NICOLAUS COPERNICUS UNIVERSITY IN TORUŃ

Quality in Sport. eISSN 2450-3118.

Journal Home Page
https://apcz.umk.pl/QS/index

SMERDZYŃSKI, Mateusz, KAŁWA, Natalia, KAŁUŻA, Kinga, PATER, Michał, STRZĘPEK, Aleksandra, ŁYŻWA, Julia, FRĄCZEK, Karolina, JANASZEK, Agnieszka, MAJCHRZYK, Aleksandra, and CHMURSKA, Agnieszka. Enhanced Recovery After Surgery (ERAS) Protocols and Postoperative Physical Function: A Systematic Review. Quality in Sport. 2026;53:70100. eISSN 2450-3118. https://doi.org/10.12775/QS.2026.53.70100

The journal has been awarded 20 points in the parametric evaluation by the Ministry of Higher Education and Science of Poland. This is according to the Annex to the announcement of the Minister of Higher Education and Science dated 05.01.2024, No. 32553. The journal has a Unique Identifier: 201398. Scientific disciplines assigned: Economics and Finance (Field of Social Sciences); Management and Quality Sciences (Field of Social Sciences).
Punkty Ministerialne z 2019 - aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398. Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych).
The authors declare that there is no conflict of interest regarding the publication of this paper.
Received: 22.03.2026. Revised: 23.03.2026. Accepted: 24.03.2026. Published: 31.03.2026.

Enhanced Recovery After Surgery (ERAS) Protocols and Postoperative Physical Function: A Systematic Review

Mateusz Smerdzyński

ORCID https://orcid.org/0009-0001-6352-8609

Email: mateuszsmerdzynski@gmail.com

Collegium Medicum, Jan Kochanowski University, Kielce, Poland

Natalia Kałwa
ORCID https://orcid.org/0009-0009-6657-7148
Email: natbanach15@gmail.com
Collegium Medicum, Jan Kochanowski University, Kielce, Poland

Kinga Kałuża
ORCID https://orcid.org/0009-0000-8226-6723
Email: kinga.kaluza777@gmail.com
Collegium Medicum, Jan Kochanowski University, Kielce, Poland

Michał Pater
ORCID https://orcid.org/0009-0001-1367-7198
Email: widzacy.arki.1g@icloud.com
Collegium Medicum, Jan Kochanowski University, Kielce, Poland

Aleksandra Strzępek
ORCID https://orcid.org/0009-0006-3045-8313
Email: a0strzepek@gmail.com
Collegium Medicum, Jan Kochanowski University, Kielce, Poland

Julia Łyżwa
ORCID https://orcid.org/0009-0004-6058-296X
Email: julia.lyzwa3@wp.pl
Collegium Medicum, Jan Kochanowski University, Kielce, Poland

Karolina Frączek
ORCID https://orcid.org/0009-0007-8065-2680
Email: fraczek.karolinaewa@gmail.com
Collegium Medicum, Jan Kochanowski University, Kielce, Poland

Agnieszka Janaszek
ORCID https://orcid.org/0009-0009-1774-6021
Email: a.janaszek76@gmail.com
Collegium Medicum, Jan Kochanowski University, Kielce, Poland

Aleksandra Majchrzyk
ORCID https://orcid.org/0009-0007-9255-9651
Email: olamatysiak67@gmail.com
Collegium Medicum, Jan Kochanowski University, Kielce, Poland

Agnieszka Chmurska
ORCID https://orcid.org/0009-0000-1883-4060
Email: agnieszkachmurska98@gmail.com
Collegium Medicum, Jan Kochanowski University, Kielce, Poland

ABSTRACT

Background. Enhanced Recovery After Surgery (ERAS) protocols represent a modern standard of perioperative care and an effective strategy for optimizing postoperative recovery. These protocols focus on reducing the surgical stress response, providing effective postoperative pain management and accelerating functional recovery. Increasing attention has been directed not only toward reducing the length of hospital stay but also toward improving postoperative physical function, which plays a crucial role in enabling patients to return to their normal daily activities.

Aim. The aim of this study is to provide a detailed analysis of the impact of ERAS (Enhanced Recovery After Surgery) protocols on postoperative physical function in patients undergoing surgical treatment. The study aims to assess the extent to which the use of integrated, multi-step perioperative care procedures influences the rate of recovery of mobility, independence in daily activities, and overall physical performance of patients after surgery.

Materials and methods. A systematic literature review was conducted in accordance with PRISMA guidelines to identify studies evaluating the impact of ERAS protocols on functional outcomes, including mobility, physical performance, muscle strength and time to return to daily activities. Studies published between 2016 and 2025 were analyzed using the PubMed, Scopus and Web of Science databases. Randomized controlled trials, cohort studies and meta-analyses were included in the analysis.

Results. The analysis of the available data indicates that the implementation of ERAS protocols is associated with earlier patient mobilization, a shorter time to regain independence and improved outcomes in functional tests compared with standard care. In many studies a reduction in postoperative complications and a shorter length of hospital stay were also observed.

