Evaluation of an enhanced recovery program for elective open colorectal cancer surgery

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Background
Traditional colorectal surgeries usually require a relatively long hospital stay of around 12 days. Inadequate pain control, intestinal dysfunction, and immobilization are the main factors associated with delay in recovery. Fast track or enhanced recovery colorectal protocols have been used to optimize the perioperative care and to enhance postoperative recovery.

Objectives
This study aimed to determine the outcome of an enhanced recovery program for selected patients with colorectal malignancies subjected to elective surgery.

Methodology
This prospective study was carried out at Fayoum University Hospital from 2008 to 2013 and included 32 patients with colorectal cancer who had undergone elective open colorectal surgeries on the basis of the fast-track protocol. Hospital stay, perioperative morbidity, and mortality data were collected, analyzed, and recorded. All patients were followed up for 24 months.

Results
The mean (±SD) age of the patients was 48.2 ± 5.3 years; 22 patients were men and 10 were women. According to the ASA score, 34.4% of the patients were 1 and 65.6% were 2; 40.6% underwent low anterior resection, 34.4% underwent sigmoidectomy, and 25% underwent right hemicolectomy. The mean (±SD) length of postoperative hospital stay was 3.56 ± 0.24 days. There was no mortality and the overall morbidity rate was 25%; 3.1% of patients developed a wound infection, 3.1% of patients developed abdominal wall dehiscence, 15.6% of patients had persistent vomiting, and one patient (3.1%) required readmission and resurgery to manage anastomotic leakage and peritonitis.

Conclusion
An enhanced recovery program for elective colorectal cancer surgery has a very good impact on postoperative recovery as it shortens the length of hospital stay with high safety and good patient compliance; thus, we strongly recommend the application of such protocols, provided that there is availability of well-trained and adequately experienced personnel in equipped centers.

Keywords:
colorectal, early recovery epidural, enhanced recovery after surgery

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Introduction

Colorectal cancer is one of the most commonly diagnosed cancers in both men and women [1]. Surgery, which is still the first-line treatment, remains a high-risk procedure with clinically significant postoperative stress, complications (8–20%), and a lengthy postoperative hospital stay (average 8–12 days) [2]. This necessitate changes to the management policy of colorectal cancer [3], and hence the idea of fast-track surgery emerged, which is considered, by some authors, the most important innovation after the advent of laparoscopy (by Fowler and White [4] in the 1990s for colorectal surgeries) in the field of colorectal surgery as in other fields of surgery [5]. Fast-track surgery or enhanced recovery after surgery (ERAS) or multimodal surgery is defined as a multimodal pathway aiming to reduce surgical stress through a global package of preoperative, operative, and postoperative techniques, which, in aggregate, result in fewer complications, reduction in and the length of hospital stay, better recovery, and quicker return to work and normal activities [6].

The principles of ERAS were first introduced by Professor Henrik Kehlet [7] in 1997 when he delineated the undesirable sequelae of major surgeries to the surgical stress response and he believed that a multimodal intervention can lead to a major reduction

in such sequelae with improved recovery and reduction in postoperative morbidity and the overall costs. Four years later, Wilmore and Kehlet [8] was the first to coin the term fast-track surgery, which was originally related primarily to pain and length of hospital stay, and then evolved to mean different things to different parties. In a short period of time, ERAS has rapidly gained popularity worldwide [5]. Kehlet and Wilmore [9] concluded that the key factors that keep a patient in hospital include the need for parenteral analgesia (persistent pain), intravenous fluids (persistent gut dysfunction), and bed rest (persistent lack of mobility). Therefore, he described a clinical pathway based on optimal pain control, stress reduction with regional anesthesia, early enteral nutrition, and early mobilization.

ERAS Program Components include preoperative, intraoperative, and postoperative strategies combined to form a multimodal pathway.

Preoperative

Preadmission care

To optimize comorbidities (such as anemia, hypertension, or diabetes), cessation of smoking and alcohol intake and adequate education of the patient and his/her family are essential [10].

