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Review

Current Perioperative Management Strategies for Enhanced Recovery After Surgery

Haldun Gündoğdu

General Surgery Lecturer, Gastroenterology Surgery Specialist, Atatürk Training and Research Hospital, Ankara, Turkey

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Address for Correspondence:
Haldun Gündoğdu
E mail: haldun@haldungundogdu.com

Abstract

Enhanced recovery after surgery is a multimodal program of multidisciplinary care designed to minimize post-operative organ dysfunction and to normalize the patient as soon as possible. This protocol forsees a radical change away from traditions and dogmas towards modern concepts in perioperative management of patients. The main philosophy of the ERAS protocol is reducing the metabolic stress caused by surgical trauma and at the same time supporting the gastrointestinal functions and mobilization without complication. The key elements of the ERAS pathways are aimed to address these issues and the interventions that facilitate early recovery covering all phases of the perioperative period starting from the outpatient clinic and ending at home. Several studies which compare ERAS programs with conventional perioperative care, have demonstrated that the ERAS programmes compared with traditional perioperative care is associated with earlier recovery and discharge after major operations. The purpose of this review is to evaluate current progresses in perioperative care in order to enhance postoperative recovery and review the protocols which use these items together.

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Introduction

ERAS (Enhanced Recovery After Surgery) is the term that defines the concept of current, multimodal perioperative interventions used to accelerate postoperative recovery.

The studies carried out by Prof. Henrik Kehlet from Denmark towards the end of the 1990s laid the foundation stones for the formation of these protocols, therefore, he is known as the creator of ERAS (1). The first results of the studies, which Henrik Kehlet started in 1997, were published two years later (2). Right after, in the year 2001, to examine this situation with a scientific protocol in accordance with evidence-based medicine guidelines and to evaluate its results, Fearon and Ljungqvist created a working group from Northern European countries (Scotland, Sweden, Denmark, Norway, and the Netherlands). The working group focused on reducing complications and accelerating postoperative recovery by modifying the metabolic response to surgical stress. This group worked to develop the protocol for approximately one year and finally prepared a proposal package containing the current practices for elective colorectal surgery (3). In 2010, the ERAS working group became an international medical association based in Stockholm and got the name of ERAS Society (Enhanced Recovery After Surgery Society for Perioperative Care) (www.erassociety.org). The ERAS Society held its first international congress in Cannes in 2012 and published its first guidelines in the same year. The guidelines published for elective colon surgery, rectal surgery, and pancreaticoduodenectomy were followed by those belonging to other areas in later years.

Philosophy of ERAS

ERAS recommends changes with regard to the whole journey of a patient, which starts in the outpatient clinic before surgery and ends at home after discharge (Fig.1).

The main philosophy of the protocol is while reducing metabolic stress due to surgical trauma, to provide a return to normal activity as soon as possible by supporting the normalization of functions in a short time.

One of the most important factors in recovery after surgery is to struggle with metabolic trauma caused by surgery. It is aimed to reduce metabolic response occurring against trauma through modern surgery, anesthesia, analgesia, and some support practices defined by ERAS. Thus, less damage will result in quick recovery. The vital point not to one should not forget is that ERAS is not only a surgeon's non-traditional practices but it is the performance of a trained team. Although the contributions of the different members of the team are in question during the process that will be experienced from the admission to the hospital till the full recovery at home, surgeons, anesthesiologists, and nurses come to the fore as the main actors. Under the leadership of these primary members of the team, all healthcare workers who will take part in the process should meet at least once in 15 days, to evaluate the results and to perform training studies.

The ERAS protocols extend out of the traditional, even dogmatic, surgical and anesthetic practices, and bring innovations that can be described as radical. The protocol includes more than 20 evidence-based elements to be applied in perioperative period (Table 1) (3, 4). These elements are grouped by the ERAS Society to include minor differences in guidelines prepared according to systems (http://erassociety.org/guidelines/list-of-guidelines/).

It is not possible to obtain good results by using one or a few of the elements in the ERAS protocols. When all of the recommendations are implemented by a trained team, the contribution to the postoperative recovery process can be observed (5). Each element has a synergistic effect on the others. The key issues, such as the proper management of pain, early mobilization, and providing early oral nutrition via the proper management of gastrointestinal motility, are supported by the use of many other elements.

