Enhanced recovery protocols versus traditional methods after resection and reanastomosis in gastrointestinal surgery in pediatric patients

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Background **Enhanced recovery after surgery (ERAS) is a group of changes in perioperative care that represent a fundamental shift from the traditional management of the gastrointestinal (GI) surgical patient.**

Objective **To compare the results of applying enhanced recovery after GI resection in children versus the traditional methods.**

Patients and methods **This prospective study included 60 patients who underwent GI resectional surgery between February 2016 and February 2017 at our institution. The patients were divided into two groups: group A (30 patients) was managed with ERAS protocol and group B (30 patients) was managed with traditional methods. All the patients underwent standard hand-sewn technique of GI resection reanastomosis. The protocol of ERAS included no routine nasogastric tube, early diet advancement, minimization of narcotic analgesics, early ambulation, and physical rehabilitation.**

Results **The most frequent cause of GI resection reanastomosis surgery was intussusception (33.3% in group A and 36.7% in group B). Patients in group A had a significant lower frequencies of postoperative fever (33.3 vs. 66.7%, $P < 0.01$) and chest infection (26.7 vs. 60%, $P < 0.01$). Moreover, group A showed a significant shorter postoperative length of hospital stay (4 ± 1.2 days in group A vs. 7.1 ± 2.05 days in group B, $P < 0.001$).**

Conclusion **Adopting ERAS protocol for resectional GI surgery in pediatric patients should be encouraged as it is results in lower incidences of postoperative fever and chest infection and is associated with less postoperative length of hospital stay.** ***Ann Pediatr Surg*** **14:214–217 © 2018 Annals of Pediatric Surgery.**

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Introduction

Traditional postoperative nutritional management of gastrointestinal (GI) surgery depends on withholding nutritional supply until bowel function had resumed, as evidenced by either passage of flatus or bowel motion [1].

Enhanced recovery after surgery (ERAS) is a multimodal perioperative care protocol that represents a fundamental shift from the traditional management of the GI surgical patients. It uses an evidence-based protocol for standardizing care, while simultaneously recognizing the needs of individual patients [2]. The main components of ERAS depend on new approaches to preoperative preparation of the patient (i.e. nutrition, hydration, and bowel preparation) and postoperative pain control, activity, and feeding [3].

There are limited data on enhanced recovery protocol for pediatric surgery. There are multiple published reports discussing patient care with the use of that protocol; many of its aspects in the adult population have long been adopted by pediatric surgery [4].

Enhanced recovery in children has been applied to appendectomy, bowel resection and reanastomosis, fundoplication, nephrectomy, and pyeloplasty. These patients treated with an enhanced recovery pathway have less complications and shorter hospitalization and more patients and parents satisfaction [5,6].

This study was designed to compare the results of applying enhanced recovery after GI resection in children versus the traditional methods in terms of postoperative complications and postoperative length of hospital stay.

Patients and methods

This prospective study included 60 patients aged from 6 months to 14 years old who underwent GI resection reanastomosis surgery, between February 2016 and February 2017, at Unit of Pediatric Surgery, Minia University Hospital. Informed consents from parents of all patients have been taken before entering the study. The patients were divided in a randomized controlled trial into two groups: group A (30 patients) was managed with enhanced recovery protocol and group B (30 patients) was managed with traditional methods. The plane of the study was reviewed and approved by the ethical committee in our department.

We excluded patients younger than 6 months (as we considered them more fragile) or older than 14 years old (as they usually not to be admitted to our unit), cases needing stoma and redo GI surgeries, patients with peritonitis with local septic conditions, cases with

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intestinal malignancy, and patients who underwent laparoscopic GI tract surgery needing resection and reanastomosis.

All patients underwent preoperative thorough clinical assessment, imaging studies, routine laboratory test, and preoperative clinical fitness for surgery in elective cases by pediatric consultations. The standard steps of hand-sewn technique of GI resection reanastomosis were considered. Single-layer interrupted sutures by vicryl 4/0 were done for anastomosis for both groups.