Conclusions. ERAS protocols represent an effective tool for improving functional outcomes following surgical procedures. Their implementation promotes faster recovery of physical function and may contribute to the optimization of the rehabilitation process. Further studies are required to more comprehensively determine the long-term effects of ERAS implementation.
Keywords: ERAS, postoperative rehabilitation, physical function, surgery, mobilization

1. Introduction

Advances in surgery over recent decades have significantly reduced perioperative mortality. However, postoperative complications and delayed recovery of full physical function remain important clinical challenges. Surgical procedures trigger a complex physiological stress response. This response leads, among other effects, to metabolic disturbances, reduced mobility and prolonged hospitalization. Consequently, increasing attention has been directed toward strategies aimed at optimizing perioperative care in order to minimize the negative consequences of surgical intervention and accelerate patient recovery [1,2].

The concept of Enhanced Recovery After Surgery was developed in response to the need to optimize surgical care through the implementation of evidence-based practices in clinical settings. ERAS represents a comprehensive, multidisciplinary model of care that includes preoperative, intraoperative and postoperative interventions. These measures are aimed at improving pain control, reducing surgical stress, promoting early patient mobilization and optimizing nutrition [2,3]. ERAS programs assume close collaboration among surgical, anesthesiology, nursing and physiotherapy teams in order to maximize treatment outcomes [3].

Early postoperative mobilization is one of the key components of ERAS protocols. Reducing postoperative immobilization decreases the risk of complications, including venous thrombosis, loss of muscle mass and respiratory complications. It also accelerates the recovery of walking ability and other motor functions [4]. Studies indicate that early patient mobilization facilitates a faster return to independence and improves perceived physical function and quality of life among patients [4, 5].

In recent years ERAS protocols have been implemented in many surgical specialties. Numerous analyses have demonstrated that their use is associated with a shorter length of hospital stay, a reduced incidence of complications and improved overall surgical outcomes [6].

Despite the growing number of studies, there are differences in the methods used to assess functional outcomes after surgery and the available data regarding the impact of ERAS on patients physical function remain heterogeneous [7].

It is therefore justified to systematically summarize the available scientific evidence regarding the impact of ERAS protocols on postoperative physical function. Such an analysis may provide important insights into the role of comprehensive perioperative care in the recovery process and help identify directions for future research in this area [8].

Research objective

The aim of this study is to assess the impact of ERAS (Enhanced Recovery After Surgery) protocols on the physical function of patients after surgical procedures. It will be analyzed whether implementing comprehensive perioperative care including: early mobilization, appropriate pain management, and nutritional support accelerates a return to full activity, improves patient independence, and shortens recovery time compared to standard care.

Research problems

1. Does the use of ERAS protocols significantly improve patient physical functioning after surgery?
2. What elements of the ERAS protocol have the greatest clinical significance and application?
3. Do the achieved effects of ERAS differ depending on the type of surgical procedure?

2. Research materials and methods

This review utilized scientific publications on ERAS (Enhanced Recovery After Surgery) protocols published between 2016 and 2026 and indexed in PubMed, Scopus, and Web of Science. Full-text articles (open access) were included in the analysis, including randomized clinical trials, prospective and retrospective studies, as well as systematic reviews and meta-analyses. The review included studies assessing the impact of implementing ERAS protocols on clinical outcomes in surgical patients, such as length of hospitalization, postoperative complication rates, mortality, rate of physical recovery, and overall recovery. The study focused on the adult surgical patient population.

The methodology was based on the analysis and synthesis of current scientific evidence. Publications were selected based on criteria including year of publication (after 2016), topic area related to ERAS use in various surgical disciplines, and availability of full text. Next, a

qualitative content analysis of the selected articles was conducted, comparing the obtained results and identifying the main conclusions regarding the effectiveness and safety of ERAS protocols in clinical practice.

3.Research results

3.1 ERAS – historical and conceptual outline.

The concept of Enhanced Recovery After Surgery (ERAS) represents a modern approach to perioperative care aimed at reducing the physiological stress associated with surgical procedures and accelerating the patient's return to full functional recovery. ERAS consists of a set of evidence-based interventions that include measures implemented before surgery, during the procedure and in the postoperative period. The common objective of these interventions is to optimize the patient's physiological condition and minimize complications associated with surgical treatment [9].

The "fast-track surgery" model proposed in the 1990s assumed that individual interventions in perioperative care produce limited effects, whereas the implementation of multiple coordinated measures can significantly improve surgical outcomes. This approach involved reducing preoperative fasting time, optimizing analgesia, introducing early oral nutrition and promoting early postoperative mobilization. In subsequent years this concept was further developed and standardized by international research groups, which led to the establishment of formal recommendations and guidelines for perioperative care in various surgical specialties [10].

Contemporary ERAS programs are based on a multimodal approach that integrates the efforts of surgeons, anesthesiologists, nurses, dieteticians and physiotherapists. The implementation of ERAS helps reduce the inflammatory and metabolic response to surgical trauma, thereby decreasing the risk of complications and shortening the length of hospital stay. Studies have shown that the use of ERAS protocols can reduce hospital stay by as much as 30-50% while simultaneously lowering the incidence of postoperative complications [11].