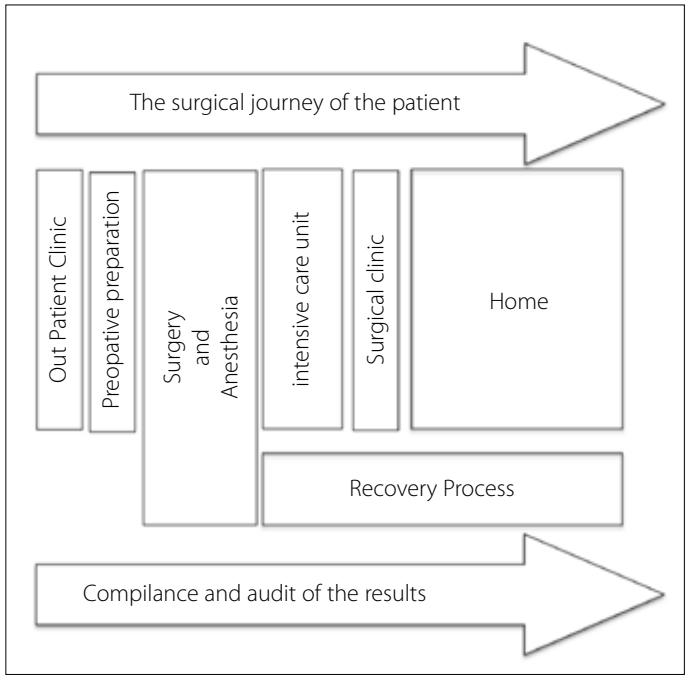

Figure 1. Surgical patient's process

Preadmission Information

The patient to whom the ERAS protocols which will be applied should be definitely informed by the ERAS team together, and this informing differs from a standardized informed consent procedure. The patient who does not know what will happen to him/her will undoubtedly worry. Therefore, the patient should be informed in detail at the first meeting. This meeting should include details about what the patient will experience during the hospitalization. Such concepts as the preoperative preparation, pain, oral food intake, and early mobilization should be explained to the patient. The critical point here is not only to passively inform the patient, but also to explain the role that the patient will undertake in the whole process. Thus, the patient will take an active role and experience less anxiety, as an important determinant of well-being.

Preoperative Bowel Cleansing

Bowel preparation practices before colon surgery have been traditionally continuing for many years. However, recent meta-analyses have revealed that bowel cleansing before colon surgery has no preventive effect on anastomotic leakage, on the contrary, increases this risk significantly and leads to severe fluid electrolyte imbalances, especially in elderly patients (6). It also causes the prolongation of postoperative ileus (7). In the Cohrane study carried out in 2011; no statistically significant difference was found among patients who have undergone bowel cleansing regarding anastomosis leakage, mortality rates, reoperation need and wound infections versus who have not, and among patients who had mechanical bowel cleansing versus those who solely had rectal enema (8). Therefore, bowel cleansing should not be performed except for patients planned for intraoperative colonoscopy. Further studies are needed to determine the optimal routine for very low rectal anastomoses. However, if a diverting ostomy is to be opened to protect anastomosis, the distal bowel should be cleaned.

In major surgeries except for colon surgery, bowel cleansing is contraindicated.

Loading Oral Carbohydrate Instead of Preoperative Fasting

Prior to elective surgery practices, the implementation of discontinuation of the patient's oral solid and fluid food intake starting at midnight (Nil-Per-Os) was initiated in order to reduce the likelihood of pulmonary aspiration and has been implemented until recently. However, there is no scientific evidence behind this dogma but a lot of studies have been published in recent years, which prove that this practice leads to a decrease in well-being and causes to some metabolic adversities, such as post-operative insulin resistance particularly (9-11). Furthermore, the Cochrane review (12), which evaluated 22 randomized controlled trials, presents robust evidence that decreasing the pre-operative fasting period for fluids to 2 hours does not increase complications. In the light of these studies, the application of preoperative fasting was officially terminated in many Northern European countries and America. In many countries, anesthesia associations now recommend allowing the fluid intake up to 2 hours before the initiation of anesthesia, as well as 6-hour fasting for solid foods. The current practice is to allow the intake of solid foods up to six hours and clear liquid foods up to two hours before surgery (Table 2).