The preoperative, intraoperative, and postoperative components of management protocol in each group are summarized in Table 1. The basic elements of the enhanced recovery protocol included shorter time of fasting, no routine nasogastric tube, no intraperitoneal drains, early diet advancement being just after returning of intestinal sounds, minimization of narcotic analgesics, early ambulation for older children, and physical rehabilitation.

In both groups, early discharge was targeted when the patient condition met the discharge criteria, which include good mobilization, adequate oral intake for liquids and solids, GI bowel function, at least one bowel movement, normal urinary function, no wound problems, pain control, body temperature not exceeding 38.5°C for at least 12 h, and parents know about possible complications and their detection. All patients were followed by a daily telephone call by a well-trained nurse, and the first outpatient visit was 10–14 days after the discharge or at any time before if the nurse or the resident received any complaint during the daily call.

Statistical analysis was performed using statistical package for the social sciences software (version 16; SPSS, Inc., Chicago, Illinois, USA). Continuous variables were displayed as mean ± SD whereas categorical variables were expressed as percentages. The Student's *t* test was used to assess the differences between means of continuous variables. χ^2 or Fischer's exact test was used to compare categorical variables. *P* values less than 0.05 were considered to be statistically significant.

Results

Demographic characteristics (Table 2) were similar between both the groups. There were no significant differences between the two groups regarding age and sex distribution ($P > 0.05$).

The causes of resection reanastomosis (Fig. 1) included intussusception (33.3% in group A vs. 36.7% in group B, $P = 0.78$), Hirschsprung's disease (16.7% in group A vs. 16.7% in group B, $P = 1$), closure of colostomy (20% in group A vs. 13.3% in group B, $P = 0.48$), mesenteric cyst (10% in group A vs. 6.7% in group B, $P = 0.64$), Meckel's diverticulum (13.3% in group A vs. 10% in group B,

Table 2 Demographic characteristic of patients in the studied groups

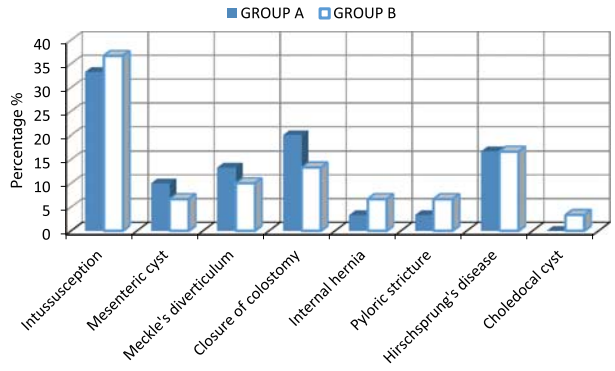
Variables	Group A ($N = 30$)	Group B ($N = 30$)	*P* value
Age (years)	1.6 ± 1.1	2.09 ± 1.8	0.20
Sex			
Male	14 (46.7)	18 (60)	0.30
Female	16 (53.3)	12 (40)	

Data are presented as mean ± SD and *n* (%).

Table 1 Components of management protocols in the studied groups (concept of multimodal surgical perioperative enhanced recovery pathway pioneered in the late 1990s by Professor Henrik Kehlet in Copenhagen 2 and modified by others)