An important element of ERAS concept is the standardization of clinical management. A set of clearly defined procedures is implemented, including preoperative patient education, nutritional optimization, goal-directed fluid therapy, minimally invasive surgical techniques, effective multimodal analgesia and early mobilization. Such an approach helps maintain metabolic balance and facilitates faster recovery of functional capacity after surgery [12].

Currently ERAS protocols are widely implemented across many surgical specialties. These programs are continuously developed by the ERAS Society, which formulates guidelines

based on the results of clinical studies and systematic reviews. As a result, the ERAS concept has become one of the key components of modern perioperative medicine, aimed not only at ensuring surgical safety but also at facilitating a rapid return of patients to functional recovery and physical activity [13].

3.2 Key elements of ERAS protocols

The phases of the protocol can be divided into pre-, intra- and post-operative, and each stage is an important element in improving the patient's recovery [14].

The preoperative period consists of pre-admission counseling and health education for the patient. The goal of these activities is to reduce patient anxiety, as an informed patient will better understand their postoperative state. This will also psychologically improve pain control and the overall recovery process. Preoperative optimization of the patient's condition primarily involves assessing the patient's physical and mental state before surgery. It includes a medical history, a physical examination, and additional tests, such as laboratory or imaging diagnostics. The patient's degree of malnutrition and the risk of its development after surgery are assessed. Assessing the presence of chronic comorbidities and striving to reduce their side effects during the procedure, for example, by implementing thromboembolic prophylaxis, may be crucial. Furthermore, information about the patient's substance use, including smoking, alcohol consumption, and drug use, is important from the medical history. A clear reduction in the incidence of cardiac complications and postoperative infections has been demonstrated as a result of patients discontinuing stimulants in the preoperative period. Another important element of ERAS is reducing the preoperative fasting period and administering oral carbohydrates two hours before surgery, which helps reduce the incidence of surgically induced insulin resistance [14].

Intraoperatively, ERAS protocols promote the use of multimodal sedation and analgesia, with limited use of opioid medications. When possible, local anesthesia, such as spinal anesthesia, is the preferred method. Adequate fluid therapy is sought to maintain fluid and hemodynamic balance. It is recommended to minimize the use of nasogastric drains and probes and to promptly resume oral feeding. Vital signs such as oxygen saturation, blood pressure, and body temperature are monitored throughout the procedure. Maintaining the patient's physiological body temperature is crucial to prevent intraoperative hypothermia, which could be associated with a higher risk of infections and complications [14].

The basic steps in the postoperative period include early oral feeding and early patient uprighting and mobilization. Studies have shown that early fluid and food intake and standing

within the first few days after surgery shorten the time to recovery of bowel function, reduce the risk of muscle hypoxia, and prevent thromboembolic complications. Removing nasal tubes and drains as soon as possible and limiting the duration of urinary catheter use also contribute to reducing the risk of infections and improving patient comfort [14].

3.2.1. Early mobilization as a key factor in improving function

One of the most important elements of ERAS protocols is early upright standing after surgery, which directly impacts the patient's physical function. Numerous studies have shown that initiating physical activity, such as walking in the ward corridor, within the first twenty-four hours after surgery significantly reduces the risk of complications and accelerates recovery. These efforts focus on limiting the patient's muscle loss and reducing the risk of insulin resistance. By quickly upprighting the patient and not requiring bed rest, we significantly improve lung ventilation, which in elderly patients reduces the risk of hospital-acquired pneumonia. Prolonged patient immobilization can also contribute to the occurrence of thromboembolic incidents, even leading to an acute condition such as pulmonary embolism. Clinically, mobilized patients achieve greater functional independence as early as the first week after surgery [14,15].

3.2.2. Optimization of analgesia

Postoperative pain is one of the main factors limiting patients' physical activity and thus prolonging recovery time. The conventional approach relies on the use of opioid-based medical devices, which is associated with numerous adverse effects, including excessive sedation and the associated drowsiness, nausea, and depression of the respiratory center in the brain. Additionally, opioids can cause impaired intestinal peristalsis, leading to constipation. Effective postoperative pain control is particularly important, and is promoted in ERAS protocols, particularly in the context of the current global opioid epidemic and the high risk of addiction. This approach utilizes nonsteroidal anti-inflammatory drugs, paracetamol, regional anesthesia techniques, and nerve blocks. This translates into improved patient well-being after surgery and a faster return to activity and daily living activities. Analyses show that reducing opioid use results in more efficient mobilization and improved tolerance of the procedure [16,17].

3.2.3. Minimally invasive surgical techniques

Robotic and laparoscopic techniques significantly reduce surgical stress and trauma. Compared to open abdominal surgery, these procedures involve smaller wounds and require

less sutures or drainage. Small postoperative wounds limit the body's inflammatory response, which contributes to the patient's overall healing process [18].