Table 1. Elements of the ERAS protocol

Preoperative	Intraoperative	Postoperative
Preadmission information	Selection of surgical incisions	Urinary catheter
No preoperative mechanical bowel cleansing	Prevention of intraoperative hypothermia	Postoperative non-opioid analgesia
No prolonge fasting	Mid-thoracic epidural analgesia	Blood sugar management
Preoperative oral carbohydrate loading	Short-acting anesthesia protocol	Stimulation of gastrointestinal motility
Evaluation of nutritional status, and nutritional support if required	Multimodal management of postoperative nausea and vomiting	Early feeding, early enteral nutrition if necessary
Preoperative optimization	Perioperative fluid management	Early mobilization
Prehabilitation	No drain	Early discharge
No premedication	Laparoscopic and robotic surgery	Audit of compliance and outcomes
Thromboprophylaxis	No nasogastric tubes	
Antimicrobial prophylaxis		

Table 2. Preoperative fasting recommendations of the "American Society of Anesthesiologists"

Food	Minimum fasting time (hours)
Clear Liquids[1]	2
Breast milk	4
Infant formula	6
Animal milk	6
Light meal[2]	6

[1]Water, pulp-free fruit juice, clear tea, black coffee;
[2]Toast (poor fat content) and tea, water, coffee

Table 3. Recommendations for continuous insulin infusion

Blood glucose mg/dL	Insulin Dose
101-125	Do not change
126-175	1 unit/hour
176-200	2 unit/hour
201-225	3 unit/hour
226-250	4 unit/hour
251-275	5 unit/hour
>300	6 unit/hour

It has been demonstrated that 400 mL of beverage containing 12.5% maltodextrin as the main ingredient decreases preoperative thirst, hunger, anxiety (10, 13) and postoperative insulin resistance (14). Giving oral carbohydrate provides a reduction in postoperative nitrogen and protein loss (15, 16) and also results in the better protection of lean body mass (17) and muscle strength (18, 19). To ensure metabolic satiety, 800 mL of carbohydrate-rich fluid food should be given until the midnight before the surgery, and 400 mL should be given 2-3 hours before the surgery to patients who will undergo surgery. It has also been shown that this practice significantly shortens the duration of hospital stay after surgery (20). This practice is one of the most important things to do in order to reduce metabolic stress during the surgical process.

In diabetic patients, carbohydrate treatment can be given together with diabetes drugs.

Preoperative Nutrition

The nutritional status of all patients who will undergo a major elective surgery should be assessed. Although many different methods can be used in this assessment, the most recommended ones are the subjective global assessment (SGA) and NRS-2002. The body mass index may also give information about nutritional status. Patients with the SGA-C or NRS-2002 score above three should undergo preoperative nutritional support planning. This planning should be regulated by teams working in the field of clinical nutrition, and surgery should be delayed for a certain time (usually 7-10 days are sufficient).

Preoperative Optimization

The necessity of medical optimization before surgery is generally accepted. The postoperative morbidity rate in alcoholics is two to three times higher. The most common complications are hemorrhage, wound complications and cardiopulmonary complications. There have been many improvements in preoperative cardiopulmonary preparations in the last 30 years, and as a result, mortality rates have been reduced. However, the same success could not be achieved in the complication rates due to obesity, diabetes, modern life styles, hypertension and old age.

To achieve success in this sense, all patients undergoing major surgery should be operated after their general conditions are maximized. In recent years, preoperative prehabilitation concept has been developed instead of the postoperative rehabilitation concept. Patients should be operated after preparation which involves giving up smoking and drinking alcohol four weeks before the operation, doing exercise programs, reducing the risk of comorbid diseases with necessary consultations, and vice versa (21).

Premedication

The side effects of long-acting premedication such as opioids, long-term effective sedatives, and hypnotics prevent recovery in such a way that causes prolongation in the duration of hospitalization (22). In contrast, short-acting anxiolytics do not prolong recovery or the duration of hospital stay. Therefore, unnecessary premedication should be avoided before anesthesia. Preoperative training can reduce patient's anxiety to an acceptable level at which anxiolytic medication is not required. Only patients who have previously used anxiolytic medication can continue to use their medication after a psychiatric consultation. If necessary, short-acting anesthetic drugs (e.g. fentanyl combined with small doses of midazolam or propofol) may be administered under monitorization prior to anesthesia induction to facilitate regional procedures such as thoracic epidural catheter insertion.

