

APPLICATION OF THE ERAS PROTOCOL IN PATIENTS TREATED SURGICALLY DUE TO SEVERE OBESITY

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ABSTRACT

Introduction: Enhanced Recovery After Surgery (ERAS) protocol includes appropriate preoperative preparation, proper surgery procedure and ensuring proper postoperative care. It is recommended that patients with obesity should be treated according to the ERAS protocol due to high risk of postoperative complications.

Aim of the study: Evaluate the implementation of an Enhanced Recovery After Surgery (ERAS) protocol in patients operated on due to severe obesity.

Material and methods: This analysis included 412 patients with morbid obesity (260 female/152 male, mean BMI 48.02 kg/m²) who had undergone laparoscopic bariatric surgery. Perioperative care was conducted according to the ERAS protocol. Examined factors included oral nutrition tolerance, time until mobilisation after surgery, requirement for opioids, length of hospitalisation, complications, and readmission rate.

Results: During the first 24 postoperative hours, oral administration of liquids was tolerated by 402 (97.57%) patients and 399 (96.8%) were fully mobile. In 107 (25.98%) patients it was necessary to administer opioids to relieve pain. The average time of hospitalisation was 2.92 days (range 1-12 days). Postoperative complications occurred in 7.29% of patients (mainly rhabdomyolysis). Four patients (0.97%) required readmission within 30 days of surgery.

Conclusions: The introduction of the principles of the ERAS protocol allowed for reduced hospitalisation times without an increased rate of complications or readmissions.

Key words: obesity, bariatric surgery, ERAS protocol.

INTRODUCTION

According to the definition of the World Health Organisation (WHO), obesity is a state of excessive accumulation of body fat, significantly exceeding the life needs and adaptability of the human body, resulting in an increase in the total body weight of a person suffering from it. Excessive body weight is a consequence of a positive energy balance, persisting for a long time. Environmental conditions, some diseases, and genetic factors may also contribute to this [1].

Obesity is more and more often called an epidemic of the 21st century, and it concerns not only highly developed countries, but also developing ones. A WHO report states that in 2016, over 650 million

adults in the world were obese. In Poland, in 2014, the percentage of overweight and obese adults was 53.3% [2]. In recent years, an increase in the incidence of overweight and obesity has been observed. This problem also affects children and adolescents.

Obesity is caused by poor nutrition habits (choosing high-calorie and highly processed food with low content of proteins, vitamins, and dietary fibre) as well as sedentary lifestyle and lack of physical activity, all contributing to weight gain [3]. Many diseases are associated with excessive body mass, among others: arterial hypertension, type 2 diabetes, circulatory insufficiency, non-alcoholic fatty liver, lipid disorders, degenerative joint changes, thromboembolic disease, hypercholesterolaemia, obstructive sleep apnoea, depressive disorders, and a greater risk of cancer. All of

these diseases worsen the quality of life and raise the costs of treatment. In addition, obesity increases by several times the risk of death in all age groups [4]. The survival time of people with obesity is 5-20 years shorter compared to people with normal body mass [5]. Studies have shown that after reducing body weight, the increased risk of premature death of people with excessive body weight returns to normal [6].

Conservative methods of treatment such as diet, physical activity, lifestyle modification, and pharmacotherapy are ineffective because they give only about 5% and usually short-term weight loss [7, 8]. Therefore, it has become necessary to develop and implement effective activities aimed at weight reduction. The only permanent and effective method of eliminating excessive body weight and decreasing morbidity and mortality of obesity-related diseases is surgical treatment. Consequently, dynamic development of bariatric surgery is currently observed [9, 6]. The name comes from the Greek words *baros* – weight and *iatrikos* – the art of healing [10]. The aim of bariatric surgery is to achieve a significant reduction in body weight, necessary to achieve beneficial changes or complete resolution of comorbidities and decline in mortality. This is possible thanks to the influence of bariatric operations on neurohormonal processes and caloric limitations. Consequently, bariatric surgery is currently also called metabolic surgery [11]. According to data presented during the 14th World Congress of the International Federation for the Surgery of Obesity and Metabolic Disorders, there was a 761% increase in the number of operations carried out from 1998 to 2008, from 40,000 a year in 1998 to 344,221 in 2008. From then until now, a stabilisation of the number of bariatric operations performed in the world has been observed. Most of these types of treatments are performed in the United States and Canada (about 220,000 a year). Thanks to the progress that has been made in surgery in recent years, the vast majority of procedures are carried out using the laparoscopic method [12, 13].