3.2.4. Optimization of nutrition and fluid therapy

To prevent sarcopenia, a well-balanced nutrition plan is crucial. ERAS protocols recommend shortening the patient's preoperative fasting period, preoperative carbohydrate intake, and early initiation of oral feeding after the procedure. Appropriate preoperative patient preparation is also important, aiming to correct protein deficiencies in malnourished patients. Early initiation of oral feeding reduces protein catabolism, improves muscle strength, and shortens the recovery time. Proper fluid therapy is another element of ERAS protocols. Excessive fluid administration during surgery can lead to tissue edema, including gastrointestinal tract edema. Intestinal edema will delay the return to normal intestinal function and may be associated with impaired intestinal transit. This approach results in fewer intestinal passage disruptions and alleviates the patient's postoperative discomfort. It is important to tailor nutrition and fluid intake individually for each patient, depending on their needs and health status [19,20].

3.2.5. Patient education and preoperative preparation

Understanding the various stages of treatment allows the patient to actively participate in the recovery process and reduces the level of anxiety associated with surgery. Before surgery, they should be informed about the procedure, possible complications, and the procedures to be followed during the recovery period. The patient should be aware of the entire treatment process. Patient education is an often-neglected, but it is still crucial element of ERAS. Rational psychological preparation and a comprehensive explanation of the procedure reduce anxiety and concerns related to the procedure. It makes the patient more engaged in the recovery process and results in better cooperation during the rehabilitation process. Research shows that patients who are aware of the treatment process engage in physical activity more quickly and achieve better functional outcomes [21].

3.2.6. Prehabilitation

This process is an essential part of patient preparation for elective surgery, which has become increasingly important in interventional medicine in recent years. The primary goal is to improve the patient's general condition before surgery. Preparation includes physical training aimed at increasing body performance and improving muscle strength. A patient's good

physical condition and regular physical activity have a positive impact on the cardiovascular and respiratory systems, which is particularly important during the perioperative period. A well-balanced diet provides the body with essential nutrients that support tissue regeneration and strengthen the immune system. Consultation with a dietitian is sometimes necessary to tailor the diet to the patient's current nutritional status. Psychological support from a specialist is also sometimes necessary, which helps reduce the stress associated with the upcoming surgery. A better-prepared patient copes more quickly with the stress of the procedure, and for this reason, more and more medical facilities are introducing post-rehabilitation programs as a standardized element of surgical preparation [22].

The effectiveness of implementing ERAS protocols depends on parameters such as:

- patient age - elderly patients undergoing surgery benefit particularly from ERAS, but require an individualized approach and personalized management
- the presence of comorbidities - diabetes, chronic obstructive pulmonary disease, coronary heart disease, or mental illness - may affect the time to return to full physical fitness
- type and mode of surgery - the greatest benefits are observed in procedures using minimally invasive techniques and performed in an elective setting
- time and degree of protocol implementation - incomplete or delayed implementation of ERAS significantly reduces its effectiveness [23]

3.3 Overview of ERAS in various fields of interventional medicine

3.3.1. ERAS in General and Bariatric Surgery

In general surgery, ERAS protocols have established their position as a model of perioperative management aimed at reducing the consequences of surgical trauma and accelerating the patient’s return to functional recovery. This approach represents a shift away from traditional, variable postoperative care toward a standardized treatment pathway. Pooled analyses indicate that the implementation of ERAS in various types of procedures within general and bariatric surgery is associated with a shorter length of hospital stay and a lower rate of complications, without an increase in the risk of hospital readmissions or perioperative mortality [24].

ERAS has become one of the fundamental standards of modern perioperative care, particularly in general surgery involving gastrointestinal procedures. The benefits do not result from a single component of the program but rather from the cumulative effect of multiple

interventions, including improved pain control, reduced opioid use, faster recovery of gastrointestinal function, earlier patient mobilization and lower incidence of medical and surgical complications. This mechanism is relevant for the assessment of postoperative physical function, as it promotes a faster recovery of independence, improved exercise tolerance and the ability to resume daily activities [25].

In bariatric surgery, the implementation of ERAS is of particular importance due to specific characteristics of the population of patients with morbid obesity, in whom the risk of thromboembolic events, respiratory complications, postoperative nausea and vomiting and difficulties with early mobilization is relatively high. Updated ERAS guidelines for bariatric surgery emphasize the importance of proper patient education, prevention of postoperative nausea and vomiting, reduction of preoperative fasting, early oral fluid intake, opioid-sparing strategies and planned mobilization already on the first postoperative day. However, the authors of these guidelines also note that quality of evidence for some interventions in this patient population remains moderate or low. This justifies further research focusing on functional outcomes and the safety of implemented care pathways [26].

Available meta-analyses in bariatric surgery demonstrate a consistent direction of effect. In the review by Zhou et al., the implementation of ERAS was associated with a significant reduction in the length of hospital stay and a lower incidence of postoperative nausea and vomiting, without a significant increase in complications or reoperations [27]. A meta-analysis of randomized controlled trials conducted by Davey et al. confirmed that ERAS protocols after bariatric surgery shorten the time to mobilization, the time to tolerance of a full diet and oral fluids and facilitate earlier discharge while maintaining a safety profile comparable to standard care [28]. From the perspective of physical function, these findings are particularly important, as earlier mobilization and faster tolerance of oral intake create favorable conditions for limiting the consequences of postoperative immobilization and promoting dynamic recovery [27, 28].

