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Review

**APPLICATION OF ENHANCED RECOVERY AFTER SURGERY
PROTOCOLS IN COLORECTAL CANCER, COMPLICATED BY
MALIGNANT BOWEL OBSTRUCTION: A REVIEW OF THE LITERATURE**

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Summary

Enhanced recovery after surgery (ERAS) protocols are standard in elective colorectal surgery. They lead to decreasing postoperative complications and shorten the hospital stay and the recovery period. Following these protocols is associated with better short-term results and better and disease-free survival in cases of respectable colorectal carcinomas. There is clear evidence of the beneficial effect of the protocols in reducing the rate of postoperative complications and shortening the hospital stay after elective colorectal surgery. There remains the question of whether these protocols are applicable effective in patients after emergency colorectal surgery. Over the last years, safe and effective ERAS protocols have been reported in patients with life-threatening conditions such as colorectal obstruction and intraabdominal infection.

Keywords: ERAS protocols, emergency colorectal surgery

Introduction

ERAS protocols are standard in elective colorectal surgery. They reduce postoperative complications, thus shortening the hospital stay and recovery period. In 2013, the ERAS group [1,2] and the Society of American Gastrointestinal and Endoscopic Surgeons (2017) recommended the protocols as an evidence-based algorithm in the elective colon and rectal surgery [3]. Adherence to the protocols has been associated with better short-term results and overall better and disease-free survival in cases of resectable colorectal tumors [4].

Aim

To show the feasibility and safety of applying ERAS protocol to emergency colorectal surgery.

Materials and Methods

An 18-month study on 53 patients with malignant left colon obstruction was carried out in the Clinic of purulent-septic surgery and coloproctology of the Georgi Stranski University Hospital in Pleven between January 1, 2017, and June 30, 2018, and review of

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available literature.

We defined two groups of patients: group I with early removal of the nasogastric tube and enteral feeding up to the 24th hour when done after intraoperative small intestinal debarassage without or with enterotomy, and group II with the removal of the nasogastric tube after 48 hours and late enteral feeding without intraoperative small intestinal debarassage [5].

For intraoperative assessment of the degree of intestinal obstruction, we applied a classification based on the lumen, intestinal wall and peritoneal space, and pathomorphological criteria for assessing changes in the intestinal wall proposed by the Department of Emergency Surgery at the University Hospital “N. I. Pirogov”.

Results

In these cases, a modified EARS protocol for colorectal surgery was applied. Tables 1 and 2 present the tumor localization and differentiation.

The extent of bowel obstruction and preoperative period are presented in Table 3.

The type of surgical interventions and degree

of bowel obstruction are shown in Table 4.

The surgical intervention we performed included three en bloc resections in left flexure cases with removal of the spleen and the pancreatic tail and forming a transverse stoma; two left hemicolectomies with hysterectomy with a latero-terminal anastomosis – 1, and one colostomy.

The following complications occurred in the patient group: postoperative hemorrhage in 2 patients necessitating re-operation on the first postoperative day; suppuration of the surgical wound in six patients, dehiscence in four patients, anastomotic insufficiency in 3 patients, and intraabdominal abscess in one patient.

On average, patients were discharged on the 9th postoperative day, and the hospital stay ranged between 9 and 15 days. The postoperative stay of patients without complications was 5 to 7 days. Two patients died within the time of hospital stay, 14 died within the 18-month study.

The patient groups according to the time of enteral feeding are presented in Table 5.

There was no statistical significance in the type and number of registered complications in

Table 1. Tumour localization

Localization	N
Distal transverse colon splenic flexure	15 (28.3%)
Descending colon	9 (16.9%)
Sigmoid colon	19 (35.8%)
Sigmoid-rectal, proximal rectum	10 (18.8%)

Table 2. Tumour differentiation

Differentiation	N
G1	6 (11.3%)
G2	39 (73.5%)
G3	6 (11.3%)
Neuroendocrine or mixed tumor	2 (3.7%)

Table 3. Degree of obstruction and timing in the management of malignant bowel obstruction

Degree	N	Preoperative time
I	4 (7.5%)	5-7 days
II	18 (33.9%)	5-7 days
III	15 (28.3%)	3-5 days
IIIa	10 (18.8%)	3-4 days
IV	4 (7.5%)	2-4 days
IVa	2 (3.7%)	Within 24 hours

Table 4. Surgical interventions and bowel obstruction degree

Surgical intervention	Degree	N
Left hemicolectomy with anastomosis	I, II, III, IIIa	28
Hartmann's surgery	IIIa, IV	18
Defunctioning stoma	IIIa, IV, IVa	7

Table 5. The time when enteral feeding is performed

Enteral feeding	N	complications	Postoperative stay
Up to 24 hours	31	6	6
After 48 hours	22	11	8

the two groups. Regarding to the hospital stay, there was no statistically significant difference. In the absence of postoperative complications, patients in the first group were discharged on the 4th-5th postoperative days, and those in the second group - on the 5th-6th postoperative days. Early mobilization and early restored intestinal passage were observed in patients groups with enteral feeding up to 24 hours compared to the second group with enteral feeding after 48 hours.

