Journal of Pediatric Surgery 56 (2021) 115–120

Contents lists available at ScienceDirect

Journal of Pediatric Surgery

journal homepage: www.elsevier.com/locate/jpedsurg

An enhanced recovery after surgery pathway in pediatric colorectal surgery improves patient outcomes☆

Laura N. Purcell [a], Kathleen Marulanda [a], Matthew Egberg [b], Sabrina Mangat [c], Christopher McCauley [c], Nicole Chaumont [a], Timothy S. Sadiq [a], Concetta Lupa [d], Peggy McNaull [d], Sean E. McLean [a], Andrea Hayes-Jordan [a], Michael R. Phillips [a,]*

[a] Department of Surgery, University of North Carolina at Chapel Hill, NC
[b] Department of Pediatrics, University of North Carolina at Chapel Hill, NC
[c] College of Medicine, University of North Carolina at Chapel Hill, NC
[d] Department of Anesthesiology, University of North Carolina at Chapel Hill, NC

ARTICLE INFO

Article history:
Received 13 September 2020
Accepted 22 September 2020

Key words:
ERAS
Pediatric surgery
Enhanced recovery
ERAS in colorectal surgery

ABSTRACT

Introduction: Enhanced recovery after surgery (ERAS) pathways in adult colorectal surgery are known to reduce complications, readmissions, and length of stay (LOS). However, there is a paucity of ERAS data for pediatric colorectal surgery.
Methods: A 2014–2018 single-institution, retrospective cohort study was performed on pediatric colorectal surgery patients (2–18 years) pre- and post-ERAS pathway implementation. Bivariate analysis and linear regression were used to determine if ERAS pathway implementation reduced total morphine milligram equivalents per kilogram (MME/kg), LOS, and time to oral intake.
Results: 98 (70.5%) and 41 (29.5%) patients were managed with ERAS and non-ERAS pathways, respectively. There was no statistical difference in age, sex, diagnosis, or use of laparoscopic technique between cohorts. The ERAS cohort experienced a significant reduction in total MME/kg, Foley duration, time to oral intake, and LOS with no increase in complications. The presence of an ERAS pathway reduced the total MME/kg (−0.071, 95% CI −0.10, −0.043) when controlling for covariates.
Conclusion: The use of an ERAS pathway reduces opioid utilization, which is associated with a reduction in LOS and expedites the initiation of oral intake, in colorectal pediatric surgery patients. Pediatric ERAS pathways should be incorporated into the care of pediatric patients undergoing colorectal surgery.
Level of evidence: Level III evidence.
Type of study: Retrospective cohort study.

Enhanced recovery after surgery (ERAS) protocols have been implemented to standardize perioperative care to accelerate recovery by attenuating the operative stress response in adult surgical patients for specific surgical procedures, particularly colorectal surgery [1]. ERAS pathways standardize the preoperative, intraoperative, and postoperative management of patients for specific surgical procedures. ERAS pathways focus on optimizing the patient preoperatively, avoiding fluid shifts by eliminating bowel preparation and intravenous fluid overload, antibiotic prophylaxis, minimizing opioids with multimodal pain control, early enteral nutrition after surgery, and early mobilization [2]. There are existing data regarding the effectiveness of an ERAS protocol in adults, and emerging data for the use of ERAS pathways in small series of pediatric patients. However, many of the initial studies in the pediatric surgical population are "fast-track" pathways, as the implemented interventions do not meet the 17 core elements standard recommended by ERAS USA and the ERAS Society [3]. A recent systematic review of pediatric gastrointestinal, urology, and thoracic surgery postoperative pathways, demonstrated studies averaged less than 5.6 interventions per protocol [4].

Recently an expert panel used a modified Delphi process to identify 19 components of adult ERAS protocols suitable for use in a pediatric pathway. The final pathway excluded the recommendation to avoid mechanical bowel preparation and the use of insulin to control severe hyperglycemia [5]. Initial implementation of this pathway has shown a decrease in length of stay, lower perioperative opioid use, and faster time to general diet, without an associated increase in complications [5].