The surgical procedure is a significant burden for the patient's body, which is why it is necessary to seek changes in perioperative care in order to reduce the metabolic stress caused by the injury, reduce the number of complications, and shorten the time of hospitalisation. In the 1990s, professor of surgery Henrik Kehlet drew attention to the factors that had the greatest impact on the prolongation of hospitalisation. Among them were: inadequate analgesic treatment and the resulting prolonged hospitalisation, delayed inclusion of oral diet, and finally excessive intravenous fluid supply, which in turn slowed the return of normal gastrointestinal function [14, 15]. His idea was investigated further by members of a special working group, who were involved

in analysing available literature and factors affecting the number of postoperative complications. In 2001, based on scientific evidence, the ERAS (Enhanced Recovery After Surgery) protocol was developed – a protocol of comprehensive perioperative care to improve treatment outcomes. The protocol contains recommendations for patient care at various stages of the perioperative period [15]. ERAS is a complex program that involves both hospital staff and the patient him/herself, so that the performed surgery and hospitalisation disturb the homeostasis of the organism as little as possible [16] (Fig. 1). The ERAS Society was officially founded in 2010 with the mission to develop perioperative care and help in accelerating recovery of the patient by minimising metabolic stress caused by injury [15]. Currently, the ERAS Society brings together over 50 centres from around the world [14].

The comprehensive perioperative care protocol for improving treatment results includes appropriate preoperative preparation, proper management during surgery, and proper postoperative care. The ERAS protocol consists of a dozen of elements that, combined, allow the patient's stay in the hospital to be shortened and the rate of postoperative complications to be reduced [17] (Table 1).

PATIENT MANAGEMENT BEFORE SURGERY

Prior to the surgery, in order to reduce the level of anxiety, the patient should be provided with comprehensive information about the planned procedure and individual stages of the treatment. The patient is informed about the necessity to stop drinking alcohol and smoking at least six weeks before the surgery, and the need to increase physical activity. The above activities are aimed at improving the general health of the patient, optimising the work of circulatory and respiratory systems, as well as reducing the impact of trauma caused by the surgery [18]. The patient is admitted to the hospital the day before the surgery [19].

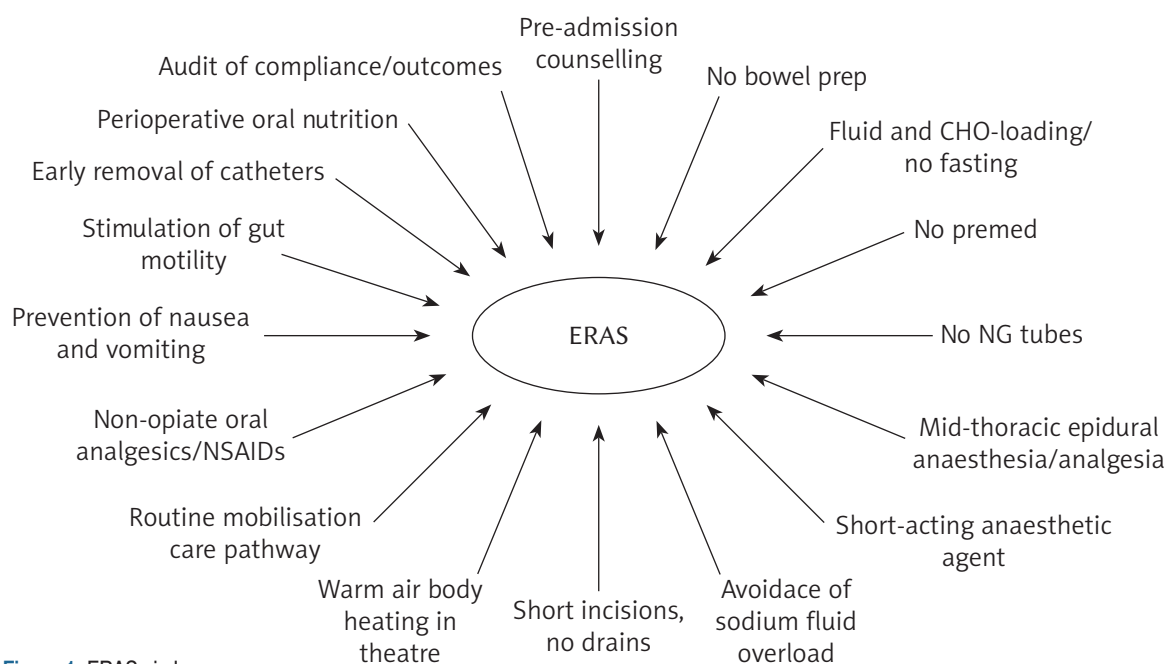
Shortening the period of fasting – it is recommended that the supply of solid food be stopped six hours, and clear fluids two hours, before the operation. It is beneficial to administer high-carbohydrate beverages a few hours before the procedure [19, 20].

