Outcomes of an enhanced recovery program after colorectal surgery: a single-center experience

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Background
Successful care of postoperative patients is dependent on optimal nutritional supports, which enhance wound healing and immune response. Enhanced recovery program (ERP) after surgery employs a multimodal perioperative care pathway with the aim of improving the stress response to surgery and outcomes across a range of participation from the patients, surgeons, anesthesiologists, pain specialists, and nursing staff.
Objective
The aim was to evaluate the outcome of fast-track rehabilitation program versus delayed oral feeding, regular forms of mobilization, and pain control in patients who underwent colorectal surgery.
Design
This is a prospective study.
Patients and methods
The present study included 60 patients who were admitted to the Ain Shams University Hospitals between September 2014 and April 2016. We prospectively compared 30 patients: group A submitted for ERP with 30 patients and group B submitted for conventional rehabilitation program for patient outcomes as regards hospital stay, rehabilitation, hospital readmission, and complications.
Results
Postoperative vomiting in group A occurred in eight (26.7%) patients, while 17 (56.7%) patients in group B without statistical significance, similar was the case with abdominal distention. The overall compliance in group A was better than in group B. Regarding pain control, only nine patients were in need for additional analgesia, while in group B no one was pain free, so additional analgesia was needed in 11 patients. During the hospital stay, only pulmonary complications and hypokalemia were statistically significant between the two groups (P=0.001 and 0.003, respectively). In group A, the mean total postoperative hospital stay was 4.2 ±1.56 days while in group B it was 8.4±1.6 days (P=0.0001).
Conclusion
ERP is safe and tolerable after colorectal surgery with no increase in postoperative morbidity and mortality. ERAS protocols should be implemented as the standard approach for perioperative care in colorectal surgery.

Keywords:
colorectal surgery, enhanced recovery, rehabilitation

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Introduction

Patients undergoing major gastrointestinal tract surgery are at risk of nutritional depletion because of surgical stress, inadequate nutritional intake, and increase in metabolic rate [1].

Enteral feeding may prevent gastrointestinal tract (GIT) mucosal atrophy, minimize the trauma stress response, maintain immune competence, and preserve normal gut flora when compared with total parental nutrition [2].

The rationale of nil by mouth is to prevent postoperative nausea and vomiting and to protect anastomosis by providing it time to heal before being stressed by food. It is however unclear whether deferral of enteral feeding is beneficial [3].

The idea of starting early enteral nutrition has been a topic of research in the past decade. Providing early enteral nutrition need to be more physiological, to prevent morphologic and functional trauma and to improve immune and inflammatory response and as well as being less expensive than total parenteral nutrition [4].

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Enhanced recovery program (ERP) after surgery is a multimodal approach that aims to optimize perioperative management. It is a package of evidence-based changes in preoperative, intraoperative, and postoperative care to improve organ dysfunction and surgical stress response to promote rapid recovery [5,6].

The key elements of an enhanced recovery pathway are extended patient information, preservation of gastrointestinal function, minimizing organ dysfunction, active pain control, and promotion of early mobilization [7].

The aim of this study was to evaluate the outcome of early oral feeding, balanced analgesia, and enforced mobilization which are integral parts of a fast-track rehabilitation program versus delayed oral feeding and regular forms of mobilization and pain control in patients who underwent colorectal surgery.

Patients and methods

The present study included 60 patients who were admitted to Ain Shams University Hospitals. All were submitted to urgent or elective colorectal surgery due to different reasons, either benign and malignant conditions, for example colorectal cancer or trauma.

After obtaining approval from the Ethics Committee of the Ain Shams University Hospital, the patients were randomly allocated into two groups. Randomization was achieved using sealed envelopes. After carefully explaining the purpose of the study, informed consent was taken from every patient.

The recruitment of patients started from the first of September 2014 till the end of April 2016 and the follow-up period was 2 weeks after discharge followed by data collection and analysis.

The patients in this study suffered from colorectal pathology managed by surgery with a possible curative respectability and the age group was above 20 and below 75 years.

Patients older than 75 years were excluded as well as patients with uncompensated cardiopulmonary disease, immunological disorders such as systemic lupus erythematosus and sarcoidosis and patients on immunosuppressive therapy for any cause. Also patients with advanced and disseminated malignancy, obstructed cases, and Crohn's disease were excluded.

Patients with contraindication to regional anesthesia, for example, coagulopathy or aortic stenosis or nearby infection in the back and patients with contraindication to NSAID, for example, low platelet count or bronchial asthma or gastritis or renal impairment were also excluded.

Patients with noncurative resection diagnosed upon surgical exploration or reoperated within the first 24 h or refused to complete participation were considered as dropouts.

Thirty patients (group A) submitted for ERP – who underwent GIT surgeries including different types of anastomosis either handmade or stapler assisted – were submitted to a fast-track protocol.

Patients in this group began clear fluids as soon as they were awake, a full liquid diet on postoperative day 1, and a normal diet on postoperative day 2 as tolerated (indicated by an absence of vomiting or abdominal distension).