In a study conducted at a bariatric center, Trotta et al. demonstrated that the implementation of ERAS was safe and associated with marked reduction in postoperative length of stay while maintaining low morbidity rates [29]. Similarly, Lam et al., in an analysis of patients undergoing laparoscopic sleeve gastrectomy, reported a reduction in median hospital stay without an increrase in complications or readmissions, as well as lower pain intensity on the first postoperative day [30]. A randomized study by Papasavas et al. further confirmed reduced opioid use in the ERAS group, lower peak pain scores and earlier readiness for discharge compared with the standard care group [31]. These findings suggest that in bariatric

surgery, ERAS influences early clinical parameters that are directly related to the recovery of physical function after surgery [29, 30, 31].

3.3.2. ERAS in Urology

Initially developed and widely used in general surgery, ERAS protocols have recently been implemented in urological surgery. They are used in large and extensive urological procedures, such as radical cystectomy and radical prostatectomy, which involve significant patient trauma. Total cystectomy and total prostatectomy are associated with significant surgical burden, long procedure times, and high rates of perioperative complications. In the case of radical cystectomy, these complications can reach up to 65%. These procedures often involve elderly patients with multiple comorbidities, and the chronicity of these conditions further increases the risk of complications and prolongs recovery time [32].

ERAS protocols in urology focus on optimizing all phases of patient treatment - from preoperative preparation, through intraoperative care, and through postoperative recovery. The primary goals are to reduce the negative effects of surgical stress, restore homeostasis, and shorten the patient's stay in the urology department. It is important to reduce complications and prevent reoperations [33].

In the modern field of medicine, urological surgery, there is an increasing trend toward minimally invasive techniques. The development of robotic technology and the use of the da Vinci surgical robot have revolutionized the way complex surgeries are performed, increasing precision in a small surgical field, improving procedural safety, and improving comfort for both the patient and the operator. The use of robotics is now limited to laparoscopic surgery, which reduces tissue trauma to the surgical site, reduces postoperative pain, and shortens the procedure time. At the same time, the number of general complications is reduced [34].

Urinary bladder drainage via catheterization, most commonly using a Foley catheter, is routinely used in major urological surgeries. The optimal duration of catheter drainage is one day (24 hours) in the case of colon resections or after pelvic surgery in patients at low risk of urinary retention. It has been proven that catheter removal within the first 24 hours after thoracic and abdominal surgery significantly reduces the incidence of urinary tract infections [33, 34]. In contrast, the duration of urinary drainage in patients after radical cystectomy is unclear in the scientific literature. According to Mattei's et al. study on drainage after total cystectomy, the placement of a ureterojejunal anastomosis contributed to the reduction of postoperative pelvicalyceal dilatation, improved postoperative bowel function, and also reduced the severity of metabolic acidosis in the patient [35].

In general clinical practice, the time to stent removal in patients with a ureteral-jejunal drainage device ranges from 5 to 14 days postoperatively. In the case of a neobladder created for bladder reconstruction, the urinary catheter is left in place for at least 14 days postoperatively [36].

Despite the growing interest in the use of ERAS protocols in urological surgery, there are still a limited number of clear and systematic urological ERAS guidelines. Many protocol factors require further verification in prospective studies. Optimization of fluid therapy, pain management methods, principles of postoperative ileus prevention, and the duration of postoperative urinary catheterization and drainage should be particularly important aspects of research [35, 36].

3.3.3. ERAS in Gynecology

In recent years, the concept of extensive perioperative care protocols has found widespread application in many different surgical fields, including gynecological surgery. Conventional patient care was often associated with longer hospitalizations, greater pain medication requirements, and higher rates of postoperative nausea and vomiting. Addressing these challenges, ERAS offers a full range of possibilities for use in surgical gynecology. This type of application is most often found in hysterectomy and other more invasive and extensive procedures. Due to the multitude of aspects of surgical gynecology, we will focus below on the use of ERAS in laparoscopic procedures without hysterectomy and its comparison with total hysterectomy using laparotomy [37, 38].

ERAS is being increasingly researched and utilized in minimally invasive gynecological procedures, such as laparoscopic procedures and non-hysterectomy procedures performed for benign conditions. These procedures are most often performed for endometriosis, uterine fibroids, or other adnexal pathologies. Implementation of the ERAS protocol in women undergoing laparoscopic gynecological procedures without hysterectomy results in early discharge from the gynecology ward. With appropriately implemented ERAS, patients undergoing laparoscopic gynecological procedures can be effectively treated with a short hospital stay or even as one day surgery. Laparoscopy is a recommended surgical method because it reduces surgical stress and is associated with improved metabolic profiles in patients. Preparation includes patient education, bowel preparation, preoperative fasting, oral carbohydrate intake, antibiotic prophylaxis, and maintaining cardiorespiratory fitness in patients undergoing surgery. The very nature of laparoscopy has been shown to significantly increase same-day discharge rates. Laparoscopic surgery is associated with less surgical trauma