Nutritional intervention – the majority of patients qualified for bariatric procedures are people with nutritional deficiencies, and malnutrition is one of the main risk factors of complications. For this reason, patients must be evaluated for nutritional status, and, if necessary, nutritional intervention should be started with special dietary foods [19, 20].

Antithrombotic prophylaxis – in obese patients, due to high risk of thromboembolic disorders, it is necessary to use pharmacological antithrombotic

Table 1. Procedure scheme based on ERAS protocol

Prior to hospital admission	<ul style="list-style-type: none"> - information regarding planned treatment - cardiological, pulmonology, endocrinological, and anaesthetic consultations – qualification for surgery - gastroscopy, test for the presence of <i>H. pylori</i> - recommendation on diet, increased physical activity, weight reduction, and smoking and alcohol consumption cessation
On admission	<ul style="list-style-type: none"> - a detailed conversation with the patient and his/her family regarding each stage of treatment - anaesthesiological consultation - unlimited fluid intake - antithrombotic prophylaxis - familiarisation with the staff and topography of the branch
Day of procedure	<ul style="list-style-type: none"> - administration of a high-carbohydrate preparation by the oral route 4 hours before surgery - cessation of fluid supply 2-3 hours before the procedure - single prophylactic dose of antibiotics - a laparoscopic procedure - prevention of postoperative nausea and vomiting - oral fluid supply, possible fluid supply intravenously in the case of vomiting - analgesic treatment - monitoring the amount of fluids accepted and diuresis - mobilisation a few hours after surgery - anticoagulant prophylaxis
One day after the procedure	<ul style="list-style-type: none"> - continuation of the proceedings from the previous day - expanding the diet - in the case of established Foley catheter – removal - full mobilisation (most of the time out of bed)
Discharge day	<ul style="list-style-type: none"> - dietary recommendations - assessment of postoperative wounds and education for management of the wound in the home environment - monitoring the amount of fluid taken in (min. 1500 ml) - assessment of the effectiveness of analgesic treatment - education of the patient on the subject of anticoagulant and analgesic treatment and the use of vitamin supplementation

**Figure 1.** ERAS circle

prophylaxis in the form of low molecular weight heparin and mechanical, e.g. pneumatic, intraoperative compression systems. Compression stockings are in this case ineffective due to the thick layer of the patient's subcutaneous fat tissue, which prevents pressure on lower limb tissues [19, 20].

PROCEEDINGS DURING THE PROCEDURE

Operational access – according to data collected during numerous examinations, laparoscopy is a surgical technique beneficial to the patient. Thanks to this procedure it is possible to reduce the intensity of

perceived pain and the risk of complications and to shorten the length of hospitalisation. In the case of a classical access, it is recommended that transverse incisions associated be performed with a lower level of perceived pain [19, 20].

