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Enhanced recovery after surgery (ERAS) and anesthesia

Ameliyat Sonrası Geliştirilmiş İyileşme (ERAS) ve Anestezi

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ABSTRACT

ERAS (Enhanced Recovery After Surgery) is a multimodal approach which aims to optimize perioperative management. ERAS is a combination of changes in preoperative, intraoperative and postoperative care to reduce organ dysfunction and surgical stress response. This concept is managed by multidisciplinary teams that include various areas of expertise to minimize the patient's surgical stress response, optimize physiological functions, and facilitate healing. In order to further increase these developments in various surgical specialties, protocols have been established on this subject and many health institutions offer their services in this way. With the use of ERAS protocols, perioperative and postoperative complications decreased, patient survival and quality of care improved, and patient satisfaction was significantly increased.

Keywords: ERAS, Anesthesia, Surgery.

ÖZ

ERAS (Enhanced recovery after surgery) perioperatif yönetimi optimize etmeyi amaçlayan multimodal bir yaklaşımdır. ERAS, organ disfonksiyonunu ve cerrahi stres yanıtını azaltmak için preoperatif, intraoperatif ve postoperatif bakımdaki değişikliklerin bir bütünüdür. Bu kavram hastanın cerrahi stres yanıtını azaltmak, fizyolojik fonksiyonlarını düzeltmek ve iyileşmeyi kolaylaştırmak amacıyla çeşitli uzmanlık alanlarını içeren multidispliner ekipler tarafından yönetilir. Günümüzde değişik cerrahi uzmanlık alanlarında bu gelişmeleri daha da arttırmak amacıyla bu konu ile ilgili protokoller oluşturulmuş ve birçok sağlık kuruluşu hizmetlerini bu kavrama dayalı bir şekilde sunmaktadırlar. ERAS protokollerinin kullanımı ile periopetif ve postoperatif komplikasyonlarda azalma, hasta sağ kalımında ve bakım kalitesinde artış ve hasta memnuniyetinde belirgin gelişmeler sağlanmıştır

Anahtar kelimeler: ERAS, Anestezi, Cerrahi

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ERAS (ENHANCED RECOVERY AFTER SURGERY) AND ANESTHESIA

ERAS (Enhanced Recovery After Surgery) is a term used to accelerate postoperative recovery, defined by the concept of multimodal perioperative interventions performed by a professional health care team, including current evidence-based medical practices. ERAS started in the 1990s with studies by Prof. Dr. Henrik Kehlet to enhance recovery after colorectal surgery and laid the cornerstones for the formation of protocols, so he is considered the creator of ERAS [1]. Kehlet considered that surgical stress, metabolic and endocrine disorders, and prolonged limitation of motion, caused symptoms such as pain, nausea, vomiting, ileus, loss of strength as well as cognitive dysfunction, and that the severity of organ dysfunction increased and the rate of recovery slowed down. The first results of the study were published two years later [2]. Then, in 2001, a scientific protocol was established by Fearon and Ljungqvist, a working group from Northern European countries (Scotland, Sweden, Denmark, Norway, and the Netherlands) to examine and evaluate the results in accordance with the rules of evidence-based medicine. He worked for a year to develop the protocol, and eventually, a package of recommendations for elective colorectal surgery was prepared and published [3]. In 2010, it was renamed the ERAS Association (www.erassociety.org). Published guidelines for elective colon surgery, rectal surgery, and pancreaticoduodenectomy were followed by other area guidelines (urology, orthopedics, gynecology) in the subsequent years.

ERAS recommends changes related to the entire process that begins in the outpatient clinic of a patient and is discharged after surgery (Figure 1) [4]. The basic philosophy is to reduce metabolic stress resulting from surgical trauma, to support the normalization of functions in a short time, in order to return to normal activity as soon as possible. One of the most important factors in postoperative recovery is the fight against metabolic trauma caused by surgery. ERAS aims to reduce metabolic response to trauma using new surgical techniques, anesthesia, analgesia, and some supportive practices. The less damage the patient has, the faster the recovery will be. ERAS can be done not by a single surgeon but by a trained team of individuals [5, 6]. The surgeon, anesthesiologist and nurses come to the fore, while dietitians and physiotherapists are the other members who complete the team.