Thromboprophylaxis

The incidence of asymptomatic deep vein thrombosis is approximately 30% in colorectal surgery patients who have not been given thromboembolic prophylaxis, and fatal pulmonary embolism occurs in 1% of cases. The risk increases further in patients with malignant diseases who have previously undergone pelvic surgery, receive preoperative corticosteroids have common comorbidities, and have conditions causing hypercoagulation (23). Meta-analyses have indicated that subcutaneous low-dose unfractionated heparin regimens are effective in reducing deep venous thrombosis, pulmonary embolism, and mortality in patients undergoing colorectal surgery. Meta-analyses comparing low molecular weight heparin (LMWH) and unfractionated heparin have not determined any difference in efficacy or the risk of hemorrhage (24). LMWH is preferred because of once daily dosage and the low risk of heparin-induced thrombocytopenia. The addition of intermittent pneumatic compression to treatment should be considered especially in patients who have a malignant disease or have previously undergone pelvic surgery (25).

Although antiaggregant drugs and intravenous dextran are less effective in the prophylaxis of deep vein thrombosis, they may be effective in preventing pulmonary embolism. Because of their side effect profiles, they can be recommended to patients at high risk, in which only LMWH and unfractionated heparin are contraindicated.

There is insufficient evidence about the safety of continuous epidural analgesia in patients administered with LMWH. Prophylactic doses of LMWH should not be given within a maximum of 12 hours before insertion and after removal of an epidural catheter (26). Although the simultaneous use of nonsteroidal anti-inflammatory drugs and LMWHs is considered safe, a potential risk of epidural hematoma is mentioned. Other factors affecting coagulation should be considered, and when required, alternative thromboprophylaxis methods (thromboembolism preventive socks, etc.) should be used.

Current international guidelines recommend the use of LMWH for prophylaxis for 28 days in patients undergoing major abdominal or pelvic cancer surgeries (25).

Antimicrobial Prophylaxis

Antibiotic prophylaxis should be performed before skin incision and in compliance with local and universal guidelines. Although a single dose is adequate, it is recommended to repeat it intraoperatively in operations lasting more than 3 hours (27, 28). New antibiotic generations should not be used for prophylaxis, and they should be kept for infectious complications.

Anesthesia Protocol

Although there is no definite information about the most appropriate anesthesia method for the surgical interventions, the use of short-acting agents seems rational. It is reasonable to use short-acting agents (propofol, remifentanil hydrochloride) instead of long-acting intravenous opioids (morphine sulfate, morphine hydrochloride, fentanyl citrate), thus allowing proactive recovery to start immediately after surgery. Maintenance of anesthesia can be sustained with short-acting inhalation anesthetics such as sevoflurane or desflurane. Alternatively, total intravenous anesthesia in which target-controlled infusion pumps are used can be applied and they may be useful in patients who are sensitive to postoperative nausea and vomiting.

Mid-thoracic epidural anesthesia, which is strongly recommended in colon surgery, will have two benefits. The first one is that it provides adequate analgesia with lower morbidity in the postoperative period. The second one is that it decreases the metabolic endocrine response to trauma since the mid-thoracic epidural blockage will also block the adrenal glands. Thus, the release of stress hormones will decrease, postoperative ileus duration will shorten, and postoperative insulin resistance will decrease. As a result, the severity of the metabolic trauma experienced by the patient will decrease, well-being will increase, and the duration of hospitalization-will be reduced (29). Although the risk of hematoma, abscess or neurological damage in epidural anesthesia is between 0.01-0.6%, this possibility should be definitely considered.

The optimal anesthetic block height for colon surgery is T 7-8 range for providing ideal anesthesia and analgesia. To avoid neurological complications, the catheter should be inserted while the patient is awake. During surgery, blockage can be provided by continuous local anesthetic infusion (e.g. 0.1-0.25% bupivacaine hydrochloride, or 0.2% ropivacaine hydrochloride), and by giving additionally a low opiate dose with 4-10 mL/h (e.g. 2.0-µg/mL of fentanyl citrate or 0.5 to 1.0-µg/mL of sufentanil citrate). Epidural opioids in small doses act synergically with local epidural anesthetics in providing analgesia (30, 31). Addition of epinephrine to the thoracic epidural infusion (1.5-2.0µg/mL) increases analgesia.