The patients were given information on the importance of early mobilization and were encouraged to stay out of bed for 4 h on postoperative day 1, 6 h on the following day, and 8 h on subsequent days. Further they were asked to walk the length of the ward twice (60 m), once on postoperative day 1, twice on day 2, and three times on subsequent days.

In these patients, an epidural catheter was inserted at the low thoracic region (e.g. T8-9, T9-10, and T10-11 spaces) and continuous infusion of 2 mg/ml of levobupivacaine and 2 μg/ml of fentanyl, at a rate of 4–8 ml/h, was established. On the following morning, the concentration of levobupivacaine was reduced to 1.5 mg/ml using a portable infusion pump. Infusion was continued until the morning of postoperative day 4.

Patients in group B (conventional rehabilitation program): the other 30 patients were managed in the traditional way. Nothing by mouth for 5 days or until the resolution of ileus, and then a fluid diet, followed by a regular diet.

Patients were mobilized by nurses on demand and received regular instructions about the importance of mobilization. Mobilization was recorded for patients assisted by nursing staff in the same manner as for the intervention group.

Pain was controlled by giving 10 mg/ml paracetamol infusion to the maximum 500 mg paracetamol infusion bottles every 6 h and ketorolac tromethamine 30 mg ampoule by intravenous infusion in 100 ml normal saline solution every 12 h.

Pain intensity scores were assessed postoperatively using the visual analog scale system with a total scoring of 10. A score of 0: no pain, a score 1–3: mild pain, a score 4–7: moderate pain, and a score 8–10: severe pain.

All patients included in this study were subjected to preoperative assessment including complete history taking, assessment of the patient as regards the presence of concomitant cardiovascular or pulmonary disease and clinical examination.

Laboratory investigations including complete blood picture, bleeding and clotting time, urea, creatinine, random blood sugar, alanine aminotransferase, aspartate aminotransferase, and serum electrolytes were done.

Radiological assessment by plain radiograph of the abdomen and pelvis, chest radiograph, abdominal ultrasound, computed tomography abdomen, and colonoscopy if indicated.

All cases were properly prepared by correction of electrolyte and acid–base disturbance. Blood was transfused if indicated. All patients underwent colonic preparation either elective or emergency (manual decompression or on table lavage).

Postoperative assessments were done including clinical assessment for the occurrence of early postoperative complications, for example, anastomotic leak, abdominal distension, vomiting, wound infection, delayed wound healing, deep venous thrombosis (DVT), chest infection, bowel obstruction, intra-abdominal abscess as well as nonsurgical cardiovascular or pulmonary complications, electrolyte disturbance, duration of hospital stay, and readmission rate.

All patients were discharged vitally stable, open bowel, and with dry wound.

Statistical analysis

'Data were described in terms of mean (SD), median and range, or frequencies (number of cases) and percentages when appropriate. For comparing categorical data, the 'χ^2-test' was performed. '*P* values' less than 0.05 were considered statistically significant. All statistical calculations were done using the program 'IBM SPSS Statistics' (statistical package for the social sciences; IBM Corp., USA) and the graph Pad Prism.

Results

This study included 60 patients who underwent colorectal surgeries and were randomly allocated into two groups: group A included 30 patients who were submitted to ERP and group B included 30 patients managed in the usual way.

The demographic data of both groups did not show any statistical significance as the age incidence in group A was nine patients under 50 years and 10 patients between 50 and 60 years and 11 patients more than 60 years with a mean age of 54.4 years, while in group B, three patients were under 50 years and 10 patients were between 50 and 60 years and 17 over 60 years with a mean age of 59 years. There were 15 men (50%) and 15 women (50%) in group A, while group B included 18 men (60%) and 12 women (40%).

In group A, eight patients were of normal weight, 13 overweight, and nine were obese, while in group B one patient was of average body weight, 20 patients were overweight, and nine patients were obese (P=0.031). Group A was associated with a higher incidence of comorbid diseases than group B (70 vs. 33.3%) (P=0.004). Most of the associated diseases were in the form of diabetes (16.7 vs. 23.3%), hypertension (76.2 vs. 30%), IHD (9.5 vs. 0%), and one patient in group A had a history of old DVT and another one had a history of rheumatoid arthritis.

As regards the preoperative evaluation and the nature of the colonic mass in both groups, the results showed no statistical significance (Table 1).

Patients in both groups underwent different types of resection and anastomosis for different reasons either urgent or elective. We also used different types of anastomosis either handmade or stapler (Table 2), we did not face any case that require more than one anastomosis.

Table 1 Comparison between two groups as regards the nature of colorectal pathology

Nature of colorectal disease	Groups [*n* (%)]		^{MC}P
	Study	Conventional	
Benign	7 (23.3)	11 (36.7)	0.260
Malignant	23 (76.7)	19 (63.3)	

MC, Monte Carlo test. $^{*}P$ value is statistically significant.

Table 2 Comparison between the two studied groups according to operative details

Surgery data	Groups [*n* (%)]		^{MC}P
	Study (*N*=29)	Conventional (*N*=29)	
Colonic preparation			
Elective	25 (86.2)	26 (89.7)	0.688
Urgent	4 (13.8)	3 (10.3)	
Type of anastomosis			
Handmade	16 (55.2)	19 (65.5)	0.440
With steppler	13 (44.7)	10 (34.5)	

MC, Monte Carlo test. **P* value is statistically significant.