ERAS protocols include more than 20 evidence-based elements to be performed during the perioperative period (Table 1) [4,5]. The critical components of ERAS are to inform preoperative patients, make use of short-acting anesthetic agents, limit the use of catheters, drains and tubes, make us of opioid-independent anesthesia, as well as rapid mobilization and feeding. It is not possible to achieve good results by applying only some of the elements contained in the ERAS protocols. When a trained team implements all or at least 80% of the recommendations, their contribution to the postoperative recovery process is improved [5]. The co-application of each element has a better effect than making use of individual parts. The application of ERAS protocols in elective major surgeries has been shown to shorten hospital stay by 2-3 days and reduce complications by 40-50% [7, 8].

Table 1: The basic elements of ERAS protocols [4,5]

Preoperative	İntraoperative	Postoperative
-Patient education -Prehabilitation -Avoid mechanical bowel preparation -Preoperative fasting -Evolution nutritional status and nutritional support -Preoperative optimization -Preoperative medication -Tromboprophylaxis -Antimicrobial therapy -Preparation of surgical side	-Analgesia protocols -Selection of surgical incisions -Avoiding hypothermia -Postoperative nausea and vomiting management -Fluid optimization -Drain management	-No nasogastric tubes -No urinary catheter -Blood sugar management -Stimulation of bowel motility -Postoperative analgesia -Early nutrition -Early mobilization -Discharge planning -Follow up and ongoing support

ANESTHESIA IN ERAS PROTOCOL

According to the ERAS protocol, anesthesia generally includes preoperative preparation and patient counseling, avoiding bowel preparation, giving carbohydrate-rich beverages in the preoperative period, avoiding premedication

with long-acting agents, thromboembolism and antibiotic prophylaxis, use of epidural anesthesia in appropriate cases, use of short-acting anesthetics and opioids in the intraoperative period, restricting parenteral sodium and fluid administration, avoiding hypothermia, preventing postoperative nausea and vomiting as well postoperative pain control with non-opioid techniques, transiting to early enteral feeding, stimulating gastrointestinal motor activity, limiting use of a nasogastric tube, choosing laparoscopic surgery in appropriate cases, ensuring removal of drainage and bladder catheters as early as possible, early mobilization, application of the protocol and evaluation of results [9].

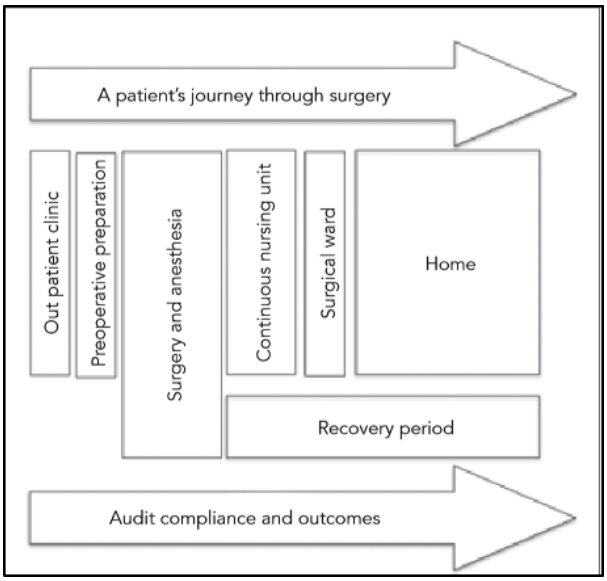

Figure 1: The journey of a surgical patient [4]

Informing the Patient

To implement the ERAS protocol, first of all, the patient should be informed and should comply with the application parameters. Preoperative counseling can alleviate fear and anxiety associated with surgical and anesthesia procedures and accelerate postoperative recovery and discharge. Ideally, the patient should be interviewed with the surgeon, anesthesiologist and nurse before the operation, and informed in writing and orally [10, 11].

Preoperative Optimization

Preoperative care aims to maximize the physical and functional status of the patient and to inform the patient about surgical expectations, cardio-pulmonary preparation, and thus to reduce mortality rates. In order to achieve success in this sense, all patients who undergo major surgery should be operated on after maximizing their general condition. In recent years, preoperative prehabilitation has been developed instead of postoperative rehabilitation [4]. The prehabilitation is a multidisciplinary approach philosophy that will improve the physical condition and nutritional status of patients preoperatively and reduce their anxiety. Accordingly, the patient should stop smoking and using alcohol eight weeks before surgery. Also, exercise programs should be organized, the necessary consultations should be made to reduce the risk of co-morbid diseases and the patient should be operated on after preparing for many similar subjects.