Nasogastric or orogastric feeding tube – the use of feeding tubes after bariatric procedures is currently not recommended. In addition, the presence of tubes prolongs the patient's stay in the hospital and promotes the development of respiratory system complications [19, 20].

Drainage of the operated area – in spite of relatively frequent complications such as anastomotic leak and gastrointestinal leak, there are no scientific studies that support retention of drains in the operated area [19, 20].

Prevention of rhabdomyolysis – an indicator of the occurrence of postoperative rhabdomyolysis is the increased value of creatinine kinase. For this reason, patients should be monitored for hourly diuresis [19, 20].

POSTOPERATIVE TREATMENT

Early oral nutrition – the shortest possible time during which patients do not receive food via the oral route is recommended. Due to smaller capacity of the stomach after the procedure, it is advisable to administer fluids and gradually increase their volume after the surgery. The next stage is the supply of semi-liquid or industrial diet [19, 20].

Analgesic treatment – effective analgesic treatment enables early commencement of motor rehabilitation and mobilisation of the patient. It is based mainly on the use of non-steroidal anti-inflammatory drugs, multimodal analgesic therapy, and the use of regional anaesthesia. Avoidance of the supply of opioid analgesics is advised [19, 20].

Early mobilisation – physical rehabilitation should be started from sitting down and getting up and short walks around the bed starting 12 hours after the surgery. On the first post-operative day patients should spend at least six hours not in bed. This is important in the prevention of respiratory disorders and thromboembolic complications [21].

Prophylaxis of post-operative nausea and vomiting – to reduce the risk of nausea and vomiting it is necessary to: shorten the time of fasting, initiate early motor rehabilitation, avoid opioid analgesics and the use of antiemetic drugs [19, 20].

Restrictive fluid therapy – both excessive and insufficient supply of fluids may lead to unfavourable complications – tissue swelling or hypovolaemia, respectively. It is therefore necessary to aim for a zero fluid balance in terms of the amount of water and electrolytes administered. It is recommended that flu-

ids be administered by the oral route and restricted by intravenous routes [22, 20].

The patient is discharged home most often on the first or second day after the surgery. The ERAS protocol sets out the conditions that must be met in order to allow for this discharge: tolerance of an oral diet, intake of 1500 ml of fluids daily, no indication for intravenous fluid therapy, pain manageable with oral medicines, and activity level close to the state before the operation. Furthermore, the patient should be provided with the care of third parties in the home environment and have no perioperative complications requiring hospital treatment [19].

AIM OF THE STUDY

The aim of the study was to evaluate the effects of the comprehensive perioperative care protocol to improve treatment outcomes (ERAS) in patients treated surgically for morbid obesity.

MATERIAL AND METHODS

The study used the analysis of medical records of hospitalised patients from 20 April 2009 to 14 September 2015. Clinical data of patients were obtained from the Lap Advanced electronic database. The study was conducted in the Clinical Department of Endoscopic Surgery, Metabolic and Soft Tissues of the University Hospital in Krakow. The study involved 412 patients operated on for morbid obesity, including 260 (63%) women and 152 (37%) men.

The study assessed tolerance of oral fluid intake, the time elapsed from surgery to full activation, the need for opioid analgesics, the time of hospitalisation, the occurrence of complications, and finally the number of re-admissions to the hospital.

The analysis was made according to the scheme based on the ERAS protocol (Table 1).

RESULTS

The age of the patients was 18-68 years, and the average age was 42.65 years, with BMI 36.33-71.13 kg/m² (average 48.02 kg/m²). In 375 patients (91%) there were diseases associated with morbid obesity. Among them were: lipid disorders (314 people), hypertension (291 people), fatty liver (281 people), joint changes (190 people), and type II diabetes (145 people). Almost all subjects had more than one co-morbid disease (Table 2).

Body mass index for all operated patients was ≥ 40 kg/m² or with at least one co-morbidity related to obesity ≥ 35 kg/m². According to the accepted system of qualifications for particular types of bariatric procedures, in the group there were 233 patients who had undergone sleeve resection of the stomach,

while in 179 gastric bypass surgery using the Roux loop was performed. All procedures were conducted using the laparoscopic method (Table 3).