One patient in group A with rectal cancer did not underwent resection due to accidental discovery of locally advanced irresectable tumor, while one patient in group B underwent re-exploration within 24 h for hemorrhage from splenic injury and splenectomy was done and those two patients were managed as dropouts in the rest of the result analysis. One patient from each group underwent closure of loop colostomy without resection.

In group A all patients started oral fluids on the day of the operation without waiting to passage of flatus under the condition that there was no vomiting and the patient tolerating oral feeding (Fig. 1), while in group B all patients were nothing per mouth (NPO) from day 0 to day 2.

Patients not tolerating to advance their nutrition, for example, presence of nausea; were continued on the same pattern of nutrition or are dependent on parenteral nutrition specially if the patients did not started oral fluid diet till day 5. One patient from group A stopped oral feeding for one day on day 4 due to vomiting while one patient from group B stopped oral feeding on day 6 due to the same cause (Figs 2 and 3).

By reaching day 3, the ileus was resolved in all patients of group A while in group B five patients had sluggish peristalsis till day 4 and resolution of ileus in those five patients occurred on day 5 with a *P* value of 0.001 (Fig. 4).

Postoperative vomiting in group A patients occurred in eight (26.7%) patients and maximum frequency was three times in one patient, while 17 (56.7%) patients in group B complained of vomiting with a frequency of three times in four patients (Fig. 5).

There was no statistical significance as regards abdominal distention in both groups (Fig. 6). Severe abdominal distention was controlled by stoppage of oral feeding and correction of the ileus. One patient in each group needed reinsertion of the ryle to control repeated vomiting and deflate distention.

Mobilization was recorded for patients assisted by nursing staff in the same manner in both groups. In group A the range of stay out of bed was 0–4 h with a mean of 3 h and 27 min which increased gradually on subsequent days, on day 5 all hospitalized patients of these groups were able to stay out of bed for 8 h (Table 3).

While in group B the range of stay out of bed was 0–2 h with a mean of 48 min and showed a less progressive increase than that of group (A) as it reached 0–4 h on day 5 with a mean of 1 h and 50 min. Thus, the period of stay out of bed was significantly more in group A patients than in group B in different days (Table 3).

In group A, 26 (89.7%) patients were of good compliance and walked the planned distance for day 1 (60 m) while in group B just six patients walked the 60 m for day 1 and 79.3% of patients preferred not to walk on that day, five patients on day 2 and single patient on day 7 preferred to stay in bed without walking (Table 3).

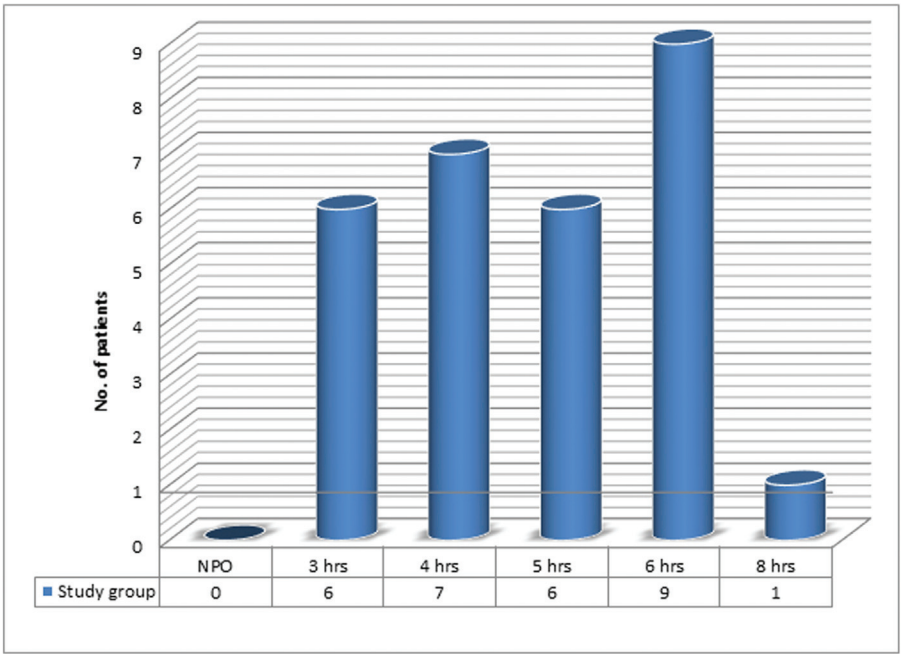
Regarding pain control, only nine patients were in need of additional analgesia in the form of diluted ketorolac tromethamine ampoule in divided doses to reach pain-free status and no one suffered from severe pain in group A. While in group B no one was pain free all over the postoperative period, so additional analgesia was needed in 11 patients in the form of diluted nalorphine ampoule as they could not tolerate pain till the time of the following dose (Fig. 7).

During the hospital stay, other complications were diagnosed and are documented in Table 4; only pulmonary complications and hypokalemia were statistically significant between the two groups (*P*=0.001 and 0.003, respectively).