Anemia, smoking, and alcohol use should be adressed before surgery. Studies have shown that interventions for these factors reduce perioperative mortality and morbidity. Smoking is associated with high postoperative risk, however the pulmonary effects of smoking can be improved by quitting four weeks before surgery. Interventions to quit smoking, such as behavioral support and nicotine replacement therapy provide short-term smoking cessation, but the evidence for lower postoperative morbidity is weak [12]. On the other hand, the chronic effects of alcohol on the liver, pancreas and neurological system are known. In the perioperative period, the effects of alcohol on cardiac functions, blood clotting, immune functions, and response to surgical stress have a role in increased morbidity. Intensive preoperative interventions aimed at quitting alcohol at least four weeks in advance to reduce postoperative complications, do not significantly reduce mortality and length of hospital stay [13]. Perioperative anemia is associated with morbidity and mortality and so, should be detected before elective surgery and the underlying disease should be treated.

Although the aim of fasting the patient before elective surgery is to reduce the risk of pulmonary aspiration during intubation, it has been shown that prolonged fasting does not reduce the risk of aspiration. Many studies have shown that prolongation of fasting time leads to an increase in insulin resistance and deterioration in a number of

metabolic conditions. Therefore, the preoperative fasting period should be kept as low as possible. It is recommended that oral intake should be restricted as little as possible, oral feeding with solid foods should be discontinued 6 hours before the operation and clear fluids and water should be administered up to 2 hours [4]. The American Society of Anesthesiologists (ASA) guidelines offer similar instructions. Also, carbohydrate-rich fluids to be applied up to 2 hours before the operation, to ensure metabolic satiety, 800ml until midnight before surgery, and 400ml carbohydrate-rich liquid food should be given before surgery 2-3 hours [14]. Studies have shown that the use of iso-osmolar carbohydrate drinks (400 ml) 2 hours before the induction of anesthesia reduces postoperative hunger, thirst, and anxiety. Besides, the development of insulin resistance will be reduced, and nitrogen, protein loss will be diminished, and lean body mass, muscle mass will be preserved. Preoperative carbohydrate loading has proven to be an independent predictor of clinical outcomes, including postoperative nausea and vomiting [15, 16].

Premedication

A wide variety of agents (such as opioids, benzodiazepines, gabapentin) are currently used to reduce preoperative anxiety. Long-acting premedication agents should be avoided in patients taken with ERAS protocol. Although midazolam has an advantage due to its short effect, it should be kept in mind that its influence can be prolonged by many factors and may prolong the recovery time. Avoiding routine administration is recommended, especially in elderly patients [17]. If necessary, low-acting intravenous drugs may be used in low doses - as they do not significantly affect the compilation - to facilitate epidural or spinal anesthesia.

Anesthesia technique and anesthetic agent selection

In the selection of anesthesia techniques and agents, techniques with minimal side effect profile should be preferred in order to encourage rapid recovery, according to the surgical intervention. The anesthesiologist is responsible for three aspects of influencing the outcome of surgery: stress response to the operation, fluid therapy, analgesia. Understanding the importance of ERAS components has enabled anesthetists to define the “trimodal approach” for the optimization of anesthesia outcomes in laparoscopic surgery [18]. The use of epidural analgesics, in addition to general anesthesia throughout the operation, reduces postoperative intravenous opioid use. Epidural long-acting opioid applications are not recommended because they increase nausea and vomiting. In appropriate cases, thoracic epidural anesthesia-analgesia sympathetic block offers several advantages. In open surgery, higher epidural analgesia is superior to opioid-based alternatives in many situations, including pain, postoperative nausea, vomiting, and complications [19]. Regional block also reduces the stress response and insulin resistance (the primary mechanism of hyperglycemia). Glucose monitoring is essential as hyperglycemia will lead to an increase in postoperative complications [4].

Fluid administration during surgery should be physiological levels and the restrictive fluid application should be preferred; after normovolemia is achieved, it should be corrected with vasopressors to avoid mean blood pressure, fluid, and salt loading. In case of hypotension due to epidural anesthesia, vasopressor agents should be used instead of the fluid application. In these cases, if epidural anesthesia is used, excess fluid should be avoided, especially to maintain the blood flow of the intestine. Local infiltration techniques, regional anesthesia, and peripheral nerve blocks are also preferred in ERAS applications [4].