As a result, performing surgery by the mid-thoracic epidural blockage accompanied by short-acting anesthetics, and providing analgesia by the mid-thoracic epidural catheter in the post-operative period is recommended.

Surgical Incisions

There are studies reporting that transverse or curved incisions used in abdominal surgery are more advantageous than longitudinal incisions regarding postoperative pain and pulmonary dysfunction. However, many surgeons prefer longitudinal incisions due to exploration advantages. Although there is not a restriction related to the shape of the incision according to the ERAS protocols, the shortest possible incision should be used.

Minimally Invasive Surgery

In colon resection, laparoscopy improves recovery regarding to postoperative complications, pain and the duration of hospitalization (32-34). According to the studies published recently, laparoscopy appears to be a method that can be used in more than 90% of patients undergoing elective surgery for colorectal cancer (35).

Other methods that may be expected to be beneficial in colon resection are robot-assisted surgery, single incision laparoscopic surgery (SILS), and hand-assisted laparoscopic surgery (HALS). However, the data are still not sufficient to reach a definite conclusion about all these methods.

Nasogastric Tube

A meta-analysis of 1995 (36) indicated that routine nasogastric decompression should be avoided after colorectal surgery since fever, atelectasis, and pneumonia are less in patients without a nasogastric tube. A recent Cochrane meta-analysis (37), which examined 33 studies involving more than 5000 patients, confirmed these results and also emphasized that patients' bowel function returns to normal earlier when nasogastric decompression is avoided.

The presence of the nasogastric tube also delays the oral nutrition of the patient. There is no use of nasogastric catheter, except for rare cases, such as aerophagia during tracheal intubation. Even if it were placed during surgery, it should be removed at the end of it.

Prevention of Intraoperative Hypothermia

Hypothermia may increase hemorrhage by stimulating sympathetic discharge and the metabolic-endocrine response to trauma, and by disrupting coagulation systems. In some studies, it has been demonstrated that the protection of normothermia using a heating blanket reduces wound infections, cardiac complications, hemorrhage, and transfusion necessity. Instead of allowing the patient's temperature to decrease and then correcting it again, it should be preferred to maintain the current temperature. It has been shown that preheating patients by using warm air blankets before entering the operating room increases the body temperature before surgery. Starting systemic heating pre-operatively, continuing it during surgery, and extending it up to 2 hours postoperatively can provide additional benefits (38). Furthermore, postoperative pain scores are also better in non-hypothermic patients (39).

Temperature can be maintained throughout the operation by using compressed air heated blankets, and heating beds or water circulation systems under patients.

Abdominal Drains

There is no current study indicating that the use of drains in elective colon surgery positively contributes to surgical outcomes. Besides, the presence of a drain reduces the patient's mobilization. It has also been demonstrated that the use of a drain does not affect anastomotic leakage (40). For these reasons, routine use of drains should be avoided.

The guidelines of other system surgeries also include recommendations that limit the unnecessary use of drains. Although the use of drain is an issue to be determined by the surgeon based on the surgery and even if it were placed due to a reason, it should be removed as soon as possible.

Multimodal Management of Postoperative Nausea and Vomiting

Postoperative nausea and vomiting (PONV) affects 25-35% of all surgical patients and is the leading cause of patient dissatisfaction and late discharge from the hospital.

Postoperative nausea and vomiting should be definitely prevented since this will restrict the early oral intake of the patient. In addition to the use of antiemetics, the use of agents that stimulate vomiting during surgery should also be avoided (41).

Risk factors for postoperative nausea and vomiting are female gender, smoking, the history of motion sickness (or postoperative nausea, vomiting anamnesis) and postoperative opioid application (42). Patients at moderate risk (2 factors) should initially receive dexamethasone sodium phosphate or prophylaxis with serotonin receptor antagonist at the end of the operation. Patients at high risk (3 factors) should receive 4-8 mg of dexamethasone sodium phosphate at the beginning of the operation, 30-60 minutes prior to the end of surgery, general anesthesia with propofol and remifentanil, which is supported by serotonin receptor antagonists or droperidol or 25-50 mg metoclopramide hydrochloride (43).