Preoperative measures

No prolonged preoperative fasting was needed, only for 2 hours for fluids and 6 h for solids [11]. Nondiabetic patients received carbohydrate loading on the day before surgery and 2 h before induction of anesthesia [12,13]. No mechanical bowel preparation was required as it could have caused dehydration, and fluid and electrolyte abnormalities [14]. No sedatives were allowed from the day before surgery [15].

Intraoperative

Maintenance of normothermia is mandatory to prevent coagulopathy, adverse cardiac events, and decreased resistance to wound infection [15]. Postoperative ileus was prevented by avoidance of fluid overload and adequate pain control [14,16]. A minimally invasive surgical approach by laparoscopy or transverse incision was used [17]. Fluid restriction is essential with care to avoid hypovolemia [18,19]. A nasogastric tube should be inserted only if ileus develops [20,21]. Drains are avoided as there is no evidence of a beneficial effect in reducing postoperative morbidity [22,23]. The use of epidural anesthesia and analgesia with infiltration of local anesthetics around a surgical incision should be a part of all fast-track protocols [15,24].

Postoperative

Overhydration should be prevented with discontinuation of intravenous fluid therapy as soon as possible with early commencement of enteral feeding [15]. Excellent epidural analgesia is very important with intravenous paracetamol and/or NSAIDs if needed, but opioids should be avoided [25]. Prevention of postoperative nausea and vomiting (PONV) through good perioperative oxygenation, use of prokinetics, antiemetics, β-blockers and dexamethasone, adequate pain control, and no opioids is believed to be effective by some authors in controlling PONV [6,26]. Early oral nutrition should be encouraged as early as possible [25]. Early removal of urinary catheters should be performed as the majority of patients can tolerate its removal on the first postoperative day [26–28]. Postoperative laxatives (oral or rectal) encourage earlier return of bowel function and reduce the incidence of postoperative ileus [29,30]. Early mobilization is the key element of ERAS in colorectal surgery, where a patient should be out of bed for at least 2 h on the day of surgery and 6 h thereafter [31]. Early discharge can be performed when the discharge criteria (e.g. good mobilization, adequate oral intake, no complications) have been fulfilled, followed by a daily telephone call by a well-trained nurse and the first outpatient visit 10–14 days after discharge [15].

Aim of this study

This study aimed to evaluate the outcome of the ERAS program in patients with colorectal cancer who were planned for elective surgeries.

Patients and methods

Study design

This study was designed as a prospective single-center study, which was carried out at the department of general surgery at Fayoum University Hospital during the period from April 2008 to June 2013 and included 32 patients with colorectal cancer who were subjected to surgery on the basis of the ERAS program. The ERAS used in our study was designed by the authors on the basis of published protocols [2,8,9,26]. For all the patients, full assessment of history, detailed clinical examination, and the investigations required were performed; a fully detailed written consent was obtained from every patient individually.

Inclusion criteria: 18 years of age or older, able to understand the requirements of the study, and able to provide adequate informed consent with an adult

responsible caretaker, diagnosed with uncomplicated colorectal cancer for elective surgery without the need for a stoma or any further surgical procedure, and no uncontrolled comorbidity with good general fitness, with an American Society of Anesthesiologists (ASA) score 1 or 2 (Table 1).

Our ERAS program

Preoperative care

All patients were admitted to the hospital 1 day before surgery to ensure that the preoperative measures were adhered to:

(1) Preoperative counseling and education were provided for each patient and his/her caretaker to reduce fear and anxiety, and included complete information on ERAS, its aim, and possible complications divided into four stages; the first stage refers to the period up to the surgery, the second stage refers to the day of surgery, the third stage is the recovery period after surgery up until discharge, and the fourth stage is post-discharge care and follow-up.
(2) Optimization of medical status of the patient by correction of any comorbidity.
(3) No mechanical bowel preparation apart from 120 ml single enema on the night before surgery only for patients with rectal cancer.
(4) No preoperative fasting; intake of clear fluids was allowed 2 h and solids 6 h before induction of anesthesia.
(5) Carbohydrate loading: (except for diabetic patients) 200 ml of fresh apple juice sweetened with three teaspoons of sugar (provides 167 kcal) was provided four to six times on the day before surgery and two times on the morning of the surgery.
(6) Prophylaxis against venous thromboembolism was administered using elastic compression stockings and low-molecular-weight heparin (enoxaparin 1 mg/kg/day subcutaneously) starting from the night before surgery until discharge.
(7) Preanesthetic medications: a β-blocker (50 mg atenolol oral tablet/day) was used; the first dose was administered 24 h before surgery and the second dose was administered on the morning of surgery and continued until discharge. Ultrashort benzodiazepines (midazolam 20 mg/kg intravenously), at a single dose, were administered the night before the surgery.