As there continues to be a lack of data in the pediatric surgery literature and current published studies have small sample sizes, ERAS

☆ How this paper will improve care: We have shown that a pediatric enhanced recovery after surgery (ERAS) pathway for open and laparoscopic colorectal surgery has reduced a patient's total morphine milligram equivalents, which was associated with a reduced urinary catheter duration and length of hospital stay.

* Corresponding author at: UNC School of Medicine, Assistant Professor of Surgery and Pediatrics, Division of Pediatric Surgery, Physician's Office Building, 170 Manning Drive, CB #7223, Chapel Hill, NC 27599-7223. Tel.: +1 919 966 4643; fax: +1 919 843 2497.
E-mail address: miphilli@med.unc.edu (M.R. Phillips).

https://doi.org/10.1016/j.jpedsurg.2020.09.028
0022-3468/

pathways for pediatric colorectal surgery require additional study [5]. Therefore, we evaluated the effect of the implementation of a comprehensive ERAS pathway in a pediatric surgical population at our institution. Specifically, we hypothesized that the implementation of an ERAS pathway would decrease the length of stay, time to oral intake, and opioid utilization without increasing 30-day complication rates in our pediatric colorectal surgery population.

1. Methods

We performed a single-institution, retrospective cohort study from 2014 to 2019 on pediatric patients (≥2 and ≤ 18 years old) undergoing colorectal surgery before and after implementation of an ERAS pathway, covering two plan–do–study–act (PDSA) cycles with various pathway elements to produce a single synthesized pathway. Patients who underwent surgery at our tertiary hospital with dedicated children's hospital were identified by querying the electronic health records for patients ≤18 years who underwent common colorectal procedures using Current Procedural Terminology (CPT) codes of interest (see Appendix A). Patients in both cohorts were operated on by eight surgeons, who operated on a minimum of five patients in each cohort.

The first ERAS pathway was implemented in September 2015 for both open and laparoscopic, elective inflammatory bowel disease surgeries with plan–do–study–act cycles adding additional components throughout its lifespan. The second PDSA cycle increasing the utilization of multimodal pain medication postoperatively (acetaminophen, celecoxib, and pregabalin or gabapentin) was implemented in November 2018. Ultimately, the final ERAS pathway (Appendix B) includes preoperative patient and guardian education, preoperative carbohydrate loading, and early postoperative oral intake. Patients received a single 15 mg/kg dose of acetaminophen in the preanesthesia care unit and on induction received the standard age-based induction anesthesia. Before the start of the laparoscopic or open operation, a regional nerve block or epidural catheter was performed, respectively. Standard intraoperative fluid management protocols were implemented, which emphasized goal-directed therapy and zero fluid balance. Finally, early mobilization is encouraged postoperative day (POD) 0 for morning operations and POD 1 for afternoon operations, with a physical therapy consult if ambulation requires more than minimal assistance on POD 1.

For analysis, patients undergoing operations before January 1, 2016, were categorized as the preintervention ERAS controls, and the remaining were categorized as postintervention ERAS patients. The *a priori* primary endpoints of our analysis were postoperative hospital length of stay, in-hospital opioid use in morphine milligram equivalents per kilogram (MME/kg), and time to oral intake. Univariate analysis was performed to assess missing data and the distribution of variables. There were less than 1% missing data. Bivariate analysis was conducted over the preintervention and postintervention ERAS cohorts. The central tendency was described as means (standard deviations [SD]) and medians (interquartile range [IQR]) for normally and nonnormally distributed covariates, respectively. To compare the distribution of exposure across demographic variables, χ^2 for categorical variables and Student's T-Test or Kruskal–Wallis for normally and nonnormally distributed continuous variables, respectively, were used. Total MME/kg per day was plotted against time.

Multivariate linear regression was used to determine if ERAS pathway implementation reduced postoperative length of stay, total MME/kg, and time to oral intake. *A priori*, age, sex, procedure category, American Society of Anesthesiologist (ASA) physical status classification, and laparoscopic *versus* open procedure were included in the regression. Variables significant ($p < 0.05$) on bivariate analysis were included in the multivariate linear regression model, including total MME/kg. Covariates were removed from the model based on a backward elimination approach, based on p-value (<0.05), with the goals to maintain precision (narrowing confidence intervals) and reduce error (<10% change in coefficient). Sex was removed from the model based on these criteria and resulted in the narrowing of the confidence interval with minimal change in the coefficients.