The anastomotic leak that occurred in one patient in group A after extended right hemicolectomy and ileorectal anastomosis was managed by re-exploration and ileostomy. While in group B it occurred in one patient who underwent sigmoid colectomy and colorectal anastomosis which was managed by re-exploration and Hartman's procedure.

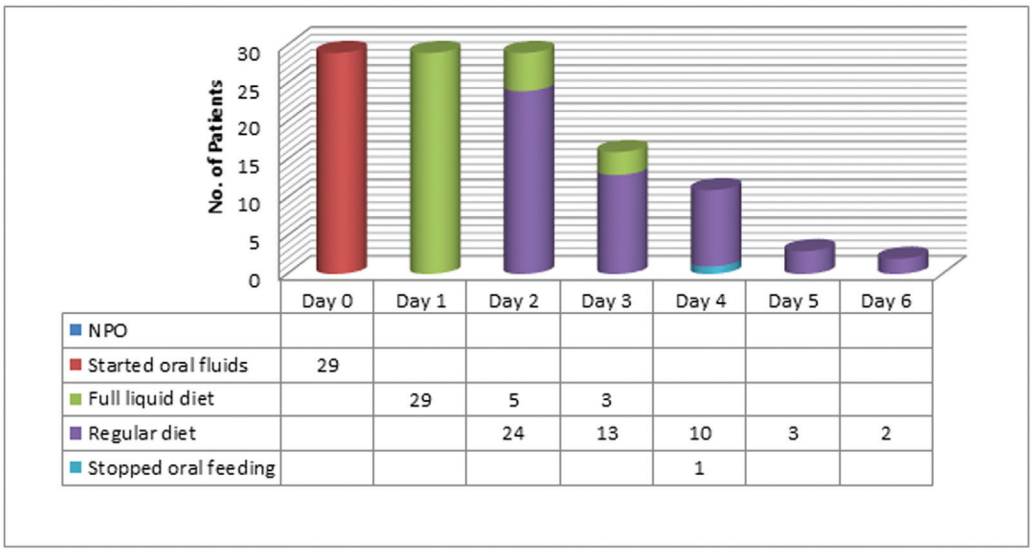
The ICU stay was not affected statistically in both groups, but the intermediate care stay was significantly longer in the study group in contrast to the ward stay

Figure 1



Start oral fluids in group A.

Figure 2



Oral nutrition sequence in the study group.

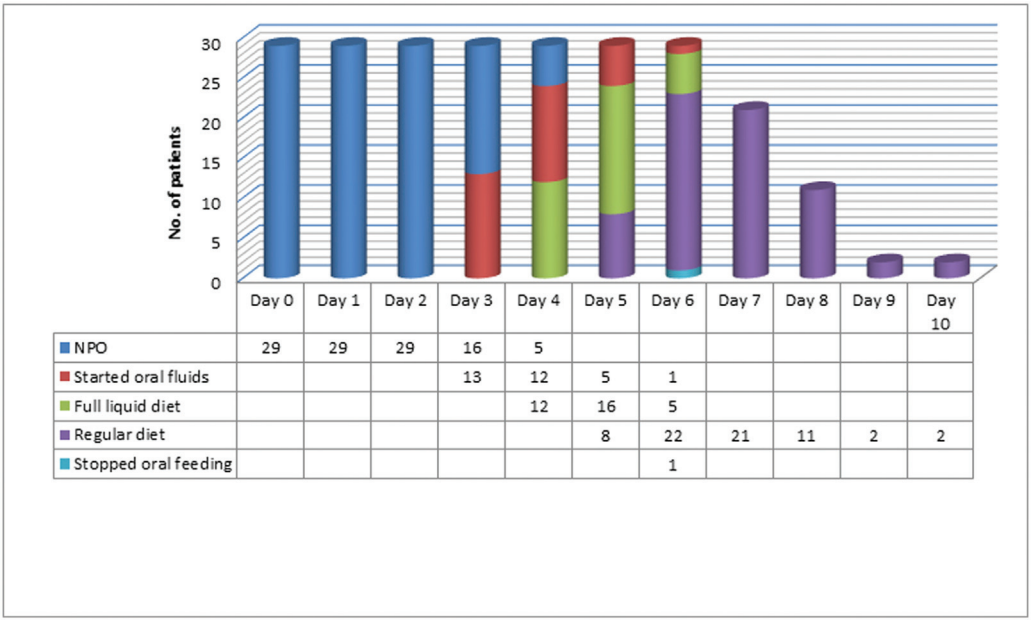
which was markedly reduced in the study group showing a high statistical significance (Table 5).

In group A, the mean total postoperative hospital stay was 4.2±1.56 days while in group B it was 8.4±1.6 days with a *P* valve of 0.0001 (Fig. 7).

Three patients were readmitted after discharge in group A (10.3%), one patient was admitted 4 days after discharge due to a burst abdomen which was managed by tension sutures under general anesthesia. The second patient was admitted 5 days after discharge by wound gaping and managed by frequent dressing and secondary sutures under local anesthesia and the third patient was admitted 6 days after discharge due to pelvic abscess managed by ultrasound-guided drainage and antibiotics according to culture and sensitivity.

