately report in younger children, especially pre-verbal children. For the follow-up duration, a minimum threshold of 2 months was selected based on previously published definitions of chronic post-surgical pain,[1] while a maximum of 12 months was selected to ensure that all eligible patients could contribute an equal duration of follow-up to the analysis. This maximum was intentionally selected to be longer than the follow-up period of previously published studies of post-surgical pain, which typically followed patients only while they were being seen in a surgical clinic.[9-12] Patients were followed until June 2019.

After the cohort of eligible patients was constructed, four study team members abstracted data from all pediatric primary care visits during the study period to note the presence of any pain complaint (based on the visit note or associated diagnosis codes), the location and severity of pain, and what current medications the patients were taking (to identify current opioid use). All visits with documentation of a pain complaint were then reviewed by two of the authors to adjudicate if the pain was plausibly related to the surgery, with any disagreement resolved through discussion with other authors. Pain was deemed to be plausibly related to the surgery if it coincided with the surgical site or the indication for surgery, and had no other explanation discernible from the chart. Study outcomes included the presence of surgery-related pain and presence of current opioid use recorded at one or more PCP visits within 2-12 months of surgery noted at one or more PCP visits in this time frame. Other data collected at the time of the index surgery included patient gender, age, race/ethnicity, procedure type, and surgery time (as a measure of surgical complexity).

Statistical analysis

Data were summarized using medians with interquartile ranges (IQR) or counts with percentages and compared according to whether patients had current CPSP or prescription opioid use noted at follow-up PCP visits in the study time frame.

Bivariate comparisons were performed using rank-sum tests, Chi-square tests, or Fisher's exact tests, as appropriate. Data analysis was performed in Stata/SE 16.1 (College Station, TX: StataCorp, LP). Two-tailed $P<0.05$ was considered statistically significant for all analyses.

Results

We identified 998 procedures meeting inclusion criteria (350 orthopedic surgeries and 648 abdominal surgeries). After limiting the sample to patients who had a pediatric primary care visit in our health system 2-12 months after the surgery, 59 cases (surgeries) were retained for analysis (32/27 female/male; median age 13 years, IQR: 10, 16). In this sample, the most common abdominal procedures included appendectomy (n=18), diagnostic or exploratory laparotomy (n=8), and umbilical hernia repair (n=6). The most common orthopedic procedures included open reduction and internal fixation (ORIF) of the upper extremities (n=4), facial bones (n=3), and lower extremities (n=2); or hardware insertion or removal (n=4). After surgery, 37 patients visited the general pediatrics clinic, while 13 were seen in the adolescent clinic and 11 were seen in the Internal Medicine-Pediatrics clinic.

Of the 59 patients seen by a pediatrician 2-12 months after surgery, 12 (20%) had a pain complaint likely to be related to the surgery or had a current opioid prescription. A total of 8 patients (14%) had a current opioid prescription (Table 1). Seven patients (12%) presented with pain potentially related to the surgery, including 3 who had a current opioid prescription (Table 2). Some of the treatments primary care clinics used to manage pain complaints included continuing opioids (n=3), prescribing or recommending a non-steroidal anti-inflammatory medication (n=2), prescribing or refilling ondansetron (n=1), omeprazole (n=1), or polyethylene glycol (n=1), ordering lab tests (n=1), or recommending lifestyle modifications (n=2; Table 2). No patients with pain potentially related to the index surgery were referred by their PCP to any other clinic.

Patient and surgery characteristics are compared in Table 3 according to documentation of surgery-related pain or current opioid use among the 59 patients seen by a PCP 2-12 months after surgery. Patients who presented to a primary care pediatrician with a surgery-related pain complaint or with current opioid use 2-12 months after surgery tended to be older (median age 15 years, IQR: 15, 16; vs. median age 12, IQR: 9, 16). However, this difference did not reach statistical significance ($p=0.068$ on rank-sum test). There were no statistically significant differences observed in the prevalence of persistent or recurring pain or in current opioid use by surgery type, surgery duration, patient gender, or patient race/ethnicity.