compared to laparotomy. This procedure also impacts patient pain scores, reducing the incidence of postoperative nausea and vomiting and the need for pain medication. Compared to open abdominal surgery, large doses of anesthetics are not required, which also shortens the recovery time in the recovery room. The use of robotic techniques results in less tissue trauma and smaller postoperative wounds, resulting in a lower pain level experienced within the first few hours after surgery. This translates into faster mobilization and improved overall patient well-being. The effectiveness of laparoscopic techniques is also evident in the reduced rate of surgical site infections due to the smaller wound size. These procedures are typically performed for benign reproductive tract pathologies in young women of reproductive age, which further supports the routine use of Enhanced Recovery After Surgery protocols. These patients prioritize a rapid return to daily activities, minimize surgical pain, optimize postoperative quality of life, and preserve reproductive function. Due to the privacy and sensitivity of gynecology departments, the psychological aspect is important, and many women prefer to recover at home. In young women, laparoscopy also reduces the risk of intraperitoneal adhesions, which can be important when planning a pregnancy. The use of ERAS in laparoscopy is safe and brings significant clinical benefits, and the integration of minimally invasive surgical techniques with modern perioperative care is the direction that contemporary surgical gynecology should follow [37, 38, 39].

Indications for hysterectomy most often include multiple uterine fibroids, advanced endometriosis, precancerous lesions, and reproductive system cancer. Although minimally invasive techniques are increasingly being used, hysterectomy remains an important treatment option, especially in cases of extensive disease processes. This surgical procedure is associated with significant surgical trauma and numerous postoperative complications. The time to return to full physical activity is also prolonged. In recent years, attention has been paid to the highest possible quality of medical services, which is why implementing ERAS protocols for patients undergoing hysterectomy is crucial. ERAS is intended to reduce the metabolic stress associated with this procedure. In patients with heavy menstrual bleeding caused by various reproductive organ pathologies, and due to the sheer extent of the surgery and potentially significant blood loss during the procedure, transfusion of red blood cells concentrate should be provided if necessary. Treatment of any anemia or other metabolic disorders can be considered prior to surgery. Correcting these abnormalities before surgery can significantly impact the postoperative period. During hysterectomy, efforts are made to minimize surgical trauma as much as possible, and the use of ERAS represents a new approach to modern surgical gynecology [38, 39].

3.3.4. ERAS in Plastic Surgery and Cardiosurgery

In plastic surgery ERAS protocols are primarily applied to breast reconstruction procedures. This group of operations has generated the largest amount of clinical data to date. ERAS guidelines for breast reconstruction have standardized postoperative management, emphasizing the importance of reducing preoperative fasting, preventing postoperative nausea and vomiting, maintaining normothermia, implementing opioid-sparing analgesia, initiating early nutrition and promoting early mobilization. In practice, this has led to a transition toward a more active and standardized recovery process [40, 41].

Systematic reviews indicate that in breast reconstruction ERAS leads to a shorter length of hospital stay and reduced postoperative opioid consumption, without clear evidence of an increased rate of complications. In a meta-analysis by Offodile et al., which included post-mastectomy reconstruction procedures, a significant reduction in opioid requirements and hospital length of stay was demonstrated in groups managed according to ERAS protocols, without significant differences in major complications, hematoma formation or infections [41]. From the perspective of physical function, these findings are clinically relevant, as more effective pain control and reduced opioid-related adverse effects facilitate earlier mobilization and a faster return to self-care [41, 42].

A similar trend has been observed in more complex autologous reconstructions. A meta-analysis by Pierzchajlo et al. demonstrated that use of ERAS protocols in this group of procedures was associated with shorter hospital stay and lower treatment costs, without an increased risk of serious adverse events [42]. Earlier cohort studies concerning alloplastic reconstructions also indicated that hospitalization could be safely shortened without an increase in complication rates when ERAS protocols were implemented. In plastic surgery ERAS influences parameters directly related to postoperative physical function, such as tolerance of early mobilization, reduced pain during movement and faster recovery of independence [43]. At the same time it should be emphasized that the evidence base in plastic surgery remains less homogenous than in classical gastrointestinal surgery. Most published studies concern breast procedures [42, 43].

In cardiac surgery the development of ERAS occurred later than in other surgical specialties. This was largely due to the specific nature of cardiac procedures, the higher perioperative risk and the more complex postoperative course. A turning point was the publication of recommendations by the ERAS Cardiac Surgery Society, which standardized preoperative, intraoperative and postoperative management for patients undergoing cardiac

surgery. The aim of these measures is to shorten the recovery period, reduce the incidence of complications and facilitate a faster return to the preoperative level of functioning [44].

Available clinical data suggest that the implementation of ERAS in cardiac surgery may provide benefits, although the strength of evidence is currently weaker than in general surgery. A meta-analysis by Diz-Ferreira et al. demonstrated a reduction in the length of hospital stay among patients managed according to ERAS protocols, without significant differences in mortality or the incidence of postoperative atrial fibrillation. However, the authors emphasized the overall low quality of evidence, the limited number of randomized studies and the lack of sufficient data regarding quality of life and indicators directly reflecting functional recovery. From the perspective of physical function, this indicates that the observed benefits have not yet been fully translated into well-standarized functional outcomes [45].

