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Comparison of Colostomy Reversal Outcomes in Paediatric Patients with Enhanced Recovery after Surgery vs. Traditional Care Protocol

Salman Ali, Hamza Sohail, Tahir Shahzad Nawaz Babar, Anum Manzoor, Ismael Asif, Sayed Elyas

Abstract

Objective: Comparing postoperative outcomes, particularly hospital length of stay (LOS), between paediatric patients undergoing colostomy reversal following Enhanced Recovery After Surgery (ERAS) and Traditional Care Protocol (TCP).

Study Design and Setting: This randomized clinical trial (RCT) was conducted at the Children's Hospital & Institute of Child Health, Faisalabad.

Methodology: Sixty paediatric patients (aged 2–13 years) who underwent colostomy reversal were enrolled in the study, over a period of three months from the date of commencement. patients were recruited using a non-probability consecutive sampling technique and were subsequently randomized into the ERAS group (n = 30) or the TCP group (n = 30). Categorical variables, such as gender and diagnosis, were summarised as frequencies and percentages.

Results: The study was completed by all sixty randomised patients, with a mean age of 6.78 ± 0.43 years, and 51.7% were male. The ERAS group had a significantly shorter mean hospital length of stay (5.3 ± 0.8 days) compared with the TCP group (7.1 ± 1.1 days; $p < 0.001$).

Conclusion: The application of the Enhanced Recovery After Surgery (ERAS) protocol in paediatric colostomy reversal resulted in a shorter hospital stay and earlier commencement of oral intake, without increasing postoperative complications compared to the Traditional Care Protocol (TCP).

Keywords: Anorectal malformation, Colostomy, Hirschsprung disease

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INTRODUCTION

Enhanced Recovery After Surgery (ERAS) is an integrated perioperative protocol that employs evidence-based interventions acting synergistically to produce an overall positive impact on patient outcomes. Multiple studies refer to this as the pathway of enhanced recovery. These proven perioperative components, when applied in combination, considerably enhance outcomes.[1] Procedures that involve prolonged presurgical fasting, chronic with delayed ambulation, and delayed oral resumption cause morbidity in 15 to 20 percent of stoma reversal cases, which can be improved by ERAS protocols.[2]

Over the past 20 years, Enhanced Recovery After Surgery (ERAS) has transformed postoperative care for adults through its evidence-based, multidisciplinary approach. However, its role in paediatric surgery is yet to be widely recognised. The ERAS concept emphasises optimising every stage of a paediatric patient's surgical journey before, during, and after the surgery, to promote faster recovery and reduce complications. The goal is to preserve regular bodily functions while reducing surgical stress. Preoperative counselling to prepare patients and families, nutritional optimisation to hasten recovery, and standardised pain management and anaesthesia protocols to ensure comfort

and safety are the essential elements of Enhanced Recovery After Surgery (ERAS). It also highlights the importance of early mobilization, the prudent use of antibiotics to avoid infection, and mechanical bowel preparation when required. Together, these measures reduce hospital stays, improve patient outcomes, and improve overall quality of surgical care for both adults and, increasingly, children.[3]

Through patient-centered strategies, ERAS protocol integrates evidence-based interventions aimed at reducing postoperative complications, standardising perioperative care, and accelerating recovery. By alleviating discomfort and enabling an earlier return to regular activities, it has also been demonstrated to improve Paediatric patient satisfaction, which is a significant development in contemporary perioperative care.[4,5]

Enhanced Recovery After Surgery protocol is a set of scientifically validated interdisciplinary approaches that aim to improve perioperative treatment and surgical outcomes. Many previous studies in adult colorectal surgery have shown that using ERAS protocol improved post-surgical recovery by reducing physiological stress from the surgical procedure and increasing early recovery and nutrition. Patients treated with the protocol of ERAS had faster recovery times due to fewer complications after surgery and better pain control using multimodal analgesia. As a result, hospital stays were shorter, decreasing the cost of healthcare and improving resource utilisation. Additionally, the ERAS protocol encourages patient interaction and education, which enhances the overall satisfaction level with the surgical procedure. The efficacy of the protocol of ERAS in colorectal surgery has driven its adoption in other surgical specialities, highlighting its ability to change traditional perioperative care protocol into a more efficient, patient-centred paradigm.[6]