Table 1 American Society of Anesthesiologists classification [32]

ASA category	Preoperative health status	Examples
ASA 1	Normal healthy patient	No organic, physiologic, or psychiatric disturbance
ASA 2	Patients with mild systemic disease	Controlled hypertension or diabetes without systemic effects
ASA 3	Patients with severe systemic disease	Controlled congestive heart failure
ASA 4	Patients with severe systemic life-threatening disease	Unstable angina or symptomatic congestive heart failure
ASA 5	Patient not expected to survive 24 h without surgery	Multiorgan failure or systemic sepsis with hemodynamic instability
ASA 6	A brain-dead patient	

ASA, American society of anesthesiologists.

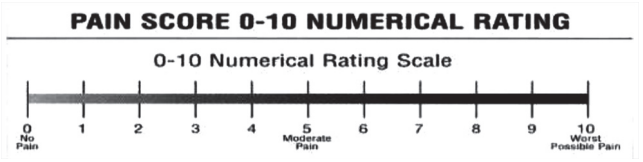
Intraoperative care

(1) Antibiotic prophylaxis was administered by a single dose of third-generation cephalosporins (ceftriaxone 2 g intravenously) at the time of induction of anesthesia together with an intravenous infusion of 1000 mg metronidazole.
(2) Anesthesia: combined thoracic epidural and general anesthesia was administered. Midazolam 1–2 mg intravenous was administered for anxious patients before placing the epidural catheter at T9–T10 or T10–T11 with administration of 6–12 ml of ropivacaine 0.2%; general anesthesia was induced with fentanyl and propofol using atracurium for curarization and sevofluorane in O_2/air to maintain anesthesia. The ventilation was set previously and adjusted during the operation with capnometric monitoring ($PetCO_2$ 32–38 mmHg). Finally, neostigmine was used at the end of the operation to antagonize the curarization.
(3) Transverse abdominal incisions were performed for all patients.
(4) Adequate intraoperative oxygenation was ensured.
(5) Intraoperative normothermia was maintained using an electric heating blanket applied on the thorax and the upper limbs and in the recovery room on the entire body.
(6) Intraoperative restriction of intravenous fluids usually to 1000–2000 ml of lactated Ringer.
(7) Close monitoring of blood sugar was performed, with tight glycemic control in diabetic patients.
(8) No nasogastric tubes were inserted.
(9) No drains were placed, except in patients with rectal cancer, where short-term drains were placed and removed after 24 h.
(10) Urinary catheters were removed at the end of surgery before transfer to the recovery room.
(11) Local anesthetic infiltration of the wound was performed using 20 ml of ropivacaine 0.5% plus 1 mg adrenaline 1 : 1000.