In clinical practice, particular importance in cardiac surgery is attributed to those ERAS components that influence early postoperative functional capacity. These include sedation, effective analgesia, early extubation, reduction of pulmonary complications and the earliest possible initiation of patient mobilization. It has been emphasized that the publication of ERAS recommendations represents only the first step, while consistent implementation and the evaluation of long-term outcomes, including the return to daily activities, remain crucial [46].

4. Discussion

ERAS protocols are one of the most important achievements in modern surgery. Their impact on physical function is well documented and results from a comprehensive impact on the patient's body. The use of ERAS protocols has a significant impact on the time to mobilization of patients after surgery.

Studies conducted by Greco and Gustafsson et al. demonstrated a significant acceleration in patients' return to full physical activity. In randomized trials, patients enrolled in ERAS programs achieved standing within an average of 6-12 hours after surgery, compared to a day or two in standard postoperative care [25, 47, 48].

The analysis by Ljungqvist et al. noted that early mobilization significantly reduces the risk of thromboembolic complications and accelerates the return of bowel motility and functional function [47]. Similar observations were presented in a meta-analysis of colorectal surgery, where the time to first standing was shortened by an average of up to 36 hours [48].

In a review of studies on the use of ERAS in orthopedic surgery, for example, in hip replacement, the use of protocols reduced the time to independent ambulation by up to 2 days [50].

The impact of ERAS on functional testing has been extensively studied. Physical function was most commonly assessed using the 6-Minute Walk Test (6MWT), Timed Up and Go (TUG), Barthel scale, and muscle strength assessment. Significant improvements in functional outcomes were demonstrated in the ERAS groups. In a cohort study of abdominal surgery, patients in the ERAS group achieved significantly better results on the 6MWT as early as the third postoperative day. On average, they walked a distance that was up to 60 to 80 meters further than the control group [51]. Similar observations were made by Barberan-Garcia et al. in their study of the Timed Up and Go test. In the ERAS group, the time to complete all test tasks was reduced by 20-30% [22]. Another study, however, demonstrated that orthopedic patients undergoing ERAS regained functional independence and the ability to perform daily activities more quickly [53].

The most consistent and conclusive results concern a reduction in the length of hospitalization. The studies reviewed showed a reduction in hospitalization length by an average of 2 to 4 days, and for some procedures, such as colorectal laparoscopy, by up to 50% [48, 55, 56]. A meta-analysis by Greco et al. showed that implementing ERAS reduced the length of hospitalization by an average of 2.3 days without increasing the risk of rehospitalization [48].

Implantation of ERAS protocols is associated with a reduction in postoperative complications and their impact on physical function. A proven reduction in complications includes surgical site infections, respiratory complications, and thromboembolic complications. The reduction in the frequency of complications directly translated into improved recovery and time to physical activity. Studies conducted by Li et al. demonstrated a reduction in complications of up to 30% on average [55]. In the group of patients analyzed by Zhuang et al., a reduction in the frequency of paralytic ileus was assessed [56].

One of the fundamental elements of ERAS is the optimization of pain management. Reducing the use of opioid medications led to optimal sedation, faster mobilization, and improved respiratory function. Wick et al. studied the effect of multimodal analgesia and demonstrated that its use shortened the time to verticalization and improved functional test results [57, 58].

The importance of early postoperative nutrition was one of the most important factors influencing physical function. Appropriate, early nutrition has been shown to reduce muscle loss and improve muscle strength. Patients who received nutrition within 24 hours of surgery achieved better functional outcomes than those undergoing prolonged fasting [59, 60, 61].

5. Conclusions

Based on the collected data and the systematic review, the following conclusions can be drawn:

1. The use of ERAS protocols significantly improves patients' early physical functioning and quality of life after surgical procedures.
2. Implementation of ERAS shortens the length of hospitalization and reduces the number of postoperative complications.
3. The most clinically significant factors in functional outcomes include early patient mobilization, multimodal analgesia, and nutrition.
4. The effect of an ERAS protocol depends on the extent of its implementation and the type of surgical procedure performed.
5. The key endpoint of surgical treatment should be maintaining the patient's physical function and fitness.

Disclosure:

Author Contributions

Conceptualization: Mateusz Smerdzyński,
Methodology: Natalia Kałwa,
Investigation: Agnieszka Chmurska, Aleksandra Majchrzyk,
Writing: Original Draft Preparation: Kinga Kałuża, Michał Pater,
Writing: Review and Editing: Julia Łyżwa, Aleksandra Strzępek,
Project Administration: Agnieszka Janaszek,
Data Curation: Karolina Frączek.

Funding

This research received no external funding.

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Not applicable.

Data Availability Statement

The data used in the work are available in the cited scientific publications.

Conflicts of Interest

The authors declare no conflict of interest.

Supplementary Materials.

No additional materials.