In group B, three (10.3%) patients were readmitted after discharge. One patient was admitted 4 days after discharge due to a burst abdomen which was managed by tension sutures under general anesthesia, Two patients were admitted after discharge by wound

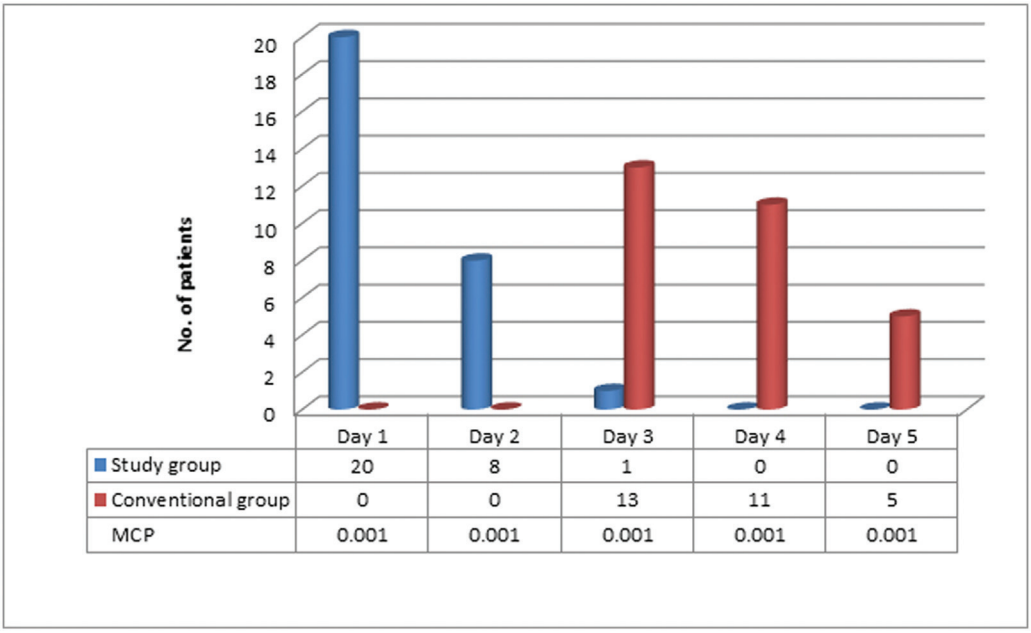
Figure 3



	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
NPO	29	29	29	16	5						
Started oral fluids				13	12	5	1				
Full liquid diet					12	16	5				
Regular diet						8	22	21	11	2	2
Stopped oral feeding							1				

Oral nutrition sequence in the conventional group.

Figure 4



	Day 1	Day 2	Day 3	Day 4	Day 5
Study group	20	8	1	0	0
Conventional group	0	0	13	11	5
MCP	0.001	0.001	0.001	0.001	0.001

Comparison between resolution of ileus.

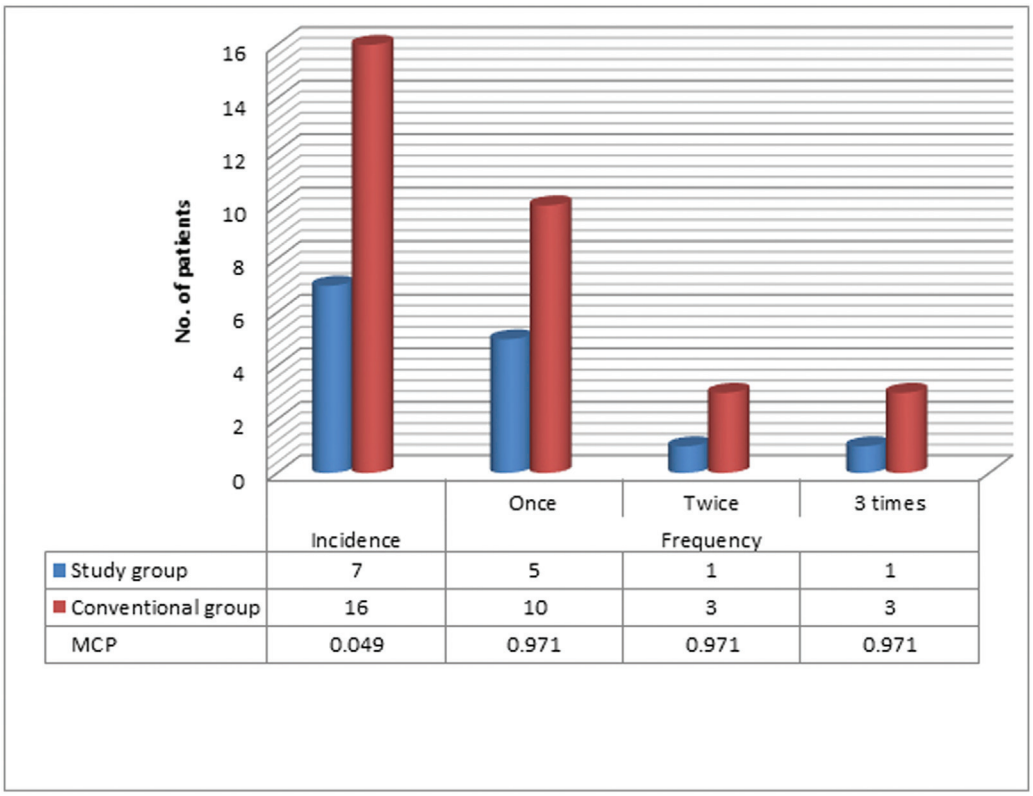
gaping one of them was admitted 4 days after discharge and the other patient was admitted 7 days after discharge and both of them were managed by frequent dressing and secondary sutures under local anesthesia (Fig. 8).