Postoperative care

(1) Postoperative multimodal pain control: Epidural analgesia was administered with morphine 0.5–1 mg and ropivacaine 0.2% in a bolus of 5 ml, followed by maintenance with morphine 0.04 mg/ml as 2 ml/2 h with orbivacaine 0.2% as 3 ml/2 h. The postoperative pain was monitored according to the Numerical Pain Rating Score (NPRS). In case of insufficient analgesia, an intravenous infusion of paracetamol 1 g was administered (up to three doses per day) and/or an intramuscular or an intravenous infusion of NSAIDS (diclofenac sodium 75 mg/3 ml) (up to three doses per day). This multimodal regimen was enough to achieve good pain control in most of our patients. The epidural catheter was removed on the third postoperative day for all patients.
(2) PONV were prevented by administration of ondansetron 8 mg/12 h intravenously, metoclopramide 10 mg intravenously/12 h, and dexamethasone 8 mg intramuscularly/24 days and atenolol 50 mg tablet/24 h. This regimen was followed for all patients starting immediately after surgery for 2–3 days when regular adequate oral nutrition was achieved with comfort.
(3) Postoperative ileus was prevented by ensuring good analgesia, oral laxatives (30 ml bisacodyl syrup) 4 h after surgery and after 12 h, and proper postoperative fluid intake that maintained urine output not less than 0.5 ml/kg/h without subsequent weight gain.
(4) Tight glycemic control was ensured, especially for diabetic patients, to prevent hyperglycemia through continuous monitoring of blood sugar every 2 h, with insulin therapy accordingly.
(5) Early oral nutrition: on the day of surgery and immediately after complete restoration of consciousness, all patients were advised to start chewing gum; 2 h later, all patients started oral intake with 50 ml apple juice every 2 h. If there was no vomiting after two drinks, we continued administration of fluids, average 500–1000 ml per day, and on the first postoperative day, patients started semisolids (jelly, low-fat yoghurt, and pudding) and small amounts of animal protein as small meals every 4 h, with an average fluid intake of 1000–1500 ml per day, and a high-protein diet from the second postoperative day and thereafter as three regular meals, with three snacks in between.
(6) Early mobilization was started 4–8 after surgery for at least 2 h with assistance on the day of surgery and 4–6 h/day independently from the first postoperative day thereafter (Figure 1).

Figure 1



Numerical Pain Rating Score [33].

Discharge and follow-up

Patients with colonic cancer (right colectomy and sigmoidectomy) were discharged on the third postoperative day, whereas patients with rectal and rectosigmoid cancer (low anterior resection) were discharged on the fourth postoperative day, provided that the patient was not in pain, could eat and drink comfortably, could walk freely, had good gastrointestinal motion, had normal urinary function, no wound infection, and no fever. We asked patients how satisfied they were with ERAS. Complete information on possible complications, wound care, maintenance of adequate nutrition, and adequate mobilization was also provided on discharge and this was followed up after the patient returned home through phone calls from the surgical nurse every 48 h for 10 days. The first follow-up visit at the outpatient clinic was scheduled 2 weeks after discharge and the second follow-up after one month, where we asked about pain, complications, fluid and food intake, and daily activities; moreover, a careful clinical examination was performed to detect any possible complications and body weight was measured to assess nutritional status. Then, the follow-up was scheduled every 3 months for 2 years and every 6 months thereafter.

Data on age, sex, diagnosis, surgical procedure, perioperative morbidity and mortality, length of hospital stay, independent mobilization, postoperative pain, sleep quality, and the degree of patient satisfaction were recorded and analyzed as mean ± SD, range, and percentage.

Results

Thirty-two patients were included in this study who initially fulfilled our inclusion criteria. Patient characteristics, tumor locations, and surgical procedures are presented in Table 2. The mean age (±SD) of the patients was 48.2 ± 5.3 years; 22 patients (68.8%) were men and 10 patients (31.2) were women. According to the ASA classification, 34.4% of patients were ASA 1 and 65.6% were ASA 2. All the patients underwent open surgery through a transverse laparotomy incision. 11 patients (34.4%) had carcinoma of the sigmoid

colon, eight patients (25%) had carcinoma of the rectosigmoid junction, eight patients (25%) had carcinoma of the right colon, and five patients (15.6%) had carcinoma of the upper one-third of the rectum. Low anterior resection made up the majority of surgical procedures, performed in 13 patients (40.6%), followed by sigmoidectomy in 11 patients (34.4%) and right hemicolectomy in eight patients (25%). No stomas were performed in any of the patients.