Table 1. Patients prescribed opioids 2-12 months following surgical procedures with the corresponding medication name, strength, amount, route, and frequency.

Opioid Prescription	Number of Patients
Acetaminophen with Codeine 300-30 mg (Tylenol #3) 1-2 Tablets Oral Every 4 Hours as Needed	1
Hydrocodone/Acetaminophen 5-325 mg (Norco) 1 Tablet Oral Every 4 Hours as Needed	3
Oxycodone HCl 3 mg (Roxicodone) Gastric Tube Every 4 Hours as Needed	1
Oxycodone HCl 5-10 mg (Roxicodone) Oral Every 4 Hours as Needed	2
Oxycodone HCl/Acetaminophen 10-325 mg (Percocet) 1 Tablet Oral Every 4 Hours as Needed	1

Table 2. Patient complaint 2-12 months following the inciting surgical procedure with the intervention(s) at the time of the follow-up appointment.

Pain Complaint	Index Surgical Procedure	Intervention(s)
Abdominal tightness	Umbilical Hernia Repair	Prescribed – Naproxen (Naprosyn) 375 mg Oral Twice a Day with Meals
Epigastric abdominal pain	Laparoscopic Cholecystectomy	Refilled – Ondansetron HCl (Zofran) 4 mg Oral Every 8 Hours as Needed Prescribed – Omeprazole (Prilosec) 10 mg Oral Daily
Left ankle pain[a]	Arthroscopy Left Ankle with Open Repair of Osteochondral Defect	Continued – Oxycodone HCl/Acetaminophen 10-325 mg (Percocet) 1 Tablet Oral Every 4 Hours as Needed Continued – Physical Therapy
Left ankle pain[a]	ORIF Left Ankle	Continued – Acetaminophen with Codeine 300-30 mg (Tylenol #3) 1-2 Tablets Oral Every 4 Hours as Needed
Rid mid-back pain[a]	Exploratory Laparotomy, Colostomy, and Sigmoidoscopy (bilateral anus)	Continued – Oxycodone HCl 5-10 mg (Roxicodone) Oral Every 4 Hours as Needed Considered – Medical Rehabilitation
Right upper quadrant abdominal pain	Laparoscopic Cholecystectomy	Prescribed – Polyethylene Glycol (MiraLAX) 17 g/day Oral Daily for One Week Recommended – High Fiber Diet Labs Ordered – Complete Blood Count with Differential, Complete Metabolic Panel, Amylase, Lipase
Right upper quadrant abdominal pain	Laparoscopic Cholecystectomy	Recommended – 3 Day Trial of Ibuprofen 600 mg Oral Every 8 Hours with Meals

[a]Patients also taking opioids at the time of the follow-up

Table 3. Patient characteristics according to documentation of surgery-related pain or opioid use at the time of primary care follow-up (N=59).

Variable	Patients without surgery-related pain complaint or opioid use (N=47)	Patients with surgery-related pain complaint or opioid use (N=12)	P-value
	Median (IQR) or N (%)	Median (IQR) or N (%)	
Age (years)	12 (9, 16)	15 (15, 16)	0.068
Gender			0.750
Female	25 (53%)	7 (58%)	
Male	22 (47%)	5 (42%)	
Race/ethnicity			0.299
Non-Hispanic Black	24 (51%)	6 (50%)	
Non-Hispanic White	8 (17%)	4 (33%)	
Hispanic or Latino	13 (28%)	1 (8%)	
Other or unknown	2 (4%)	1 (8%)	
Surgery type			>0.999
Abdominal	34 (72%)	9 (75%)	
Orthopedic	13 (28%)	3 (25%)	
Surgery duration (min)	113 (61, 215)	128 (97, 187)	0.763