Discussion

The fast-track technique sometimes referred to as enhanced recovery after surgery has been introduced in the context of better understanding of perioperative pathophysiological processes. It is applied before the surgery, during preoperative period and after surgery. In general, the fast-track principles shorten the duration of hospitalization and recovery and lowers morbidity connected with pulmonary, thromboembolic, and infectious complications.

This study has been conducted to evaluate the concept of early oral feeding, thoracic epidural analgesia to

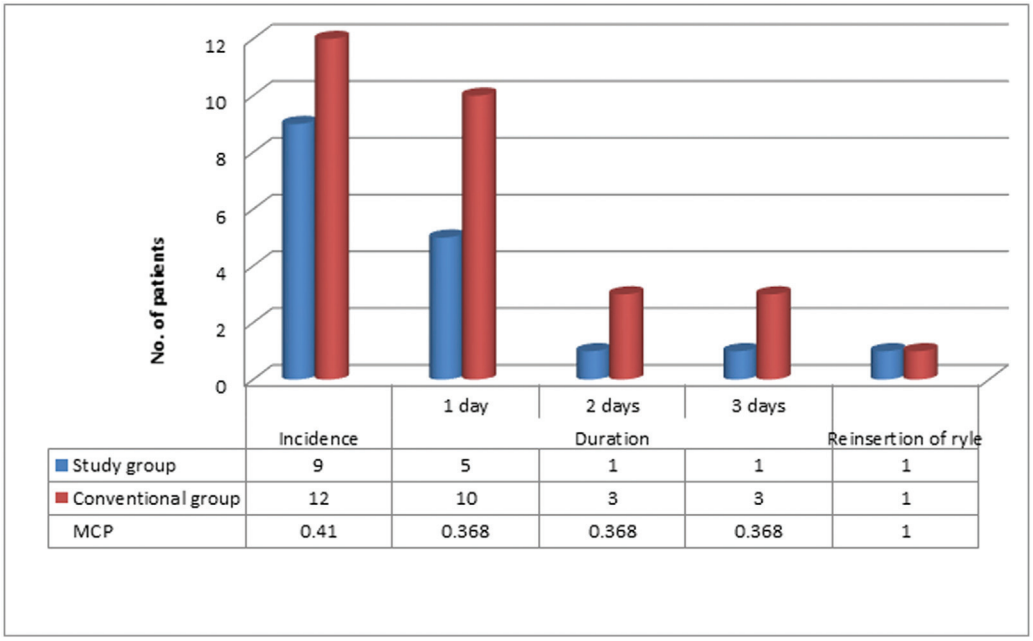
Figure 5



	Incidence	Frequency		
		Once	Twice	3 times
Study group	7	5	1	1
Conventional group	16	10	3	3
MCP	0.049	0.971	0.971	0.971

Comparison between incidence and frequency of vomiting.

Figure 6



	Incidence	Duration			Reinsertion of ryle
		1 day	2 days	3 days	
Study group	9	5	1	1	1
Conventional group	12	10	3	3	1
MCP	0.41	0.368	0.368	0.368	1

Comparison between incidence and duration of distention.

control postoperative pain and enforced mobilization protocol and integral parts of ERP compared with delayed oral feeding, conventional analgesia, and mobilization as tolerated by patients in terms of primary outcome parameters such as hospital stay, and surgery-related immediate postoperative complications in patients undergoing emergency or elective colorectal surgery.

Table 3 Comparison between periods of stay out of bed in both groups

Period of stay out of bed by	Groups		*t* (*P*)
	Study (h:min)	Conventional (h:min)	
Day 1			
Range	0.00–4.00	0.00–2.00	13.4 (0.001)*
Mean	03:27	00:48	
SD	00:55	00:35	
Day 2			
Range	2.00–6.00	0.00–3.00	16.7 (0.001)*
Mean	05:22	01:18	
SD	1:05	00:52	
Day 3			
Range	4.00–8.00	0.00–4.00	14.8 (0.001)*
Mean	7:00	01:51	
SD	01:35	0:55	
Day 4			
Range	8.00–8.00	01.00–4.00	16.0 (0.001)*
Mean	08:00	01:53	
SD	00:00	00:54	
Day 5			
Range	8.00–8.00	0.00–4.00	10.9 (0.001)*
Mean	8.00:00	01:50	
SD	00:00	00:30	
Day 6			
Range	8.00–8.00	0.00–6.00	0.01*
Mean	8:00	03:22	
SD	00:00	01:42	
Day 7			
Range	–	0.00–6.00	–
Mean	–	03:52	
SD		01:28	
Day 8			
Range	–	1.00–8.00	–
Mean	–	04:45	
SD		01:44	
Day 9			
Range	–	1.00–6.00	–
Mean	–	03:42	
SD		02:40	
Day 10			
Range	–	1.00–5.00	–
Mean	–	03:00	
SD		02:43	