A colostomy is the formation of an opening of the large bowel onto the surface of the abdomen for the excretion of faecal matter. In paediatric surgery, colostomy formation is often a damage control measure, such as in cases of Anorectal Malformation (ARM) or Hirschsprung's disease (HD), or a means of faecal diversion, such as in severe cases of peri-anal injuries.[7] Reversal of colostomy is a common treatment in Paediatric surgery that restores bowel continuity following a temporary colostomy. However, generally secure, it has a significant risk of complications. These include infection of wounds, anastomotic leak, bowel obstruction, incisional hernia, and postsurgical ileus. The probability of complications differs according to the child's nutritional health, chronic disease, time of colostomy, and surgical method. Careful perioperative evaluation, excellent technique of surgery, and appropriate postsurgical care are required to reduce risks and assure successful recovery after the colostomy reversal procedure in Paediatric patients.[8] The decision to undergo a colostomy procedure depends on various factors, including the extent of the underlying illness, the individual's overall health, and the potential for complications. Colostomy is a life-saving procedure for preterm/critically unwell infants, but it comes with problems.[9] A study conducted in Pakistan revealed that before surgical procedures for diseases like Hirschsprung's disease and anorectal malformation are undertaken, risks involved in the development of a colostomy should be taken into account. With careful surgical procedures and appropriate nursing assistance, complications can be avoided.[10]

This study was designed to compare the hospital length of stay (LOS) between paediatric patients undergoing colostomy reversal under Enhanced Recovery after Surgery (ERAS) and Traditional Care Protocols (TCP).

METHODOLOGY

The Paediatric surgery department of the Children's Hospital & Institute of Child Health, Faisalabad, conducted this single-centre, randomised clinical trial. This study was approved by the institutional review board (IRB) under registration no. 696/CH and ICH/FSD, and all study participants' parents/guardians provided written informed consent (IC). The randomized clinical trial number for this study was NCT07206836. The study began in August 2025 and culminated in October 2025. The sample size was calculated by using the Formula for comparing the two means:

$= 2(Z_{1-\alpha/2} + Z_{1-\beta})^2 \sigma^2/\Delta^2$.
In this formula,
$Z_{1-\alpha/2} = 1.96$ (two sided $\alpha = 0.05$)
$Z_{1-\beta} = 0.84$ (Power = 80%)
$\sigma = 1.265$ (SD)
$\Delta = 7.26 - 3.77 = 3.49$ (Means difference)

The World Health Organisation sample size calculator was used to compare two means, with á = 0.05 and a power of 80%. Based on the expected mean hospital stay of 3.77 days in the ERAS group and 7.26 days in the TCP group, and assuming a standard deviation of 1.265, the hypothetical minimum sample size was calculated to be 2 patients per group. Therefore, a total of 60 paediatric patients (30 in each group) were included using a non-probability consecutive sampling technique to account for variability and potential missing data, as the estimated minimum sample size was considered too small given the assumptions.

Children aged between 2 and 13 years, of either gender, who were scheduled for elective colostomy reversal were included in the study. Exclusion criteria included the presence of significant cardiac, endocrine, spinal, or haematological disorders, and a history of more than one abdominal surgery.

Study participants were randomised 1:1 to either the ERAS protocol or TCP using a computer-generated randomisation technique. Study participants and doctors could not be blinded because the interventions were not kept secret. The data analyst, however, was unaware of the group assignment.

Paediatric surgeons with at least 5 years of post-fellowship experience performed all surgical procedures.

Postoperative LOS, or the number of days between surgery and the time of discharge, was the study's main outcome. Criteria for this included being afebrile for 24 hours, being able to tolerate solid food, having adequate pain relief with oral painkillers, and passing stool. Additional clinical observations included the number of days required to start oral feeding and the incidence of postoperative complications like prolonged ileus, anastomotic leak, infection of the wound, and vomiting.