The mean duration of surgery was 142.4 ± 13.6 min, with no intraoperative complications. The mean time spent in the recovery room before transfer to the ward was 159.4 ± 25.4 min; all patients were transferred to the ward and none of them needed intensive care unit admission. The overall morbidity rate was 25% (eight patients), (Table 3); one patient (3.1%) developed a moderate superficial wound infection on the fifth postoperative day (after right hemicolectomy) 2 days after discharge and was treated with repeated dressing and a systemic antibiotic at home, with complete cure after 1 week. Another patient (3.1%) developed partial abdominal wall dehiscence on the fourth postoperative day (after low anterior resection for upper rectal cancer) the day discharge was planned; the patient was reoperated. The wound was closed with secondary tension sutures and systemic antibiotics were administered. The patient was advised to remain at the hospital for 3 more days after the second surgery; persistence of PONV for 24 h was observed in five patients (15.6%) that necessitated cessation of oral intake and use of antiemetic and prokinetic drugs such as ondansetron 16 mg intravenously/12 h and metoclopramide 10 mg intravenously/8 h, dexamethasone 8 mg/12 h, and intravenous fluids (1500 ml lactated ringer and 500 ml dextrose 10%). This regimen was successful for the treatment of PONV after 24 h in four patients (80%) and after 48 h in one patient (20%), with restoration of oral intake and discharge on time in three patients (60%) and 1 day later in two patients (40%) (the last two patients underwent low anterior resection for high rectal cancer). Finally, one patient (3.1%) required readmission and resurgery to manage anastomotic leakage and peritonitis that presented 6 days after surgery (2 days after discharge after low anterior resection for rectosigmoid carcinoma), where the patient underwent peritoneal lavage (which is the usual management in peritonitis) with closure of the rectal stump and left colon colostomy on the anterior abdominal wall. Postoperative management included close monitoring with parenteral antibiotics, intravenous fluid therapy, proton pump inhibitors, and NSAIDs, with nothing per oral for 3 days, after which oral intake was started gradually. Fortunately, this patient was discharged after 1 week in good general health and restoration of gut continuity was performed after 6 months.

In our study, the 30-day readmission rate was 3.1% and no postoperative mortality was encountered.

The mean (±SD) total postoperative hospital stay for all patients including primary admission-related and readmission-related days was 3.78 ± 0.25 days, whereas without readmission days was 3.56 ± 0.24 days. The mean (±SD) POHS in patients who underwent right colectomy and sigmoid colectomy was 3.15 ± 0.21 days, which was significantly shorter than postoperative hospital stay (POHS) in patients who underwent low anterior resection, which was 4.69 ± 0.27, with a *P* value = 0.01 (statistically significant) (Table 4).

The postoperative pain according to the NPRS was 3 in 25 patients (78.2%) and 4 in seven patients (21.8%) on the day of surgery, 3 in 27 patients (83.4%), and 4 in five patients (15.6%) on the first postoperative day, 2 in 23 patients (71.9%), 3 in eight patients (25%), and 4 in one patient (3.1%) on the second postoperative day, 2 in 29 patients (90.6%) and 3 in three patients (9.4%); on the day of discharge, NPRS was 2 in 28 patients (87.5%) and 3 in four patients (12.5%). During the first week after discharge, pain control was satisfactory, with a maximum NPRS of 2 at the first follow-up visit (Table 5).

Table 2 Patient characteristics, tumor locations, and surgical procedures

Variables (*n* = 32)	Value
Age (mean ± SD) (years)	48.2 ± 5.3
Sex [*n* (%)]	
Males	22 (68.8)
Females	10 (31.2)
ASA classification [*n* (%)]	
ASA 1	11 (34.4)
ASA 2	21 (65.6)
Location of the tumor [*n* (%)]	
Upper rectum	5 (15.6)
Rectosigmoid junction	8 (25)
Sigmoid colon	11 (34.4)
Right colon	8 (25)
Surgical procedure [*n* (%)]	
Low anterior resection	13 (40.6)
Sigmoidectomy	11 (34.4)
Right hemicolectomy	8 (25)

ASA, American society of anesthesiologists.

Table 3 Postoperative morbidity and mortality

Complications	Value [*n* (%)]
Mortality	0
Morbidity	8 (25)
Wound infection	1 (3.1)
Abdominal wall dehiscence	1 (3.1)
PONV	5 (15.6)
Anastomotic leakage	1 (3.1)

PONV, postoperative nausea and vomiting.

The first bowel movement occurred after a mean (±SD) of 23.1 ± 4.3 h after surgery. Patient satisfaction was excellent in 13 patients (40.7%), good in 12 patients (37.5%), acceptable in four patients (12.5%), poor in one patient (3.1%), and two patients (6.2%) provided no answer, with an overall rate of patient satisfaction of about 90.7%.