Administration of liquids

The introduction of oral liquids in all operated patients began within the first five hours after the surgery and was well tolerated in 311 (75.49%) patients. Patients who did not tolerate clear liquids at that time received intravenous antiemetics (4 mg ondansetron). Another attempt to administer fluids took place within the next six hours. On the first postoperative day, intake of liquids by oral route was well tolerated by 402 (97.57%) people; the remaining 10 patients were ordered to receive fluids intravenously.

Movement rehabilitation

Movement rehabilitation of all patients began within a day of the surgery from verticalisation. Above 80% (331) of the patients were able to get out of bed several hours after the procedure. In the first 24 hours after the surgery, the majority – 399, which accounts for 96.9% of patients, were fully mobile.

Demand for opioid analgesics

Administration of opioid drugs to relieve postoperative pain was necessary in 107 patients (25.98%) in the first hours after the surgery. These were usually single doses of 10 mg morphine, administered via the subcutaneous route. Within a day, the total dose in any patient did not exceed 40 mg. Twenty-four hours after the surgery, the supply of opioid analgesics was only required in 22 patients (5.34%).

Postoperative complications

Of the 412 operated patients, 30 had postoperative complications. The most common complication was rhabdomyolysis (10 subjects) and anastomotic leak and gastrointestinal leak (five subjects). Gastroparesis occurred in three patients. In two people, the features of circulatory insufficiency occurred, and in one there was pulmonary embolism. In the case of two people, early bleeding occurred, and the same number of patients developed pneumonia, urinary tract infection, and incarcerated hernia. One person had a fever of unknown aetiology (Table 4).

Time of hospitalisation

The average time of hospitalization was 2.92 days (range 1-12). The majority, 221 patients (53.64%), spent 2 days in the hospital, 91 people (22.08%) – 3 days, 51 people (12.38%) – 4 days, 28 people (6.8%)

Table 2. Comorbid conditions

Name	N	%
Diabetes	145	35.19
Glucose intolerance	17	4.12
Lipid disorders	314	76.21
Fatty liver	281	68.2
Hypertension	291	70.63
Obstructive sleep apnoea	35	8.49
Joint changes	190	46.11
Varicose veins of lower extremities	125	30.33

Table 3. Types of performed surgery

Type of performed surgery	Number of people	
	n	%
Laparoscopic sleeve resection of the stomach	233	57
Laparoscopic gastric exclusion	179	43
Total	412	100

Table 4. Postoperative complications

Name	n	%
Rhabdomyolysis	10	2.42
Anastomotic leak	5	1.21
Gastroparesis	3	0.73
Early bleeding	2	0.49
Pneumonia	2	0.49
Incarcerated hernia	2	0.49
Circulatory failure	2	0.49
Urinary tract infection	2	0.49
Pulmonary embolism	1	0.24
Fever	1	0.24
Total	30	7.29

Table 5. Reasons for readmission

Reason	n	%
Vomiting and dehydration	3	0.73
Pneumonia	1	0.24
Total	4	0.97

– 5 days, and 11 people (2.67%) – 6 days. The length of hospitalisation of 10 people (2.43%) was seven or more days.

Reasons for re-admission to the hospital

During the first month after the surgery, four patients required re-admission due to vomiting and dehydration (3 people) and pneumonia (1 person). No patient required another surgery; all were treated conservatively (Table 5).

DISCUSSION

The World Health Organisation in 1997 recognised overweight and obesity as epidemic. The number of patients treated surgically for this reason is systematically increasing (in some countries more bariatric operations are performed than cholecystectomies). However, it is still inadequate for the number of patients requiring such a treatment [23, 24]. Bariatric surgery is currently one of the fastest growing branches and efforts are being made to reduce the invasiveness of the treatments and improve their safety.

The results of the study confirm the efficacy and safety of the procedures consistent with the assumptions of the comprehensive perioperative care protocol for improving the results of treatment in patients operated on due to morbid obesity. In available literature there are reports of similar effects achieved in other centres [25-28].