In the ERAS group, the protocol included limited preoperative bowel preparation a day prior to the surgery with two per-rectal (or distal colostomy loop) enemas administered 12 hours apart, oral antibiotics, laxatives, and restriction of diet to only clear fluids. Intake of clear fluids was permitted up to three hours preoperatively. Intraoperatively, a caudal epidural block for analgesia and minimal bowel handling were employed. Postoperatively, multimodal opioid-sparing analgesia, removal of the nasogastric tube within 48 hours, early enteral feeding with oral rehydration solution, and gradual advancement to a tolerated diet were implemented.

In the TCP group, the protocol involved three days of mechanical bowel preparation that comprised the following: daily administration of laxatives and distal colostomy-loop or rectal enema, restriction of the diet to clear fluids only, and oral antibiotics. Postoperatively, routine opioid analgesia was used; the nasogastric tube was kept in situ for a minimum of three days, with the patient-maintained nil per os. Enteral feeding was initiated after nasogastric tube removal, typically on postoperative days three to four.

A pre-designed proforma was used to collect all the data, and IBM SPSS version 27.0 was used for analysis. Age and hospital length of stay are examples of continuous variables that are displayed as mean and standard deviation. Frequencies and percentages were found for categorical variables. The independent samples t-test was used to compare the mean hospital stay which was the primary outcome, between the ERAS protocol and the Traditional Care Protocol groups. The analysis used stratification to control age, gender, and diagnosis as effect modifiers to account for potential confounders, and an independent t-test was used post-stratification.

RESULTS

Table 1 shows the preoperative characteristics of the 30 participants in each of the ERAS and TCP. The mean age of the ERAS group was 6.7 ± 0.4 years, while that of the TCP group was 6.9 ± 0.5 years ($p > 0.05$). There were 16 males and 14 females in the ERAS group, and 15 males and 15 females in the TCP group. Anorectal malformation was identified in 40.0% of patients in the ERAS group and 43.3% in the TCP group. Hirschsprung's disease was diagnosed in 53.3% of the ERAS group and 50.0% of the TCP group. Other causes of colostomy formation were observed in a small proportion of patients.

As seen in Table 2, ERAS group had a significantly shorter mean hospital length of stay, 5.3 ± 0.8 days, as compared to TCP group, 7.1 ± 1.1 days, p-value less than 0.001.

DISCUSSION

A study conducted by Bhasker et al. showed that the ERAS group had a significantly shorter postsurgical hospital stay, averaging 3.7 days vs. 7.2 days for traditional care protocol. Only one child in the group of ERAS had difficulties, whereas 9 cases were reported in the group of TCP that developed some complications; however, none required surgical intervention. Additionally, 1 patient in the ERAS group needed antiemetics. These findings indicated that the group of ERAS protocol had substantially decreased stay in hospital and postsurgical problems or complications, enhancing recovery and decreasing the requirement for extra medication when compared to the general care pathway.[1]

A study conducted by Suliman et al. revealed that colostomy development and closure in Paediatrics are associated with a high risk of problems, involving bleeding, retraction, stenosis, prolapse, infections, and stoma closure concerns like anastomotic leaks and bowel obstruction. These issues are more common in Paediatrics than in the older population and can impair their growth and general quality of life (QoL).

Table 1: Participants' baseline characteristics

Variable	ERAS Group (n=30)	TCP Group (n=30)	p-value
Age in years	6.7 ± 0.4 years	6.9 ± 0 .5 years	> 0.05
Distribution of Gender (Male/Female)	16 / 14	15 / 15	> 0.05
Diagnosis			
1. Anorectal malformation	12 (40.0%)	13 (43.3%)	>0.05
2. Hirschsprung disease	16 (53.3%)	15 (50.0%)	>0.05

Table 2: Clinical outcomes comparison across both groups

Outcomes	ERAS Protocol Group (n=30)	TCP Group (n=30)	P-value
Duration of Hospital stay (days)	5.3 ± 0.8 days	7.1 ± 1.1 days	< 0.001