In the multivariate linear regression for evaluating the change in total MME/kg with ERAS implementation, age, sex, laparoscopic *versus* open procedure, preoperative opioid use, and administration of epidural or block were included *a priori*. ASA physical status classification and procedure category were included in the multivariate linear regression based on the significant p-value on bivariate analysis. On backward elimination, as previously described, sex, laparoscopic *versus* open, and ASA physical status classification were removed to maintain precision and reduce error.

In the multivariate linear regression for evaluating the change in time to oral intake with ERAS, covariates included *a priori* were age, sex, procedure category, laparoscopic surgery, and preoperative and postoperative ERAS medications. ASA physical status classification and total MME/kg were included based on previously described bivariate analysis criteria. On backward elimination, sex and procedure categories were removed based on the aforementioned criteria.

This analysis was performed using StataCorp v14.2, College Station, Texas. Confidence intervals are reported at 95%, and alpha was set at 0.05 for this study. The University of North Carolina Institutional Review Board approved this study and waived informed consent.

2. Results

Of the 139 patients that met inclusion criteria, 70.5% ($n = 98$) were ERAS patients who underwent colorectal surgery with an ERAS pathway, and the remaining were classified as ERAS controls ($n = 41$, 29.5%). There was no statistically significant difference between age, sex, or body mass index between the ERAS patients and control cohorts. The ERAS patient and control cohorts were primarily ASA physical status classification 2 and 3, respectively, $p = 0.005$. In both the ERAS patient and control cohort, the primary diagnoses were Crohn's disease and ulcerative colitis, $p = 0.5$, Table 1.

There was no difference in preoperative steroid or opioid use between the two cohorts. In the preanesthesia care unit, both the ERAS patients and controls were premedicated with acetaminophen ($p = 0.6$). Patients in the ERAS patient cohort were more likely to be premedicated in the preanesthesia unit with pregabalin or gabapentin ($p < 0.001$), Celebrex ($p < 0.001$), and Entereg ($p = 0.002$). The ERAS patient cohort primarily underwent ileocecectomy ($n = 33$, 33.7%) and total abdominal colectomy with diverting ostomy ($n = 19$, 19.4%), while the ERAS control cohort primarily underwent ileostomy takedown ($n = 9$, 22.0%) and ileocecectomy ($n = 7$, 17.1%). Between the cohorts, there was no difference between the number undergoing laparoscopic surgery, receiving an epidural, or the procedure time. Patients in the ERAS patient cohort had lower total perioperative MME used than the ERAS controls, 0.4 (SD 0.3) *versus* 0.7 (SD 0.4), $p < 0.001$, Table 1.

The ERAS patients and the control cohorts had no difference in postoperative acetaminophen ($p = 0.5$) or Toradol ($p = 1.0$) use. The ERAS patient cohort was more likely to use pregabalin or gabapentin ($p < 0.001$), Celebrex ($p < 0.001$), and Entereg ($p = 0.008$) than the control cohort. ERAS patients used less total MME/kg ($p < 0.001$) over their hospital stay, Fig. 1. ERAS patients had shorter postoperative time with Foley catheter ($p < 0.001$), time to oral intake ($p < 0.001$), and hospital length of stay ($p = 0.002$). There was no statistical difference in the number of returns to the emergency room, hospital readmissions, or unplanned returned to the operating room within 30 days between the ERAS patients and control cohorts, Table 1.

On multivariate linear regression of factors influencing the patient's total MME/kg, the presence of the ERAS pathway (−0.055, 95% CI −0.093 – −0.036, $p < 0.001$) and increasing age (−0.0051, 95% CI −0.010 – −0.0014, $p = 0.02$) decreased total MME/kg used, Table 2.

On multivariate linear regression showing factors assessing the length of stay, increasing total MME/kg increased the patient's length of stay (1035.97, 95% CI 651.07–1420.87, $p < 0.001$). The presence of

Table 1
Patient demographics, operative, and postoperative characteristics — comparison of demographic data, and operative and postoperative characteristics in the overall cohort, and our control patients (pre-enhanced recovery after surgery (ERAS) implementation), and patients managed with a pediatric-specific ERAS pathway.