IQR, interquartile range

Discussion

CPSP and chronic post-surgical opioid use have not been well characterized in pediatric populations.[7,14] Among children and adolescents in our study who were seen by a PCP 2-12 months after abdominal or orthopedic surgery, 20% had a pain complaint potentially related to surgery or had a current opioid prescription, matching an estimate of CPSP incidence from previous research.[4] However, in our health system, very few (6%) of pediatric patients undergoing these types of surgery were seen by an affiliated PCP 2-12 months after surgery, raising the question of where and how pediatric CPSP is managed. Many patients may have been seen by private practice pediatricians after undergoing surgery, or may have been lost to follow-up. Although the single-center design and final sample size in our study limited the conclusions that could be drawn, it demonstrates a novel approach of tracking postsurgical pain among patients presenting to primary care clinics, and these initial findings may be useful for other centers considering how best to identify and treat children experiencing prolonged or recurring pain after surgery. Furthermore, the evidently high incidence of CPSP among patients who were followed in our pediatric clinic suggests that surgical services should plan ahead for the possibility of CPSP and for transitioning the care of pediatric patients developing CPSP to community pediatricians and other primary care clinics.

Within the context of previous work, our finding of a 20% incidence of patients with a pain complaint or opioid prescription following orthopedic and abdominal surgeries is consistent with available estimates, including an incidence range from 11-15%[15–18] in prospective studies and 10-19%[19,20] in retrospective studies. However, in contrast to our investigation, some studies have focused only on opioid prescriptions, while others focused on the pain complaints but did not analyze opioid prescriptions. The inherent subjectivity of CPSP can lead to potential differences in coding and is a possible limitation in studies that use International Classification of Disease (ICD) codes to gather data on CPSP. Further, studies using administrative databases often lack a method to determine if pain diagnoses or opioid use are attributable to the index surgery being evaluated. Our study sought to overcome these limitations by reviewing details of patient encounters to attempt to rule out causes of pain other than the index surgery.

Although PCPs treat the majority of pediatric chronic pain,[21] prior studies have generally not considered where chronic pain specifically related to surgery is managed. Surgical follow-up for the common procedures used in our sample is typically 2-6 weeks,[22-26] but we identified significant fragmentation of care past this period, such that most children undergoing abdominal or orthopedic surgery in our health system were not followed up by a pediatrician in the same health system. These children may have sought care for CPSP from private practice pediatricians, or from other specialties (e.g., family medicine, general internal medicine), urgent care facilities, or emergency departments. One study found 30-day emergency department visits and readmissions were significantly reduced for patients who had appropriate outpatient follow-up,[27] suggesting that improving

patient handoff from surgical services to outpatient primary care may improve outcomes and reduce acute care use among children experiencing CPSP. Our study indicates a need to better understand where children are receiving care after surgery to ensure that CPSP can be adequately addressed through outpatient follow-up.

One limitation to our study is that the findings may have been influenced by the approach to postoperative pain management in our center, since other centers may have lower or higher rates of CPSP. A consistent approach to postoperative pain management between surgeons and PCPs in the same health system could reduce chronic opioid use in children by avoiding unnecessary outpatient opioid prescribing and further standardize the approach to postoperative pain management. Other limitations include the retrospective nature of our review and evaluation of a single center. In particular, unlike many centers which have published their experience in treating children with chronic pain, our center serves a predominantly rural community with a high proportion of patients who are Black or Latino. Recent studies have emphasized the potential for racial and ethnic disparities in the treatment of pediatric pain,[28,29] and investigating these disparities in the setting of pediatric CPSP remains an important direction for future work. Additionally, there was a relative lack of information available on patient follow-up outside of our health system, so it is unknown if rates of pain complaints or current opioid prescription were substantively different among children receiving care in outside clinics.

Our study presents a novel description of pediatric CPSP and opioid use as encountered by primary care pediatricians in an academic health system. Whereas few patients followed up with a PCP in our health system after surgery in the affiliated children's hospital, the rate of CPSP among those who did was similar to estimates derived from administrative claims data in past research. A coordinated approach among all clinics involved in following children after surgery can improve continuity of care and potentially reinforce new initiatives aimed at reducing post-surgical pain and opioid use.

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Conflicts of interest

The authors declare no competing interests.

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