Discussion

Up to 30% of colorectal surgical interventions are performed in life-threatening conditions: malignant colorectal obstruction, perforating diverticulitis of the colon, fulminant colitis, heavy bleeding in distal portions of the intestines, and traumas of the large intestine and the rectum [6]. Patients with complicated colorectal diseases necessitating emergency treatment are usually at high risk, particularly in cases of more complex surgical interventions like multi-visceral resection for malignant bowel obstruction [7]. Several studies have demonstrated more extended hospital stay and higher disease rates and mortality in patients undergoing emergency colorectal surgery than patients receiving elective surgery [6,8].

The clear evidence for the advantages of the ERAS protocols in decreasing the rate of postoperative complications and shortening the hospital stay in elective colorectal surgery [9] raises the question of whether these protocols can be effectively applied in emergency colorectal surgery.

In recent years, the evidence-based effective and safe ERAS application has been reported in patients receiving emergency surgical treatment for life-threatening conditions like colorectal

obstruction and intraabdominal infection. There are three cohort studies published comparing the ERAS algorithm with conventional methods in cases of emergency colorectal surgery for malignant bowel obstruction [10,11,12].

In a report published in 2014, Lohsiriwat et al. compared the results from treating 20 patients for colorectal carcinoma, complicated by malignant bowel, using the ERAS protocol with the results in 40 controls who received routine treatment [10]. The study design excluded patients with bowel perforation and peritonitis. The hospital stay in the ERAS group was significantly shorter (5.5 vs. 7.5 days in the control group). The recovery period of the gastrointestinal tract function was also shorter. Adjuvant chemotherapy was started earlier: after 37 days on the average compared to 49 days in the controls. The postoperative complications registered in the ERAS group were 25%, compared to 48% in the control group.

In 2017, Shida et al. reported the clinical results in patients undergoing colorectal resection for obstructive colorectal cancer. The ERAS protocol was applied in 80 patients, and 42 received routine treatment [11]. Like in the study of Lohsiriwat et al., patients with concomitant bowel perforation were not included. The authors reported a decrease in the average hospital stay by three days in the ERAS protocol group. Regarding the rate of postoperative complications in the two groups, they were comparable to the results reported by Lohsiriwat et al.

A report about an 8-year multicenter study in China was published by Shang et al. in 2018 [12]. The study included 839 patients with colorectal carcinoma complicated by malignant bowel obstruction, operate in 4 medical centers. The patients were divided into two groups of 318

patients: a study group managed according to the ERAS protocol and a control group in which a routine perioperative protocol was applied. A shorter period for recovery of the gastrointestinal tract, shorter hospital stay (6 vs. 9 days), fewer postoperative complications (34% vs. 45%, respectively) was observed. The interval between surgery and adjuvant chemotherapy was also shorter: 36 vs. 48 days.

The studies comparing the results from applying the ERAS protocols in emergency and elective colorectal surgery are also of interest.

A retrospective study published in 2012 by Verheijen PM et al. compared the results from applying the ERAS protocols in various groups of patients, including 41 who underwent emergency colorectal resections of benign or malignant tumors [13]. The authors reported a considerably longer hospital stay, a significantly higher rate of non-scheduled re-operations in the group undergoing emergency surgery. Simultaneously, there was no substantial difference between the groups regarding the anastomosis insufficiency registered. The authors recommended that the ERAS protocol be modified before applying it in emergency operations for colorectal cancer.