	Overall ($n = 139$)	ERAS ($n = 98$, 70.5%)	Controls ($n = 41$, 29.5%)	p-value
Age: μ (SD)	14.8 (2.9)	14.7 (3.0)	14.9 (2.4)	0.7
Female sex: *n* (%)	76 (54.7)	50 (51.0)	26 (63.4)	0.2
Body mass index: median (IQR)	19.7 (17.3–22.3)	18.7 (16.7–21.4)	19.7 (17.7–22.3)	0.2
ASA physical status classification: *n* (%)				0.005
2	66 (47.5%)	54 (55.1)	12 (29.7)	
3	73 (52.5)	44 (44.9)	29 (70.7)	
Diagnosis: *n* (%)				0.5
Crohn's disease	66 (47.5)	47 (48.0)	19 (46.3)	
Ulcerative colitis	60 (43.2)	39 (39.8)	21 (51.2)	
Hirschsprung disease	5 (3.6)	5 (5.1)	0 (0.0)	
Familial adenomatous polyposis	2 (1.4)	2 (2.0)	0 (0.0)	
Other	6 (4.3)	5 (5.1)	1 (2.4)	
Preoperative steroids: *n* (%)	34 (24.8)	27 (27.6)	7 (18.0)	0.2
Preoperative opioid use: *n* (%)	13 (9.4)	7 (7.1)	6 (14.6)	0.2
Preoperative ERAS medications				
Acetaminophen: *n* (%)	93 (66.9)	67 (68.4)	26 (63.4)	0.6
Pregabalin or gabapentin: *n* (%)	57 (41.0)	53 (54.1)	4 (9.8)	<0.001
Celebrex: *n* (%)	44 (31.7)	44 (44.9)	0 (0.0)	<0.001
Entereg: *n* (%)	20 (14.4)	20 (20.4)	0 (0.0)	0.002
Procedure: *n* (%)				
Small bowel resection	6 (4.3)	4 (4.1)	2 (4.9)	0.04
Completion coloproctectomy without ostomy	13 (9.4)	11 (11.2)	2 (4.9)	
Completion coloproctectomy with diverting ostomy	17 (12.2)	10 (10.2)	7 (17.1)	
Total abdominal colectomy with diverting ostomy	23 (16.6)	19 (19.4)	4 (9.8)	
Ileocecectomy	40 (28.8)	33 (33.7)	7 (17.1)	
Diverting ostomy	7 (5.0)	2 (2.0)	5 (12.2)	
Ileostomy takedown	22 (15.8)	13 (13.3)	9 (22.0)	
Partial colectomy with diverting ostomy	1 (0.7)	1 (1.0)	0 (0.0)	
Partial colectomy without diversion	10 (7.2)	5 (5.1)	5 (12.2)	
Laparoscopic surgery: *n* (%)	78 (56.1)	59 (60.2)	19 (46.3)	0.1
Procedure time (min): μ (SD)	193.6 (84.0)	187.0 (83.0)	209.4 (85.2)	0.2
Epidural: *n* (%)	31 (22.3)	18 (18.4)	13 (31.7)	0.09
Total perioperative MME: μ (SD)	0.5 (0.3)	0.4 ± 0.3	0.7 ± 0.4	<0.001
Postoperative medications				
Acetaminophen: *n* (%)	137 (98.6)	97 (99.0)	40 (97.6)	0.5
Pregabalin or gabapentin: *n* (%)	65 (46.8)	59 (60.2)	6 (14.6)	<0.001
Celebrex: *n* (%)	54 (38.9)	53 (54.1)	1 (2.4)	<0.001
Entereg: *n* (%)	15 (10.8)	15 (15.3)	0 (0.0)	0.008
Toradol: *n* (%)	34 (24.5) 1	24 (24.5)	10 (24.4)	1.0
Floor total MME per day: median (IQR)	0.2 (0.1–0.4)	0.2 (0.1–1.8)	0.4 (0.2–0.7)	<0.001
Total MME per kg: median (IQR)	0.03 (0.02–0.06)	0.02 (0.02–0.04)	0.06 (0.03–0.1)	<0.001
Time with Foley (h): μ (SD)	39.5 (35.5)	33.0 (29.9)	54.9 (42.9)	<0.001
Time to oral intake (h): μ (SD)	31.4 (30.9)	24.5 (22.8)	47.9 (40.6)	<0.001
Length of stay (h): median (IQR)	118.9 (89.2–187.7)	99.3 (76.5–167.6)	139.3 (116.1–216.4)	0.002
Complications				
Return to the emergency room in 30 days: *n* (%)	20 (14.4)	13 (13.3)	7 (17.1)	0.6
Readmission in 30 days: *n* (%)	27 (19.4)	18 (18.4)	9 (22.0)	0.6
Unplanned return to operating room in 30 days: *n* (%)				0.5
None	126 (91.3)	88 (89.8)	38 (95.0)	
Unplanned	10 (7.3)	8 (8.2)	2 (5.0)	
Planned	2 (1.5)	2 (2.0)	0 (0.0)	