Discussion

The application of ERAS protocols in patients undergoing colorectal surgery, whether open or laparoscopic, positively affects the postoperative outcome [34]. The expanding evidence-based medicine shows that the ERAS program benefits not only all patients but also the health service [15].

The present study is the first application of an ERAS protocol at our hospital and aimed at assessing the possibility of its introduction into our clinical practice as the results presented in our study provide new evidence supporting the feasibility and safety of the ERAS program in the colorectal surgery.

It is worth mentioning that one of the most difficult challenges that we faced in this study is the collision with some deep-seated beliefs in the minds of patients who underwent abdominal surgery especially cancer, and it was extremely difficult to change such beliefs completely (e.g. early mobilization and keeping the patient out of bed shortly after surgery, early oral intake and early discharge), but fortunately we have succeeded to do our mission to a very good extent.

Table 4 Postoperative hospital stay (mean ± SD)

POHS (mean ± SD)	Value (days)
Total POHS with readmission days	3.78 ± 0.25
Total POHS without readmission days	3.56 ± 0.24
POHS in patients underwent colectomy	3.15 ± 0.21
POHS in patients underwent low anterior resection	
Without readmission days	4.15 ± 0.23
With readmission days	4.69 ± 0.27

Table 5 Postoperative pain control

Time	Numerical pain rating scale	Number of patients (%)
Day of surgery	3	25 (78.2)
	4	7 (21.8)
First postoperative day	3	27 (83.4)
	4	5 (15.6)
Second postoperative day	2	23 (71.9)
	3	8 (25)
	4	1 (3.1)
Third postoperative day	2	29 (90.6)
	3	3 (9.4)
On discharge	2	28 (87.5)
	3	4 (12.5)
At the first follow-up visit (1 week after discharge)	1	14 (43.75)
	2	18 (56.25)

Early postoperative mobilization is important in accelerated recovery, to reduce insulin resistance and the risk of thromboembolic complications, undesired muscle loss, and fatigue, and improve pulmonary function and tissue oxygenation [9]. In the present study, early mobilization was started for all patients on the same day of surgery (4–8 h after surgery) with assistance on an average of 2 h/day and for 4–6 h/day independently from the first postoperative day; this rate is slightly lower than that reported by some authors, who recommended earlier mobilization within 2 h or less after surgery and for longer periods (4 h in the day of surgery and 6–8 h/day thereafter) [25,35].

The first oral intake was started 2 h after complete restoration of consciousness and full orientation, which was usually achieved 2–4 h after surgery with about 1000 ml clear fluids (apple juice) divided into 50 ml/30 min on the day of surgery; some studies have reported that patients resumed a liquid diet 2 h after surgery and began to take a protein supplement orally 4 h later [36,37]. On the first postoperative day, we fed patients semisolids and small amounts of animal protein (50 mg) as a small meal every 4 h, with an average fluid intake of 1000–1500 ml per day, and from the second postoperative day, high-protein diets were provided as three regular meals, with three snacks in between. Frontera *et al.* [35] recommended only water for the patients on the first day, a liquid diet on the second day, a half liquid diet on the third day, and a solid diet on the fourth day, whereas some authors recommend a free diet from the first postoperative day [37].

Because fluid restriction is believed to enhance mobilization and recovery and reduce the complication rates [15], the patients in our study group received less intravenous fluid (total fluid intake both oral and intravenous should be around 1500 ml/day).

Our study found a mean postoperative hospital stay of 3.78 days with readmission and 3.56 days without readmission. A total of 18 patients (56.3%) were discharged on the third postoperative day, 11 patients (34.4%) were discharged on the fourth day, two patients (6.2%) were discharged on the fifth day to control PONV, and one patient (3.1%) was discharged 1 week after surgery because of reoperation to repair partial abdominal wall dehiscence. The mean postoperative hospital stay varies markedly in many studies: 2.44 days in the study by Zhuang *et al.* [38], 2.6 days in the study by Jakobsen *et al.* [25], 4 days in the study by Mohn *et al.* [39], 4.57 days in the study by Bona *et al.* [37],

and as high as 6 days in the study by Ramírez *et al.* [36] or even 6.9 days in the study by Frontera *et al.* [35].