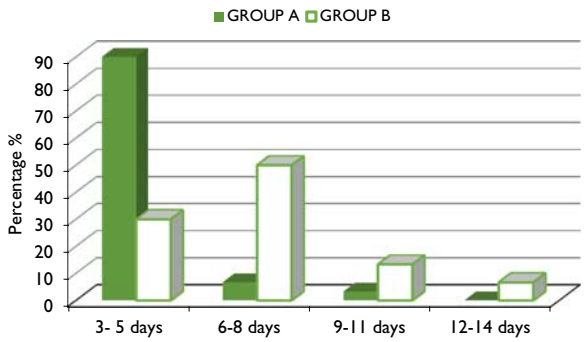
Variables	Group A	Group B	Both groups
Preoperative			
Fasting and carbohydrate loading	Fasting 6 h for artificial feeding and 4 h for breast feeding Intake of clear fluids until 2 h before anesthesia	Last meal until midnight and no oral intake at the day of surgery. In elective cases only	Nondiabetic patients receive carbohydrate loading preoperatively
Mechanical bowel preparation	No mechanical bowel preparation Rectal wash by diluted betadine may be done for fecal impaction after general anesthesia	Cleansing methods: osmotic agents, stimulant laxatives, or a combination of osmotics and laxatives	–
Medication	Prophylactic antiemetic	–	Antibiotic prophylaxis 1 h before surgery
Intraoperative			
Normothermia	–	–	An upper-body forced-air heating cover should be used routinely
Approach	–	–	Preferential transverse incisions to reduce postoperative pain
Nasogastric tubes	Reinserted only if ileus developed	Nasogastric tubes should be used routinely	–
Surgical drains	Avoided	Routinely used	–
Postoperative			
Hydration	Administer 75–80% of the calculated maintenance rate If need for more fluid, a bolus of crystalloid solution (10–20 ml/kg) is given	Administer 100% of the calculated maintenance rate	–
Nutrition support	The enteral diet is begun within 12–24 h, usually after returning of intestinal sounds	Nothing by mouth within 72 h until documentation of bowel function	–
Analgesia	Analgesia is used with paracetamol and NSAIDs	Analgesia is used with paracetamol and NSAIDs. Nalbuphine and ketorolac may be used in severe pain	–
Nausea and vomiting	Regular using antiemetic and prokinetics	Antiemetic and prokinetics only if vomiting developed	–
Urinary catheter	Early removal after the patient allowed oral fluid within 12–24 h	Removal if the patient allowed oral fluid within 48 to 72 h	–

Fig. 1



Causes of intestinal resection reanastomosis.

Fig. 2



Length of hospital stay after surgery in the studied groups.

Table 3 Comparison of postoperative complications between the studied groups

Variables	Group A ($N=30$)	Group B ($N=30$)	P value
Fever	10 (33.3)	20 (66.7)	0.009*
Paralytic ileus	9 (30)	11 (36.7)	0.58
Intestinal leakage	1 (3.3)	2 (6.7)	0.55
Chest infection	8 (26.7)	18 (60)	0.009*
Abdominal distension	9 (30)	11 (36.7)	0.58
Vomiting	7 (23.3)	10 (33.3)	0.39
Wound infection	4 (13.3)	6 (20)	0.48

Data are presented as *n* (%).
*Significant difference.

$P=0.68$), internal hernia (3.3% in group A vs. 6.7% in group B, $P=0.55$), pyloric stricture (3.3% in group A vs. 6.7% in group B, $P=0.55$), and choledochal cyst (0% in group A vs. 3.3% in group B, $P=0.31$). P values were put for each cause to find any significant difference in causes of both groups, and there were no significant differences between the two groups regarding the causes of resection and reanastomosis ($P>0.05$).

The postoperative complications in both groups are listed in Table 3. Compared with group B, patients in group A had a significant lower frequencies of fever (33.3% in group A vs. 66.7% in group B, $P<0.01$), and chest infection (26.7% in group A vs. 60% in group B, $P<0.01$), whereas there were no significant differences between both groups regarding occurrence of postoperative intestinal leakage, paralytic ileus, abdominal distension, vomiting, and wound infection ($P>0.05$).

The postoperative length of hospital stay ranged from 3 to 9 days in group A with a mean of 4 ± 1.2 days in group A, whereas it ranged from 5 to 12 days with a mean of 7.1 ± 2.05 days, which was significantly different between both the groups ($P<0.001$). The distribution of postoperative length of hospital stay is shown in Fig. 2. Most of patients in group A had hospital stay between 3 and 5 days (90% vs. 30% in group B, $P<0.001$), whereas most of the patients in group B had hospital stay between 6 and 8 days (50% vs. 6.7% in group A, $P<0.001$).