There is a published randomised trial comparing treatment based on a comprehensive perioperative care protocol with a traditional care model, showing the benefits of using ERAS [29]. The study is limited only to patients undergoing laparoscopic sleeve gastrectomy, without analysis of other types of bariatric procedures.

In our research all patients who were to undergo the surgery took part in surgical, pulmonary, endocrine, and anaesthetic consultation before the procedure. Patients received detailed information about each stage of the treatment and had the opportunity to ask questions. The same approach is presented by other researchers, who are of the opinion that preoperative consultations of the patient and his/her knowledge about the planned procedure are necessary to ensure safety before, during, and after the procedure [30]. An important element of the procedure in accordance with the ERAS protocol is the application of minimally invasive surgical techniques that cause less injury and this way accelerate the return to normal activity and shorten the hospital stay. That is in contrast to procedures performed by means of the classical method [31]. All patients in the study were operated on using the laparoscopic method; no conversion to the laparotomy was required. To reduce the supply of opioid analgesics, patients were treated with regional anaesthesia with 0.5% bupivacaine at the trocar sites. As a result, in most patients the combination of NSAIDs and paracetamol was sufficient to alleviate pain. In fewer than 6% of patients, 24 hours after the surgery opioid analgesics were required. Similar proceedings were conducted in several other centres [30, 32].

Elimination or at least reduction of postoperative pain is also necessary for faster convalescence and the mobilisation of patients. Rapid improvement after surgery reduces the number of postoperative complications and shortens a patient's stay in the hospital ward. At the centre where the study was carried out,

patients started their respiratory and motor rehabilitation a few hours after the operation. Almost 97% of the patients were fully mobile within 24 hours of the operation. Similar results are presented in the research by Bergland [33].

In the analysed group postoperative complications occurred in 7.29% of operated patients; a similar frequency of complications is described in other studies [25, 27, 30, 34]. It should be emphasised that a significant number of patients with complications were diagnosed with rhabdomyolysis, which was not included in many publications of other authors.

The average hospitalisation time was 2.92 days. This is a longer period than in other centres where patients are discharged even on the day of surgery. McCarty *et al.* report that 84% of patients with a Roux loop laparoscopic gastroduodenal surgery were discharged from the hospital within 24 hours of the surgery [30, 35]. The main reason for these differences may be the fact that the majority of these patients were from distant places from Poland and would have difficulty getting back to the hospital in case of complications. Dos Santos observed that the distance between the patient's place of residence and the hospital is an important factor affecting the length of hospital stay [30]. The average length of hospitalisation after a laparoscopic bariatric surgery is still much shorter than that of a patient after the classical method of gastric bypass surgery using the Roux loop. Lujan *et al.* reported that in this case hospital stay was 7.9 days (range 2-28 days) [31].

In our study, re-admission to the hospital within one month of surgery was required only in four patients (0.97%). This is a much lower value than that presented in other studies. For example, Geubbels declared 4.8% of re-hospitalisations in patients after bariatric procedures [28]. This is undoubtedly related to the shorter period of stay of the patients in the centres analysed by these authors. A greater rate of re-admissions is expected in patients discharged home within the first 24 hours after the procedure. Geubbels is of the opinion that although every patient operated on for morbid obesity is eligible for perioperative care in accordance with the ERAS assumptions, not everyone is a suitable candidate for discharge at the time of surgery [27].

Patients with obesity are a group of patients with a significantly increased risk of postoperative complications, mainly due to the existence of comorbidities. Therefore, it became necessary to seek solutions to reduce metabolic stress caused by injury. This is possible thanks to the implementation of care principles based on the ERAS protocol.

CONCLUSIONS

1. A new model of perioperative care used in bariatric patients allowed for a faster return to normal activities and a significant reduction in hospitalisation

time, without an increased risk of postoperative complications and re-admissions to hospitals within 30 days of the surgery.

2. Most patients met discharge criteria within 24 hours of the surgery. A longer period of stay in the hospital was caused mainly by the patients' distant place of residence from the centre rather than by the fears connected with the possibility of complications.
3. The implementation of the comprehensive ERAS perioperative care protocol is possible in practice and gives positive results

Disclosure

The authors declare no conflict of interest.

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