Our 30-day readmission rate was 3.1%, which is in agreement with that of many studies that have reported rates ranging from 2.7 to 8.7% [31,36,37], and significantly lower than that reported in the study by Mohn *et al.* [39], in which the rate was 15%. Thus, some believe that the fast-track surgery will not reduce the readmission rate and consider readmission an adverse effect that reflects low medical quality [40,41]; however, others believe that it is because of a low threshold for readmission after accelerated discharge, which is a sign of quality and ensures the safety of patients [39].

The overall postoperative morbidity rate in the literature shows a wide range from 12.5 to 31% [31,36,38,39]; we recorded an overall complication rate of 25% (eight patients). The most common complication that we encountered was PONV in five patients (15.6%), which resulted in a delayed discharge of two patients (6.2%) 24 h beyond the planned time; this rate of PONA is consistent with that found in many of the studies, ranging from 4.3 to 13.8% [31,35,36,39], whereas currently there is no consensus on the exact regimen to prevent PONV. However, we believe that the use of a multimodal approach with prokinetic and antiemetic drugs (ondansetron 8 mg/12 h and metoclopramide 10 mg/12), β-blockers (atenolol 50 mg/day), excellent pain control, and opioid avoidance are the cornerstones to control PONV. β-Blockers are very effective for controlling transient acute autonomic responses to noxious surgical stimuli [26].

In our study, one patient (3.1%) developed wound infection, one patient (3.1%) had anastomotic leak with peritonitis, and one (3.1%) patient developed abdominal wound dehiscence, which is in agreement with the results reported in many studies [31,35,36].

For our patients, we did not carry out the traditional intestinal preparation because mechanical bowel preparation for colorectal surgeries has recently been the subject of considerable debate [42] as it was found that the use of polyethelyne glycol or sodium phosphate could negatively affect early postoperative healing and recovery [43].

Many recent studies do not recommend preoperative absolute fasting to avoid postoperative nitrogen and protein losses [44,45]; moreover, on providing a clear carbohydrate-rich drink 2 h before surgery, patients can undergo surgery in a metabolically fed state with a reduction in the prevalence of preoperative thirst, hunger, anxiety, and the endocrine catabolic response; it also improves insulin resistance, yielding better surgical results and hastening recovery [9,44]. Therefore, we gave our patients carbohydrate-rich drinks (sweetened apple juice) 1 day before surgery and on the morning of the surgery.

Effective analgesia is a prerequisite to decrease surgical stress response and to enhance mobilization [46]; continuous epidural analgesia has been considered beneficial in major open abdominal procedures not only to control pain but also to decrease catabolism, paralytic ileus, nausea, and vomiting [47].

Epidural analgesia was therefore used in all patients in this study, in addition to paracetamol 1000 mg/8 h for 15 patients (46.89%) on the day of surgery, paracetamol 1000 mg/8 h and NSAID (dicofenac 100 mg/12 h) for 17 patients (53.1%) on the first postoperative day, paracetamol 500 mg/8 h and diclofenac 75 mg/12 h for 10 patients (31.25%) on the second postoperative day, and paracetamol 500/8 h or diclofenac 75 mg/8 h for five patients (15.6%) on the third postoperative day. On discharge, we administered diclofenac 75 mg/12 h alternating with paracetamol 1000 mg/12 h (e.g. diclofenac at 8 a.m. and 8 p.m. and paracetamol at 2 p.m. and 2 a.m.) for 1 week for all patients. Still, we believe that further studies are needed to define optimal procedure-specific analgesia in enhanced recovery after colorectal surgery.

Conclusion

There is now extensive evidence that enhanced recovery programs aid the recovery of colorectal patients, and are also useful for clinicians and healthcare systems. A well-run program reduces the physiological response to the tissue insult from surgery and as a result there is less postoperative pain, fewer complications, a shorter hospital stay, and faster recovery and return to work. The practice of ERAS should be encouraged in both laparoscopic and open surgery. Therefore, we strongly recommend the application of such protocols, provided that these are carried out in well-equipped hospitals with very well-trained and adequately experienced personnel.

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Conflicts of interest

There are no conflicts of interest.

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