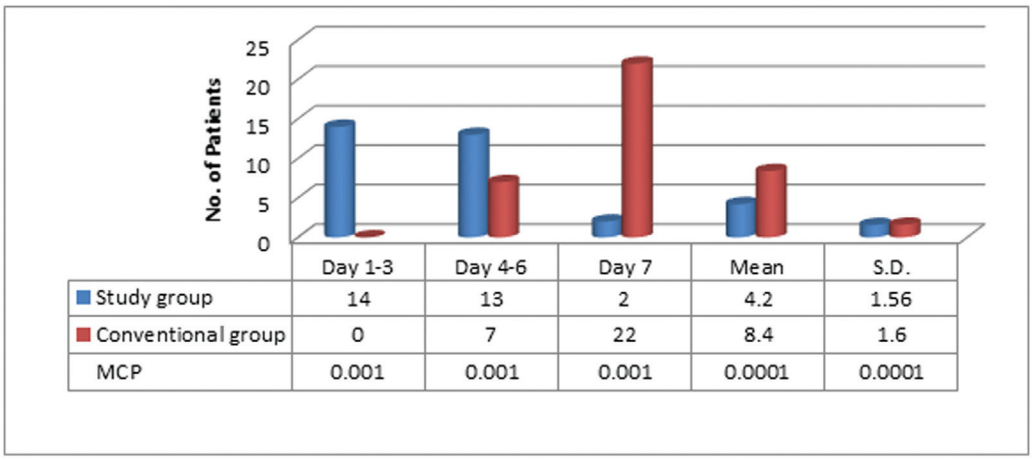
**P* value is statistically significant.

As regards age and sex, in this study, no relation was observed between age and sex and tolerability and benefits of early postoperative feeding, compliance to early mobilization, and benefits of epidural analgesia. Difronzo *et al.* [8] observed that no significant differences were noted for age, but observed that men are more associated with early postoperative feeding intolerance than women. This idea is not supported by this study; also Petrelli *et al.* [9] did not find male sex to have an effect on tolerability of early oral feeding.

In this study, different indications for emergency bowel resection and different types of intestinal anastomosis were performed. No relation was observed between the type of anastomosis and tolerability and benefits of early postoperative feeding. Fanaie and Ziaee [10] found no effect of the type of anastomosis on tolerability and benefits of early postoperative feeding.

Lewis *et al.* [11] published a meta-analysis in 2001 looking at early feeding versus a restricted diet based on 11 studies, which concluded that there was no benefit in adhering to a restricted diet. Schilder *et al.* [12] showed bowel activity before flatus was passed which illustrates that patients tolerate fluid secretions of 1–2 l

Figure 7



Comparison between total hospital stay.

Table 4 Comparison between complications in both groups

Complications	Groups [*n* (%)]		^{MC}P
	Study	Conventional	
Cardiovascular complications			
Atrial fibrillation controlled onCordarone	1 (3.45)	0 (0.0)	0.601
Malignant hypertension controlled on Tridil	1 (3.45)	1 (3.45)	
No	27 (93.1)	28 (96.55)	
Pulmonary complications			
No	27 (93.1)	18 (62.7)	0.001*
Productive cough improved by expectorant	1 (3.45)	8 (27.6)	
Chest infection	1 (3.45)	3 (10.34)	
Wound infection	3 (10.3)	6 (20.68)	0.278
Anastomotic leak	1 (3.4)	1 (3.3)	0.1000
Hypokalemia	1 (3.4)	9 (31.03)	0.003*
UTI	0 (0.0)	2 (6.89)	0.15

UTI, urinary tract infection. **P* value is statistically significant.

from the stomach and pancreas immediately after surgery.

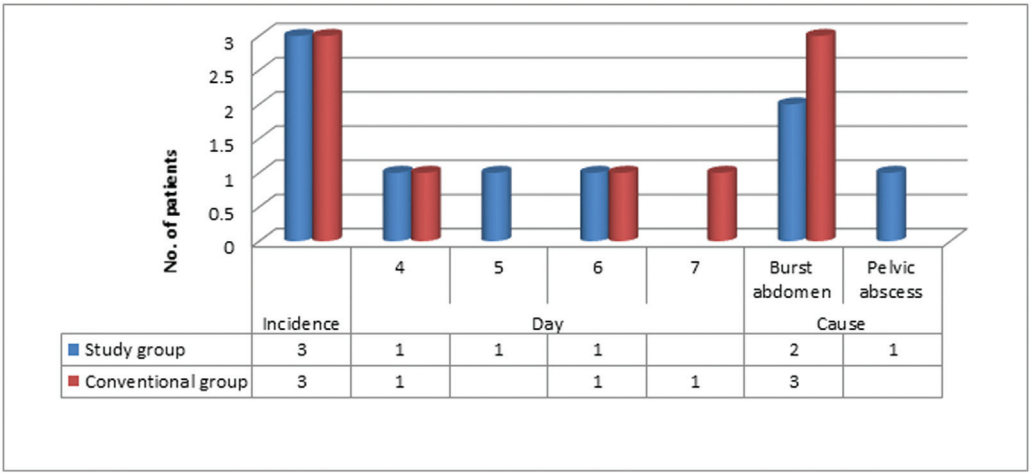
Thoracic epidural analgesia is often regarded to be the gold standard for postoperative pain relief. Gottschalk *et al*. [13] studied many clinical trials which concluded that thoracic epidural analgesia was superior to IV opioid analgesia after surgery as IV boluses of opioids cause inconsistent plasma level.