Discussion

The traditional practice of postoperative starvation after abdominal surgery recently has been challenged. Various clinical trials revealed that early enteral feeding has benefits in reduction of postoperative ileus and hospital stay [7].

As a multimodal perioperative care pathway, ERAS is designed to reduce the stress response during the patient's journey through a surgical procedure to facilitate the maintenance of postoperative bodily compositions and organ function with achievement of early recovery. The concept of multimodal surgical perioperative enhanced recovery pathway was pioneered in the late 1990s by Professor Henrik Kehlet in Copenhagen [2].

The main philosophy of the ERAS protocol is to attenuate the metabolic stress caused by surgical trauma and to support the return of functions that allow patients to recover rapidly [8].

There are limited data on ERAS for pediatric surgery. There are multiple published reports discussing streamlining patients care with ERAS use after surgical protocol in adults. Many of the aspects of enhanced recovery pathway in the adult population have long been adopted in pediatric surgery [4]. Our study assessed the outcome of the patients managed with enhanced recovery protocol and the patients managed with traditional methods after resectional GI surgery, comparing between them mainly regarding postoperative complication and postoperative hospital stay.

Fever was the most frequent postoperative complication in our study, as it occurred in 33.3% of group A (ERAS protocol) and 66.7% of group B (traditional methods), which was statistically significant.

In the study conducted by Sangkhathat *et al.* [9], fever occurred in 5.9% of ERAS group and 10% of traditional method group. In the study done by Yadav *et al.* [10], fever occurred in 13% of ERAS group and 42% of traditional method group, with statistically significant difference, which correlates with our finding.

The higher incidence of fever in our study in comparison with other studies may be related to the most frequent

diagnosis in both groups, which was intussusception. It was observed that intussusception usually presented late and was associated with high-grade fever and usually associated with stormy postoperative course, (as patients usually presented 24 h after the onset of symptoms) and this aggravated the systemic sepsis, explaining the high-grade fever.

Chest infection occurred in 26.7% of group A and 60% of group B in our study, which was statistically significant. The higher incidence of chest infection in group B may be explained by the longer postoperative hospital stay and the usually inserted nasogastric tube in group B.

The reduction of the rates of postoperative complications in ERAS group is likely to result from a combination of multimodal perioperative interventions, aiming to reduce metabolic response to surgery, to support the return of organ function, and to preserve postoperative immune system [3,11]. The quicker GI recovery in ERAS group might be partly owing to the combination of the administration of postoperative nausea/vomiting prophylaxis, fluid therapy, and the use of nonopioid analgesia in the ERAS pathway.

Our study demonstrates shorter postoperative length of hospital stay in group A with a mean of 4 versus 7.1 days in group B, which represents statistically significant difference between both the groups. This finding is consistent with similar comparative studies. In the study conducted by Sangkhathat *et al.* [9], the mean postoperative hospital stay was 4.5 days in ERAS group and 6.1 days in traditional methods group, with a statistically significant difference. Moreover, Yadav *et al.* [10] reported statistically significant difference in mean postoperative hospital stay, which was 7.2 days in ERAS group and 9.45 days in traditional methods group. Other noncomparative studies reported postoperative hospital stay ranged from 3.2 to 6.8 days after implication of ERAS protocol [5,12].

The reduced postoperative length of hospital stay after ERAS may be attributed to rapid GI recovery and reduction in rate and severity of postoperative complications related to this protocol of management.

Conclusion

In conclusion, patients who are managed with enhanced recovery protocols have less incidences of postoperative fever and chest infection and take less postoperative hospital stay than patients managed with traditional methods. Best results are achieved when the whole multidisciplinary team believes and takes part in the protocol and individual interventions are implemented all together. Therefore, surgeons should be confident in adopting enhanced recovery protocols as a part of standard practice for resectional GI surgery in pediatric patients.

Conflicts of interest

There are no conflicts of interest.

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