Abbreviations: μ: mean, SD: standard deviation, IQR: interquartile range, ASA: American Society of Anesthesiologists, ERAS: enhanced recovery after surgery, MME: morphine milligram equivalents, kg: kilogram.

an ERAS pathway, increasing age, increasing ASA Physical Status Classification, and procedure performed did not change the length of stay when controlling for pertinent factors, Table 3.

Using multivariate linear regression to determine factors influencing time to oral intake, the presence of an ERAS pathway (−15.10, 95% CI −26.21 – −3.98, p = 0.008) and increasing age (−3.06, 95% CI −4.75 – −1.36, p = 0.001) decreased time to oral intake. Increasing total MME/kg increased the time to oral intake (102.99, 95% CI 32.44–173.53, p = 0.005), Table 4.

3. Discussion

This is the largest study to date on ERAS pathways for pediatric patients undergoing colorectal surgery. We have shown there was a decrease in the postoperative hospital length of stay by 40 h and reduction in time with Foley and time to oral intake by nearly a day in the ERAS postintervention cohort. Also, there was a significant decrease in total MME/kg over a patient's hospitalization with the initiation of an ERAS pathway. Multivariable regression showed the implementation of an ERAS pathway reduced the total MME/kg used in the perioperative period and decreased the time to oral intake when controlling for pertinent covariates. Finally, we showed a reduction of MME/kg was associated with a decrease in hospital length of stay. Importantly, there was no difference in complications between the two cohorts.

Only a few studies have examined the effect of the implementation of ERAS pathways in pediatric surgical patients. A recent systematic review found five studies examining the implementation of a “fast-track” pathway, all with six or fewer ERAS pathway components. Even with the relatively small number of components, the pediatric fast-track patients were shown to have a shorter length of stay and decreased opioid

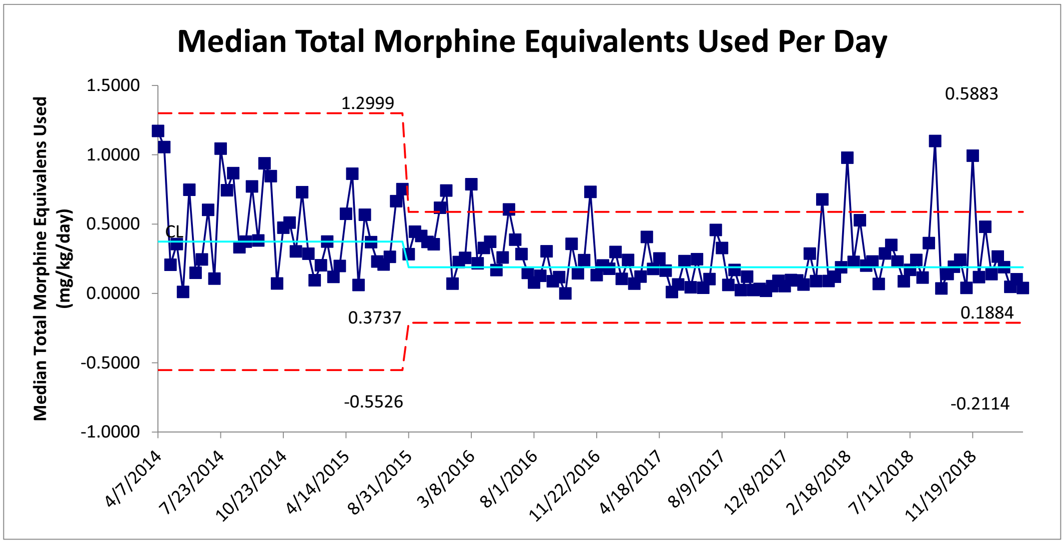

Fig. 1. Run chart — total morphine milligram equivalents per kilogram per day (MME/kg/day) before and after enhanced recovery after surgery (ERAS) pathway implementation (September 2016). The blue line represents median morphine equivalents used controlling for weight and time. The red lines represent upper and lower confidence intervals.