In a randomized, controlled trial by Şentürk *et al*. [14], on 69 patients undergoing surgery, epidural analgesia (0.1% bupivacaine and 0.05–0.1 mg. ml morphine) provided lower pain scores at rest and on coughing in comparison with intravenous morphine after surgery. This can be attributed to the additive analgesic effect of morphine to local anesthetic both peripherally and centrally.

This study supports the beneficial effect of early postoperative feeding on postoperative morbidity. There was no increase in the rate of important postoperative complications; wound infection occurred in three (10%) cases in the early-fed group versus six (20%) cases in the traditional group. One case of burst abdomen and another one of wound dehiscence occurred in the early-fed group while wound gaping occurred in one case and burst abdomen in two cases in the control group. Also chest infection occurred in one (3.3%) case in the study group, while it occurred in three (10%) cases in the traditional group. The relative increased incidence of postoperative complication noticed in the traditional group was attributed to prolonged hospital stay and prolonged recumbence. However, comparing both groups no statistically significant difference was noted in certain complications such as wound infection, anastomotic leak, intra-abdominal abscess, and urinary tract infection.

Andersen *et al*. [15] conducted a systematic review of 13 randomized trials on 1173 patients undergoing

Figure 8



Comparison between readmision, incidence, timing, and cause.

Table 5 Comparison between the two studied groups as regards postoperative hospital stay

Admission days	Groups [*n* (%)]		*P*
	Study	Conventional	
ICU			
No	25 (86.21)	27 (93.1)	
1 day	4 (13.79)	2 (6.9)	0.251
Intermediate CU			
No	0 (0.0)	5 (17.24)	0.001*
1 day	0 (0.0)	23 (79.31)	
2 days	29 (100.0)	1 (3.45)	
Ward			
No	0 (0.0)	0 (0.0)	0.001*
1–2 days	16 (51.72)	0 (0.0)	
3–5	11 (37.93)	1 (3.45)	
>5	2 (6.9)	28 (96.55)	

**P* value is statistically significant.

gastrointestinal surgery. There were no significant differences between restricted and early postoperative diets, but the findings also suggested that there was no advantage to dietary restriction. Although not reaching statistical significance, the direction of effect in the analysis also indicated that earlier feeding may reduce the risk of postoperative complications.

Fanaie *et al.* [10] in 2005 found that early feeding in gastrointestinal seems to be safe, well tolerated, and not associated with increased postoperative complaints including ileus and postoperative complications such as wound dehiscence, infection, anastomotic leakage, and mortality. Difronzo *et al.* [8] also found no incidence of anastomotic leak in 200 patients studied for early postoperative feeding after open colon resection.

Fast-track rehabilitation was evaluated thoroughly in elective colonic surgery as mentioned by Schwenk *et al.* [16]. They also reported that fast-track decreased general complications from 20 to 30% to below 10%.

As regards the length of hospital stay, the main achievement of early postoperative feeding was the considerable reduction in hospital stay. In the present study, the length of hospital stay was significantly shorter among patients of the study group with a mean postoperative hospital stay of 4.1 days, while in the traditional group the median was 8.5 days with high statistical significant difference between the groups. This confirmed the beneficial effect of ERP after surgery in reducing the length of hospital stay with its physical, psychological, and economic benefits.

Raue *et al.* [17] reported that fast-track patients after laparoscopic sigmoidectomy were discharged on day 4, the range was 3–6 days and conventional care patients were discharged at day 7, the range was 4–14 days. Hjort Jakobsen *et al.* [18] had the same results of median hospital stay of 2 days versus 8 days in fast-track versus conventional care with less cost and more patients' satisfaction with earlier resumption of normal activities as well, but they reported more frequent readmissions, five fast-track patients versus one patient in conventional care.

As regards mortality, in this study no mortality was reported in the study group. This confirmed that ERP is not associated with increased mortality. Proske *et al.* [19] found that there were no significant differences in mortality between early oral feeding and delayed oral feeding after intestinal anastomosis.

Conclusion

Early oral feeding is safe and tolerable after colorectal surgery with no increase in postoperative morbidity and mortality. Epidural analgesia is a more effective method for postoperative pain control than conventional systemic analgesia. Enforced mobilization protocol helps patients to get early rehabilitation. The main achievement of ERP is the considerable reduction in hospital stay with its physical, psychological, and economic benefits. Finally, It was also suggested that ERP could be adopted after emergency or elective colorectal surgery.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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