In recent years, the concept of multimodal approach has gained momentum. In this approach, non-pharmacological and pharmacological antiemetic techniques are combined in addition to the ERAS programs (44). Non-pharmacological techniques include avoidance of emetogenic stimuli such as inhalation anesthetics and the use of propofol for anesthesia induction and maintenance. Avoiding preoperative fasting, carbohydrate loading and adequate hydration of patients also have beneficial effects. It has been proved that regional anesthesia techniques, such as epidural anesthesia and transversus abdominal blockade reduce postoperative opioid use, which in turn affects the prevalence of nausea and vomiting (45). As an alternative to opioids, the use of non-steroidal anti-inflammatory drugs is also recommended.

Perioperative Fluid Management

Fluid therapy plays a vital role in achieving optimal results after surgery. In compliance with traditional perioperative intravenous fluid regimes in abdominal surgery, patients may receive 3.5-7 liters of fluid on the day of surgery, and more than 3 liters of fluid within 3-4 days consecutive days. Depending on this situation, 3-6 kg weight gain may occur. These practices may delay the return of normal gastrointestinal function, impair wound and anastomosis healing, and affect tissue oxygenation. Thus, it causes long-term hospitalization (46).

Pieces of evidence revealed in recent studies indicate that to avoid overloading and to restrict fluid intake significantly reduces postoperative complications and shortens the duration of hospitalization and therefore should be recommended. Fluid shifts should be minimized. For this purpose, it is necessary to avoid bowel preparation, to maintain hydration by performing oral preloading until 2 hours before surgery, to minimize the duration of keeping bowel outside the abdomen and bowel manipulation, and to avoid blood loss.

Fluid infusion adequate enough to prevent dehydration is considered sufficient in modern fluid management. The best way to limit postoperative intravenous fluid administration is to interrupt intravenous infusions early and to start oral fluids immediately. The target here should be the first day after surgery. According to this, oral fluid should be started to be given to the patient after postoperative 2 hours and it should be ensured that at least 800 mL is received on the day of surgery. As oral fluids intake increases, the amount of parenteral fluid should be reduced.

Since central venous pressure is a weak determinant of fluid response, central venous catheters should not be routinely used to monitor fluid balance. Central venous catheters are placed only when they are needed for drug infusions. In the early postoperative period for the management of fluid therapy, using central venous saturation which indicates oxygen extraction has been confirmed by some studies, and it has been shown that it can be useful in high-risk patients (47, 48).

For hypotension management in the intraoperative and early postoperative periods, even if especially it were induced by epidural blockage, administration of vasopressor agents instead of fluid infusions is recommended. Transesophageal doppler ultrasonography may be an appropriate guide for maintaining hydration in high-risk patients by measuring the cardiac output.

In fluid management balanced crystalloids have been shown to be superior to 0.9% saline for maintaining electrolyte balance.

Urinary Catheters

The bladder catheter should be removed in the early period due to its disadvantages such as urinary infection and restriction of mobilization. However, as the possibility of urinary retention increases as a result of epidural blockage, the catheter must be kept as long as blockage continues. Suprapubic catheterization should be preferred instead of a urinary catheter in surgeries with large pelvic dissection. A meta-analysis indicated that suprapubic bladder catheterization in abdominal surgery results in less bacteriuria and less patient discomfort than urinary catheterization (50). However, these data are related to urinary drainage lasting for 4-7 days, and the benefit of suprapubic catheterization in short-term drainage is unclear.

Glucose Level Management

Insulin resistance is the cause of postoperative hyperglycemia. Increased insulin resistance and glucose levels have been demonstrated to be associated with complications and mortality after major abdominal surgery (51).

When the ERAS protocols are applied, blood glucose levels are easier to manage. Since both metabolic stress and postoperative insulin resistance are minimized with many elements, hyperglycemia that is difficult to control in a very few patients is encountered.