use, with no associated increase in perioperative complications [4,6,7–10]. In addition, each included study had its challenges. Specifically, in two studies, controls were taken from national billing databases, which introduced significant unaccounted for provider and practice variability [6,7,9]. In a third study, there was no control group in which to compare the ERAS cohort [8]. Finally, the population was limited to include only laparoscopic procedures, which limited its generalizability [10].

Short et al. introduced a pediatric colorectal ERAS pathway in 2015 [6]. The authors show that patients undergoing major laparoscopic colorectal operations in the ERAS postintervention arm had a decrease in length of stay by one-day, received a lower volume of intraoperatively intravenous fluids, and had an earlier start to a regular diet compared to the preintervention arm. In addition, there was a reduction in operative MME/kg and postoperative MME. While this represents the most comprehensive pediatric ERAS study to date, it is limited by its sample size ($n = 79$) and focus on only laparoscopic surgery rate in the pre- and postintervention cohorts [11].

While each of the previously mentioned studies has limitations, findings in these studies correlate with what we have found in our study. Unfortunately, we cannot compare the magnitude in MME reduction in our study with Short et al. owing to the inconsistency in the reporting of opioid use and units of measurement (MME and MME/kg). Our study builds on the work of Short et al., by broadening the generalizability, as it includes a significant cohort of open operations [11].

Individual components of the ERAS pathway have been shown to be effective in children. Specifically, studies have demonstrated that multimodal analgesia, early mobilization and oral intake, nausea control, and avoiding unnecessary urinary catheters were safe in pediatric patients. Also, excluding mechanical bowel preparation has been associated with improved outcomes [12–16]. Previously, it has been demonstrated that ERAS pathways were effective in reducing LOS, opioid utilization, and time to oral intake in pediatric IBD patients. The current study expands on those findings and demonstrates that the effect was consistent across other indications and patients. The current study also demonstrates our findings across a much larger cohort (nearly double). Interestingly during the PDSA to expand the use of multimodal pain medications, we did not see a significant effect on our run chart as we anticipated. However, we continued the practice based on similar complication rates and likely unrecognized benefits. Our study contributes to the growing body of work demonstrating that individual components combined into a comprehensive ERAS pathway can improve patient

Table 2
Multivariate linear regression showing the change in the total morphine equivalents per kilogram with implementation of an enhanced recovery after surgery (ERAS) pathway and controlling for age, preoperatively opioid use, neuraxial and regional anesthesia, and procedural category.

	Coefficient	95% Confidence interval	p-value
ERAS	−0.055	−0.093 – −0.036	<0.001
Age	−0.0051	−0.010 – −0.0014	0.02
Preoperative opioid use	0.031	−0.017 – 0.065	0.1
Epidural	0.0031	−0.023 – 0.044	0.8
Block	−0.030	−0.051 – 0.017	0.2
Procedure category			
Small bowel resection	Ref	-	-
Completion coloproctectomy without ostomy	−0.077	−0.14 – −0.016	0.02
Completion coloproctectomy with diverting ostomy	−0.086	−0.15 – −0.027	0.006
Total abdominal colectomy with diverting ostomy	−0.063	−0.12 – −0.0037	0.04
Ileocectomy	−0.066	−0.13 – −0.012	0.02
Diverting ostomy	0.029	−0.044 – 0.010	0.4
Ileostomy takedown	−0.086	−0.15 – −0.029	0.005
Partial colectomy with diverting ostomy	−0.095	−0.23 – 0.048	0.2
Partial colectomy without diversion	−0.083	−0.15 – −0.016	0.01

Abbreviation: ERAS: enhanced recovery after surgery.