Understanding the incidence and associated risk/risk factors are critical for better surgical planning and post-surgical care. The results emphasise the importance of standardised management measures and enhanced assistance for families in order to decrease morbidity and improve outcomes. In general, this analysis provides information to help clinicians improve their practice and impact future Paediatric surgery guidelines.[11] Formation of colostomy and the subsequent closure in children are complicated surgical procedures that are associated with a high risk of postsurgical complications, resulting in morbidity. Infection of wounds, stoma prolapse, bowel obstruction, electrolyte imbalance, and delayed healing are all potential complications. The high occurrence of such complications emphasises the requirement for enhanced perioperative care protocols, like the ERAS protocol. ERAS protocol highlights validated approaches such as effective pain management, early feeding to children, early mobilisation, and minimal fasting durations to promote faster healing and prevent complications. These standardised interventions, which standardise care and focus on the child's overall physiological recovery, can shorten stay in hospital, lower costs related to healthcare, and enhance surgical outcomes. As a result, the introduction of standardised perioperative care protocol is crucial to ensuring safer and quicker recovery in children undergoing colostomy-based procedures.[12]

In the present study, the demographic characteristics of Paediatric patients in the ERAS and TCP groups were almost similar, decreasing potential confounding variables. The mean age of paediatric patients and the gender distribution of paediatric patients were also comparable, highlighting a well-balanced group. The primary surgical conditions, such as anorectal malformation and Hirschsprung disease, were also similarly distributed among both groups. This homogeneity in basic characteristics implies that any observed problems in postsurgical outcomes, like recovery time, complication proportions, and/or length of hospital stay, were most likely caused by perioperative care measures rather than variations in patient characteristics. Such comparability improves the internal reliability of the research by confirming that the impact measured is reflective of the protocol under consideration rather than demographic or diagnostic differences.

Implementation of structured perioperative care pathways in paediatric colorectal surgery has been shown to improve measurable outcomes, even when applied to younger age groups.[13] A meta-analysis conducted by Loganathan et al. included several studies with a high number of Paediatric patients. The outcomes showed that paediatric patients maintained under an ERAS protocol started tolerating enteral diet earlier and progressed to intake of age appropriate full diet faster than those receiving traditional care. Furthermore, the demand for opioid-based analgesics was significantly reduced in the ERAS group, indicating better postsurgical satisfaction and pain management. The period of hospitalisation was also significantly reduced, indicating a faster general recovery. Notably, the incidence of postsurgical complications and hospital readmissions were similar between groups, indicating that the extended recovery method improves recovery measures without raising clinical risk factors.[14] According to a meta-analysis including 2112 adult patients, early initiation of oral feeding following bowel surgery was associated with shorter duration of hospital stay.[15] According to another meta-analysis of four RCTs including 186 cases, early initiation of feeding in children following anorectal anastomosis supported early bowel function recovery, reduction in hospital stay, and reduction in the incidence of surgical infection, without increasing postoperative complications.[16]

Regarding postoperative morbidity, our findings revealed no significant difference in complication rates between the ERAS and TCP groups. The incidence of postoperative vomiting, wound infection, and anastomotic leak was low and comparable between groups. This observation supports the safety of ERAS in paediatric colostomy reversal, alleviating concerns that accelerated recovery might compromise patient outcomes. The favourable safety profile of ERAS has been consistently reported across multiple studies. The ERAS Society's recommendations for paediatric colostomy closure emphasise a significant reduction in surgical stress and the potential for lower complication rates.[17] Additionally, a meta-analysis of ten studies involving 1,298 patients demonstrated that enhanced recovery protocols in paediatric colorectal surgery reduce intraoperative fluid administration (through judicious use), postoperative opioid requirements, bowel recovery time, time to oral intake, hospital readmissions, length of stay, and overall healthcare costs.[18]