A group of Swiss authors carried out a prospective cohort study using the ERAS® Interactive Audit System [14]. They compared the clinical results in 28 patients undergoing emergency colectomies to those in 63 elective colectomies performed in an ERAS-certified surgery clinic. Patients needing more than two days in intensive care and those undergoing a total rectal resection were not included in the study. The authors found a significantly lower intraoperative degree of adherence to the ERAS protocol in emergency cases than in elective surgery (57% vs. 77%), despite the relatively satisfactory compliance with the preoperative and postoperative ERAS logarithms. They found no statistically significant difference in the rates of postoperative complications in the two groups (64% in emergency surgery vs. 51% in emergency surgery), irrespective of more underlying conditions and the higher operative risk in the emergency surgery group. In this study, emergency surgery is associated with a significantly longer hospital stay: 8 days vs. 5 days. The authors concluded that the application of the ERAS protocol in emergency colorectal

surgery is possible and useful.

Preoperative nutritional support, additional carbohydrate intake, and optimization of clinical parameters are not applicable in emergencies. Risk stratification should be based on evidence-based protocols that eliminate subjective factors.

Preoperative optimization aims to achieve central venous pressure of 8 to 12 cm H₂O, mean arterial pressure \geq 65 mmHg, and diuresis of at least 0.5cc/kg/hour [15]. Perioperative glycemic control is crucial for the therapeutic results in diabetic patients and of critical importance in patients without diabetes mellitus. Management of blood sugar level should aim at serum glucose levels ranging between 140 and 180 mg / dL (7.7-10 mmol/L) [16]. The adequacy of intra- and postoperative organ perfusion depends on goal-directed fluid therapy's efficacy (*GDFT*). Refinement of intravenous infusion, transfusion of blood products, and vasopressor medication administration depend on the changes in heart rate, average arterial pressure, and central venous pressure.

A meta-analysis published in 2016 included 2099 patients who had undergone major surgical interventions, including colorectal surgery. GDFT, applied as part of the EARS protocol, was found to be associated with a significant decrease of intensive postoperative care and the time to first bowel movement. The authors did not find a difference regarding morbidity, lethality, and postoperative bowel obstruction [17].

The necessity of abdominal drainage after colorectal surgery for malignant bowel obstruction is debatable. Currently, there is not enough evidence in support of routine drainage after bowel resection [18]. Many authors recommend avoiding abdominal or pelvic drainage, except in cases of heavy intraoperative hemorrhage, purulent or stercoral peritonitis, and impending anastomotic failure [19].

Placement of a nasogastric tube is a crucial part of managing patients with malignant bowel obstruction related to colorectal cancer. It decreases the intraluminal pressure proximally to the obstruction and provides physiological comfort to the gastrointestinal tract. Surgeons tend to remove nasogastric tubes on the first or second postoperative day [14].

In a report from 2017, Venara et al. analyzed

the results from removing the nasogastric tube in patients immediately after emergency colectomy for malignant bowel obstruction [20]. On the other hand, routine placement of a nasogastric tube does not necessarily prevent gastrointestinal discomfort or anastomotic insufficiency [21].

There is no doubt that early introduction of enteral nutrition in elective colorectal surgery reduces postoperative complications and hospital stay without, however, significantly changing the rates of recurrent anastomotic failure, postoperative pneumonia, and re-introduction of a nasogastric tube [22]. The patients undergoing emergency treatment for malignant bowel obstruction are more likely to suffer from persisting postoperative ileus [14,23].

A significantly shorter hospital stay was reported in a retrospective study on 84 patients undergoing emergency bowel resection and early introduction of enteral nutrition [24].

The early introduction of enteral nutrition after emergency abdominal surgery was published by Tonchev P., Iliev, S. and collaborators in 2008, 2011, and 2014 [25, 26, 27]. The authors found a significant reduction of hospital stay and morbidity ($p=0.002$) in cases of early enteral nutrition, irrespective of the food intake mode: bolus feeding every two hours or slow infusion via a nasogastric feeding tube, and a statistically significant difference regarding the stay in an ICU ($p=0.044$).

In 2018, a team from the Clinic of Purulent-Septic Surgery and Coloproctology of the Georgi Stranski University Hospital in Pleven reported its results from applying the modified ERAS in patients with malignant left colon obstruction operated on urgently. The results of the study demonstrate a shortening of hospitalization and low postoperative morbidity [28].

Early enteral feeding following emergency colorectal surgery is possible, but certain precautions should be taken. Should postoperative ileus be suspected, enteral feeding is contraindicated or needs a thorough evaluation and correction [29].

Conclusion

The ERAS protocol application in patients with malignant bowel obstruction operated in emergency settings shortens the hospital

stay. Early introduction of enteral nutrition and physical rehabilitation provide effective prevention of malnutrition and pulmonary thrombosis in such patients. There is increasing evidence proving the safety and efficiency of applying the ERAS protocol in emergency surgery for malignant bowel obstruction.

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