Agents with a short duration of action and minimal side-effect profiles are generally preferred because they shorten the recovery time in “fast-tracking” applications. Inhalation anesthetics and intravenous hypnotics are commonly used in general anesthesia. The use of short-acting inhalation anesthetics may be advantageous. Propofol is preferred in iv agents due to its short duration of action, its use in induction and maintenance of anesthesia, and its effects on reducing nausea and vomiting after anesthesia. Propofol can be used a dose range of 1.5-2.5 mg/kg in the induction of anesthesia; it can also be used in maintenance anesthesia, a dose range of 4-12 mg/kg/h and target-controlled infusion (TCI) in a dose range of 2-6 µg/mL. Avoiding

profound anesthesia will accelerate recovery [17]. Nitrous oxide is disadvantageous because it increases nausea and vomiting, accumulates in third cavities, and increases thrombotic morbidity [20]. Monitoring of the depth of anesthesia is advantageous as it reduces unnecessary excess drug consumption and recovery. There is new evidence that deep anesthesia can be harmful in elderly patients and increases the risk of postoperative confusion. In these patients, the use of bispectral index monitoring may be useful to keep the depth of anesthesia to a minimum. In the selection of agents, it should be kept in mind that the half-life of opioid infusions may increase with the infusion time. Remifentanil infusion of 0.05-2 μg/kg/min was associated with effective intraoperative analgesia and shortened extubation time following the end of the operation [18]. Neuromuscular blockers are frequently used in general anesthesia practice because of improving intubation and mechanical ventilation conditions as well as improving surgical field quality. The use of short and medium-acting agents in ERAS practice can be chosen to reduce the possibility of postoperative complications and residual block. In addition to delaying recovery, residual block causes an increase in postoperative complications such as desaturation, airway obstruction, and decreased muscle strength. The use of neuromuscular monitoring methods such as “train of four” (TOF) to avoid residual block is important to prevent postoperative complications. Sugammadex, which is used to restore aminosteroid muscle relaxants, is faster and safer than conventional agents, but it should be noted that it increases costs [21].

Antimicrobial prophylaxis should be used as it reduces surgical site infection. The best time for this application is 30-60 minutes before the incision. In prolonged and high blood loss surgeries, it is beneficial to repeat the dose in 3-4 hours, depending on the half-life of the drug. Antibiotic selection depends on local guidelines and should include aerobic and anaerobic bacteria [22, 23].

Postoperative Nausea And Vomiting (PONV)

Postoperative nausea and vomiting affect 25-35% of surgical patients. Nausea and vomiting lead to difficulty in mobilization, delayed discharge, and patient dissatisfaction. The cause of nausea and vomiting may be from the patient, anesthesia, or surgery. Female patients, non-smokers, and those with a history of motion sickness are at risk. The use of inhalation anesthetics, nitrous oxide, and parenteral opioids significantly increases the risk. A high prevalence of PONV was found in 70% of patients who had major abdominal surgery for the colorectal disease [24]. It is stated in the guidelines that the frequency of PONV can be reduced to 40% or less through the use of antiemetics [25]. The scoring system used for PONV is the Apfel score system (Table 2) [26]. These scoring systems reduce the incidence of PONV but have not yet been used in routine clinical practice. Antiemetic prophylaxis is given by a multimodal approach to all patients undergoing major abdominal surgery using inhalation anesthesia and opioids to reduce PONV. Non-pharmacological and pharmacological antiemetic methods are applied together in ERAS programs [27]. Non-pharmacological methods are an avoidance of emetogenic stimuli (such as inhalation anesthetics), use of propofol in induction and maintenance of anesthesia. Keeping the preoperative fasting period short, carbohydrate loading and sufficient hydration is also useful. The use of regional anesthesia techniques reduces PONV by reducing the need for postoperative opioids. NSAID and paracetamol use are also recommended as an alternative to opioid use. The effects are increased with the combined use of two or more antiemetics.

Table 2. Apfel Nausea Vomiting Scoring [26]

Risk factors	Points
Female gender	1
Non- smoker	1
History of PONV	1
Postoperative opioids	1

PONV: Postoperative nausea and vomiting

Early Mobilization, Early Nutrition

Early mobilization may counteract insulin resistance due to immobilization by reducing lung complications [28]. Although studies are supporting the direct beneficial effects of postoperative mobilization, prolonged immobilization is associated with an increased risk of pneumonia, insulin resistance, and muscle weakness. Providing early postoperative mobilization is

also important to avoid pain and ileus. Patients are advised to spend outside the bed for 2 hours on the day of surgery and 6 hours per day until discharge.