Diabetic patients should be well prepared preoperatively and should be closely monitored in the postoperative period. Patients with high levels of preoperative glycosylated hemoglobin (HbA1c) remain approximately 1 mmol/l higher when compared to patients with normal preoperative HbA1c levels, and further complications develop in these patients. Although each unit has guidelines for intervention in hyperglycemic patients, the generally accepted approach is summarized in Table 3. As recommended in many guidelines, it should be aimed to keep the blood glucose level at around 140-180 mg/dL (52).

Stimulation of Gastrointestinal Motility

Prevention of postoperative ileus, which is the leading cause of late discharge after abdominal surgery, is the primary purpose of the ERAS protocols. Although no prokinetic agent is currently effective in reducing or treating postoperative ileus, many other interventions have been successful. Mid-thoracic epidural analgesia is very effective in preventing postoperative motility disorder compared to intravenous opioid analgesia (53). Excessive fluid loading during and after surgery disrupts gastrointestinal function, and this should be avoided.

In the early postoperative period, stimulation of gastrointestinal motility and, perhaps more importantly, not using agents that can negatively affect motility are essential for providing early enteral feeding. Therefore, epidural analgesia, opiates, and excessive hydration should be avoided and 2x1 g/day of oral magnesium oxide should be used.

Perioperative use of chewing gum has a positive effect on the duration of postoperative ileus (54). It is also reported that it contributes to the patient's feeling better.

Furthermore, in laparoscopic surgeries compared to open surgery, the intestinal function returns earlier, and oral diet intake is achieved more quickly (32).

Postoperative Analgesia

In major surgeries, effective analgesia, early mobilization and intestinal function, and early return of nutrition should be ensured by optimal analgesia management (55). Meta-analyses have demonstrated that in both open and laparoscopic surgery optimum analgesia is ensured with opioids or continuous epidural local anesthetics during 2-3 days after surgery. Intravenous opioid administrations do not provide the same effectiveness and have a lower beneficial effect on the surgical stress response compared to epidural local anesthetic techniques.

After the application of epidural blockage, some changes occur in the perfusion of the splanchnic area, cardiac flow and mean arterial pressure. Therefore, vasopressors should be considered to balance blood pressure. In case of coronary failure, a sufficient preload is required to improve the blood flow of the colon, a sufficient preload is required, and so positive inotropes are compulsory. Low-dose noradrenaline and dobutamine hydrochloride are not detrimental to the perfusion of the splanchnic area.

Recent publications have indicated that the duration of pain requiring major analgesics after laparoscopic surgery is much shorter than open surgery (56). In these patients, provided that early oral intake is tolerated, in the postoperative 24th hour, analgesia is usually accomplished by oral multimodal approach without the need for regional blockade or strong opioids. There is an increasing interest in searching for alternatives to thoracic epidural analgesia or opioids using spinal analgesia or transversus abdominis blockades.

After the operation, during the first 2 days continuous analgesic infusion through the epidural catheter together with 4 mg/day paracetamol should be used routinely. If this protocol is insufficient, nonsteroidal anti-inflammatory drugs may be added occasionally. Nonsteroidal anti-inflammatory drugs should be started routinely shortly before the removal of epidural catheter, and they should also be used after discharge on demand.

Postoperative Nutritional Care

In major surgeries, effective analgesia by optimal pain management, early mobilization and intestinal function, and early return of enteral nutrition should be provided (55). Early nutrition reduced both the risk of infection and the duration of hospitalization and did not create a high risk of anastomotic leakage. However, the risk of vomiting increased in early-fed patients, and problems such as distention impaired pulmonary function, and delay in mobilization were observed when multimodal motility treatment was not added.

Patients should be encouraged to take oral fluid in the second hour after surgery and solid food in the fourth hour. They should be supported by oral nutritional solutions until adequate oral nutrition is provided (58).

Postoperative support should be continued for at least eight weeks in patients given preoperative nutritional support due to nutritional disorder (especially in cancer patients). In the ERAS programs, oral nutritional products were successfully used the day before the surgery and at least for the first four days after the surgery to achieve the ideal energy and protein intake. When used in combination, preoperative oral carbohydrate loading, epidural analgesia, and early enteral nutrition have been demonstrated to provide appropriate nitrogen balance without causing hyperglycemia.