Table 3
Multivariate linear regression showing the change in length of stay (LOS) with implementation of an enhanced recovery after surgery (ERAS) pathway and controlling for age, American Society of Anesthesiologist physical status classification, mode of surgery (open vs. laparoscopic), opioid utilization, and procedure category.

	Coefficient	95% Confidence interval	p-value
ERAS	34.62	−26.03 – 95.27	0.3
Age	6.05	−3.20 – 15.31	0.2
ASA			
2	Ref	–	–
3	50.31	−1.64 – 102.25	0.06
Laparoscopic surgery	−41.15	−98.80 – 16.51	0.2
Total MME per kg	1035.97	651.07–1420.87	<0.001
Procedure category			
Small bowel resection	Ref	–	–
Completion coloproctectomy without ostomy	93.59	−50.65 – 237.84	0.2
Completion coloproctectomy with diverting ostomy	8.43	−128.05 – 144.91	0.9
Total abdominal colectomy with diverting ostomy	−38.14	−168.81 – 92.53	0.6
Ileocectomy	3.48	−123.12 – 130.08	1.0
Diverting ostomy	9.84	−147.62 – 167.20	0.9
Ileostomy takedown	21.27	−116.45 – 159.00	0.8
Partial colectomy with diverting ostomy	49.11	−256.99 – 355.20	0.8
Partial colectomy without diversion	49.61	−98.54 – 197.76	0.5

Abbreviations: ERAS: enhanced recovery after surgery, ASA: American Society of Anesthesiologists, MME: morphine milligram equivalents, kg: kilogram.

Table 4
Multivariate linear regression showing the change in time to oral intake after implementation of an enhanced recovery after surgery (ERAS) pathway and controlling for age, mode of surgery (open vs. laparoscopic), American Society of Anesthesiologist physical status classification, opioid utilization, and procedure category.

	Coefficient	95% Confidence interval	p-value
ERAS	−15.10	−26.21 – −3.98	0.008
Age	−3.06	−4.75 – −1.36	0.001
Laparoscopic surgery	−6.01	−16.57 – 4.56	0.3
ASA			
2	Ref	–	–
3	5.52	−6.18 – 12.80	0.3
Total MME per kg	102.99	32.44–173.53	0.005
Procedure category			
Small bowel resection	Ref	–	–
Completion coloproctectomy without ostomy	−23.06	−49.50 – 3.38	0.09
Completion coloproctectomy with diverting ostomy	−19.05	−44.06 – 5.97	0.1
Total abdominal colectomy with diverting ostomy	−18.02	−41.97 – 5.93	0.1
Ileocectomy	−9.13	−32.34 – 14.07	0.4
Diverting ostomy	−23.59	−52.44 – 5.27	0.1
Ileostomy takedown	−7.12	−32.36 – 18.12	0.6
Partial colectomy with diverting ostomy	6.99	−49.11 – 63.09	0.8
Partial colectomy without diversion	−1.89	−29.04 – 25.26	0.8

Abbreviations: ERAS: enhanced recovery after surgery, ASA: American Society of Anesthesiologists, MME: morphine milligram equivalents, kg: kilogram.

outcomes without increasing complication rates [11].

This study was limited owing to its retrospective nature. All of the components in the ERAS protocol could not be tracked on retrospective review. Specifically, preoperative carbohydrate loading, time to first postoperative mobilization, time to return of bowel function, and postoperative nausea and emesis were not consistently recorded and identified on chart review. In addition, this study includes a heterogeneous mix of patient diagnoses, including patients with severe ulcerative colitis and elective prophylactic procedures, such as total abdominal colectomies for familial adenomatous polyposis. In an attempt to control for this, ASA as a proxy for illness severity was examined but found not to impact our study outcomes.

4. Conclusion

This study corroborates the existing literature that pediatric colorectal ERAS pathways can be safely implemented and reduce time to oral intake, length of stay, and hospital perioperative total opioid use. This study expands the current literature to include patients who are undergoing open surgery and supports laparoscopic surgery data. Further evaluation and prospective studies are needed to identify specific ERAS pathway factors that lead to surgical quality improvements.

Declarations of competing interest

None.

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpedsurg.2020.09.028.

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