Postoperative early feeding is one of the essential components for postoperative well-being and early discharge. The perioperative nutrition management algorithm recommended for patients to be operated according to ERAS protocols begins with a routine nutritional assessment and proceeds at each stage by targeting oral/enteral nutrition (Figure 2) [29]. With three components of ERAS - preoperative carbohydrate intake, epidural analgesia, and early enteral nutrition - nitrogen balance is maintained without minimal insulin resistance and hyperglycemia [30]. In the ERAS protocol, oral fluid intake should be encouraged immediately after the patient awakens from anesthesia. With early enteral feeding, there is a reduced risk of hospitalization and infection without increased anastomotic leakage.

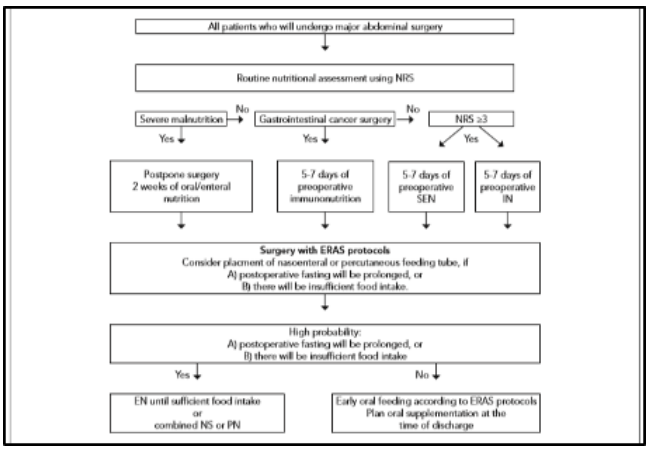

Figure 2: Perioperative nutritional planning algorithm [29]. (NRS: Nutritional Risk Score NS: Nutritional IN: Immuno Nutritional SEN: Surgical Enteral Nutrition PN: Parenteral Nutrition EN: Enteral Nutrition)

Meta-analyses also showed that clinical benefits of immuno-nutrition, including arginine, glutamine, omega-3 fatty acids, and nucleotides. In patients with malnutrition, supportive (oral and parenteral) treatment initiated 7-10 days before surgery has been observed to reduce complications [31]. Enteral solution administration should be continued for at least eight weeks postoperatively.

Postoperative Analgesia

Ideal analgesia regimens after major surgery should relieve pain, facilitate early mobilization and return bowel movements, to help switch to oral nutrition, and should not cause complications. In upper abdominal open surgery, TEA (Tx 5-8 level-thoracoepidural analgesia), in which short-acting opioid and local anesthetic agents are combined in the first 48-72 hours postoperatively, should be preferred. According to meta-analyses, compared with opioid-based analgesia, TEA produced better results in pain control, complications, prevent postop nausea and vomiting, and decreased insulin resistance. The most commonly used alternative method to TEA is the TAP block (transversus abdominis plane block). This method is a local anesthetic injection between the internal oblique and transversus abdominis muscles under ultrasound guidance. TAP block is associated with less narcotic use, low pain score, and decreased postoperative nausea and vomiting. The multimodal analgesia regimen includes Paracetamol and NSAIDs. Paracetamol 4 mg / day is sufficient [32].

Discharge

According to the ERAS protocol, the following criteria must be met if the patient is to be discharged: the need for intravenous fluid should be eliminated and the patient should be able to take enough food orally, pain control should be achieved with oral analgesics, adequate mobilization should be possible, intestinal functions should return, infection signs and symptoms should not be present, and comorbid diseases should be controlled. Patients sent home should be contacted by telephone after 24 - 48 hours, and their status should be noted. If there are no problems, the patient should be invited to control the wound and remove the sutures on postoperative days 7-10. Since the pathology report will also be prepared during this period, additional oncologic treatment should be planned if necessary. Anastomosis leakage or other major complication should be kept in mind in 1-3% of the patients taken home, and every complaint should be carefully examined. The next interview can be done by telephone on the 30th postoperative day [4].

To increase the success rates of these goals in different clinical applications and branches, it is vital to reveal the factors and mechanisms that

most affect recovery. To increase patient safety and medical practice success in ERAS applications specific to various surgical branches and different surgical types, and to decrease complications, costs, and length of hospital stay are being made in many new clinical studies. Successful implementation of ERAS protocols require the cooperation of the surgery, anesthesia, nursing and nutrition departments.

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