In addition to elderly patients, patients with chronic diseases or alcohol dependence should undergo a special assessment regarding nutrition, since micronutrient deficiency may be present and prescription of vitamins and minerals at recommended doses may be reqired for these patients, and they may need support before and after surgery (59, 60).

Early Mobilization

As long as the bed rest after surgery increases, insulin resistance prolongs muscles weaken, and muscle mass loss develops. Besides, pulmonary functions impair and the risk of thromboembolism increases (61). Epidural analgesia plays a key role also in early mobilization as in many respects. It should be aimed to provide physical conditions in which the patient will be painless and will be mobilized. According to the ERAS protocol, it should be ensured that the patient stays out of bed for 2 hours on the day of operation and for 6 hours per day in the following days until the day of discharge.

Non-mobilization on the postoperative first day may be due to inadequate pain control, continuous intravenous fluid intake, permanent urinary catheter, lack of the patient's motivation and pre-existing comorbidities. According to a recent study, non-mobilization is one of the most common causes of deviation from ERAS and is directly related to the lengthening of hospital stay (62).

Discharge from the Hospital

The patient's home discharge plan should be made at the time of admission and should be fully explained to the patient. Patients should be informed about the duration and possible disruption reasons in this plan. The following criteria must be met for discharge from the hospital according to the protocol:

- Adequate pain control has been ensured.
- The need for intravenous fluid has been eliminated.
- The patient can mobilize by himself/herself as much as preoperatively.
- The patient is willing to return home.

Follow-up

Patients sent home should be called by phone 24-48 hours later, and their condition should be learned. If there are no problems, on the 7-10th postoperative days, they should be invited to check the wound and to take the stitches. Since the pathology report will be prepared by the time additional oncological treatment should be planned, if necessary. It should be considered that anastomotic leakage or other major complications will develop in 1-3% of the patients discharged to home, thus every complaint should be carefully examined. The next interview can be done by phone call on the 30th postoperative day.

Supervision of the Results

Systemic supervision is mandatory to determine the clinical outcome and ensure the successful implementation of the protocol. If the results do not reach the desired quality standards, it is important to distinguish between the failed application and the failure to achieve the desired effect from the applied protocol. It is necessary to compare the results with other centers, which use similar protocols and the same registration methods (5).

Outcomes of ERAS

In the last five years, many prospective randomized studies, reviews, and meta-analyses were published, most of them in the field of colorectal surgery. In almost all of these publications, the positive contribution of ERAS to the results was highlighted.

In all recent meta-analyses, it was determined that by applying the ERAS protocols, the length of hospitalization was reduced by 2-3 days and complications decreased by 30-50% in major surgeries (63-65). The effect of protocol compliance on the results is evident. Mortality decreased by 42% when compliance to apply the ERAS's components exceeds 70% (66). There were severe reductions in the number of patients going to intensive care units. Even if the patients to whom the ERAS protocols were applied were admitted to the intensive care unit for some reason, their length of stay was significantly shortened. With the application of laparoscopic surgery, the duration of hospitalization was shortened, and the mean duration of hospitalization was reported to be 2-7 days (5).

As the cost analyses of the ERAS protocols were announced, it was observed that they provided an important advantage in this sense. In particular, the cost analysis announced by the Canadian, Alberta hospital chain was impressive, and it indicated that with the ERAS protocols a profit of $2800-5900 per patient was obtained (67).

In Turkey, many activities were also carried out in order to draw attention to the subject, and it was included in the conference programs. However, the results of a survey that we did at the beginning of the study demonstrated that although awareness increased about the subject there were difficulties in putting it into practice (68). We have tried to apply many components of the ERAS protocols since 2006 in our clinic. When we evaluated our results, we found out that it was possible for our patients to start the oral food intake early in the postoperative period, the duration of hospitalization shortened compared to the duration of hospitalization of patients followed up with traditional approaches, and there was no increase in major complication rates such as anastomosis leakage and ileus (69).

Nowadays, some centers have begun to change the old classical practices in colorectal surgery with the ERAS protocol. The successful results obtained in this area have led to the development of similar protocols for other surgical interventions. Despite all this, even if the results are significant, it is unrealistic to expect that radical changes in surgery, which is based on traditions and rules as a whole, can be quickly spread, even if the results are significant.

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