The success of the ERAS protocol can be attributed to the synergistic effect of its components, of which two major components are: opioid-sparing multimodal analgesia, and early commencement of enteral feeding. Multimodal analgesia effectively manages postoperative pain without opioids. A literature analysis and anecdotal data revealed that opioid-sparing multimodal analgesia is just as effective (or even slightly more) than opioid-based treatments in treating postoperative pain without the use of opioids.[19]

On the other hand, a review found that paediatric patients who were given early enteral nutrition had fewer post-surgical complications and faster recovery as compared to those who received delayed feeding. Early oral feeding was associated with lower complications related to infection and septic events, proposing improved immune and bowel recovery. Additionally, it allowed for an earlier return of bowel function and a shorter hospital stay, highlighting its function in accelerating recovery. These outcomes add to the increasing body of evidence that providing early nutritional support in paediatric surgical care is both safe

and beneficial.[20]

A retrospective case-control study was conducted by Dipasquale et al. (2022), which revealed that 61 procedures in 33 paediatric patients with inflammatory bowel disease assessed the effectiveness of the ERAS protocol versus the traditional care protocol. The results showed that the intervention of ERAS protocol resulted in a considerable decrease in surgical complication proportions and faster recovery of bowel function. Paediatric patients who were managed with the ERAS protocol had better surgical outcomes, with shorter hospital stays, and faster return to daily life activities. These findings show the effectiveness and safety of ERAS in paediatric inflammatory bowel surgery, promoting its increased adoption to improve recovery and minimise morbidity in this patient group.[21]

In a study, it was found that the ERAS protocol significantly lowers the length of stay in the hospital and shortens recovery duration following colostomy reversal in paediatric patients. There has been no rise in complications or readmissions in hospitals, indicating that it is a safe protocol, with improved inflammatory, metabolic, and dietary recovery characteristics. Reduced expenses and increased parental satisfaction indicate that the ERAS protocol is a better surgical management protocol than the traditional care protocol.[22]

Our study has a few limitations that should be acknowledged. For instance, because the study was conducted in a single child medical center, the outcomes may be limited in their relevance to other children's hospitals due to differences in surgical procedure techniques, patient populations, and healthcare facilities. Secondly, while the sample size was enough for evaluating the primary objectives, it may have been insufficient to uncover uncommon or infrequent complications. Thus minimising certain adverse events. Additionally, the study did not observe readmission rates or late postoperative problems, which are important markers of the long-term effectiveness and safety of the ERAS protocol. The lack of such follow-up data makes it difficult to have a complete understanding of the protocol's long-term effectiveness. To further solidify the evidence foundation, new multicenter studies with large sample sizes, greater follow-up durations, and standardized ERAS components are required to improve external validity and confirm consistency across clinical settings.

CONCLUSION

In this study, we compared the findings of paediatric patients operated under ERAS protocol to those paediatric patients who were operated under TCP protocol for colostomy closure. Both groups had similar baseline characteristics, like age, gender distribution, and primary diagnoses, e.g., anorectal malformation and Hirschsprung's disease, confirming their comparability. The findings revealed that the ERAS treatment procedure resulted in a significantly better postsurgical recovery than the standardised technique. Patients treated with the ERAS protocol had a shorter stay in the hospital, as compared to TCP. It indicates faster recovery and earlier discharge from the hospital. The improved outcomes can be attributed to the multidisciplinary, scientifically proven techniques integrated into the ERAS protocol, including improved pain management, early feeding and early mobilisation, all of which reduce surgical stress and promote physiological balance.

By emphasising patient-centered and focus on recovery care, the ERAS protocol helps to improve clinical effectiveness, minimise hospital stays, and increases satisfaction of paediatric patients. The protocol's organized approach standardises perioperative therapies, minimises clinical variability, and promotes collaboration across surgical anaesthesia and nursing teams.

Application of the ERAS protocol in paediatric patients having colostomy closure greatly enhances recovery as compared to standard treatment. These findings promote the broad adoption of the ERAS protocol in paediatric surgical practices, as it improves recovery, decreases stay in hospitals, and is an excellent resource utilisation. Additional research studies are needed to validate these outcomes and improve the ERAS components for implication in various surgical procedures and patient demographics.

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