Declaration of Generative AI and AI-Assisted Technologies

During the preparation of this work, the authors used ChatGPT-5.2 to improve grammar and language clarity. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

References

1. Elsenosy AM, Hassan E, Abdelgader M, Elgamily OS, Hegazy A. Enhanced Recovery After Surgery (ERAS) approach: a medical complex experience. Cureus. 2023;15(12):e51208. https://doi.org/10.7759/cureus.51208
2. National Guideline Centre (UK). Evidence review for enhanced recovery programmes. In: *Perioperative care in adults*. NICE guideline no. 180. London: National Institute for Health and Care Excellence; 2020. Available from: https://www.ncbi.nlm.nih.gov/books/NBK561974/
3. Jain SN, Lamture Y, Krishna M. Enhanced Recovery After Surgery: exploring the advances and strategies. Cureus. 2023;15(10):e47237. https://doi.org/10.7759/cureus.47237
4. Tazreean R, Nelson G, Twomey R. Early mobilization in enhanced recovery after surgery pathways: current evidence and recent advancements. J Comp Eff Res. 2022;11(2):121-129. https://doi.org/10.2217/cer-2021-0258
5. Willner A, Teske C, Hackert T, Welsch T. Effects of early postoperative mobilization following gastrointestinal surgery: systematic review and meta-analysis. BJS Open. 2023;7(5):zrad102. https://doi.org/10.1093/bjsopen/zrad102
6. Sauro KM, Smith C, Ibadin S, et al. Enhanced recovery after surgery guidelines and hospital length of stay, readmission, complications, and mortality: a meta-analysis of randomized clinical trials. JAMA Netw Open. 2024;7(2):e2359871. https://doi.org/10.1001/jamanetworkopen.2023.59871
7. Salamanna F, Contartese D, Brogini S, Visani A, Martikos K, Griffoni C, et al. Key components, current practice and clinical outcomes of ERAS programs in patients

undergoing orthopedic surgery: a systematic review. J Clin Med. 2022;11(14):4222. https://doi.org/10.3390/jcm11144222

8. Hu ZC, He LJ, Chen D, Li XB, Feng ZH, Fu CW, et al. An enhanced recovery after surgery program in orthopedic surgery: a systematic review and meta-analysis. J Orthop Surg Res. 2019;14(1):77. https://doi.org/10.1186/s13018-019-1116-y
9. Parks L, Routt M, De Villiers A. Enhanced recovery after surgery. J Adv Pract Oncol. 2018;9(5):511-519.
10. Golder HJ, Papalois V. Enhanced recovery after surgery: history, key advancements and developments in transplant surgery. J Clin Med. 2021;10(8):1634. https://doi.org/10.3390/jcm10081634
11. Ljungqvist O, Scott M, Fearon KC. Enhanced recovery after surgery: a review. JAMA Surg. 2017;152(3):292-298. https://doi.org/10.1001/jamasurg.2016.4952
12. Liu H, Wang L, Wang X, et al. The application of enhanced recovery after surgery and negative-pressure wound therapy in the perioperative period of elderly patients with colorectal cancer. BMC Surg. 2021;21:336. https://doi.org/10.1186/s12893-021-01331-y
13. Ljungqvist O. Enhanced recovery after surgery and the ERAS® Society. J Pancreatol. 2019;2(3):65-68.
14. Nicholson A, Lowe MC, Parker J, et al. Systematic review and meta-analysis of enhanced recovery programmes in surgical patients. Br J Surg. 2017;104(3):292-299.
15. Varadhan KK, Neal KR, Dejong CH, et al. The enhanced recovery after surgery (ERAS) pathway for patients undergoing major elective open colorectal surgery: a meta-analysis of randomized controlled trials. Clin Nutr. 2016;35(3):573-580.
16. Memtsoudis SG, Poeran J, Cozowicz C, et al. The impact of multimodal analgesia on perioperative outcomes and resource utilization. Br J Anaesth. 2018;120(5):1080-1087.
17. Chou R, Gordon DB, de Leon-Casasola OA, et al. Management of postoperative pain: a clinical practice guideline. J Pain. 2016;17(2):131-157.
18. Veldkamp R, Kuhry E, Hop WC, et al. Laparoscopic surgery versus open surgery for colon cancer: short-term outcomes. Lancet. 2005;365:477-484.
19. Ljungqvist O. ERAS nutrition principles. JPEN J Parenter Enteral Nutr. 2017;41(5):713-720.
20. Smith MD, McCall J, Plank L, et al. Preoperative carbohydrate treatment for enhancing recovery after elective surgery. Br J Surg. 2014;101(8):998-1007.
21. Auyong DB, Allen CJ, Pahang JA, et al. Patient education and enhanced recovery pathways. J Surg Res. 2019;241:1-7.

22. Barberan-Garcia A, Ubré M, Roca J, et al. Personalised prehabilitation in high-risk patients undergoing elective major abdominal surgery. Ann Surg. 2018;267(1):50-56.
23. Hughes MJ, Hackney RJ, Lamb PJ, et al. Prehabilitation before major abdominal surgery: systematic review. World J Surg. 2019;43(7):1661-1668. https://doi.org/10.1007/s00268-019-04950-y
24. Zhang W, Wang F, Qi S, Liu Z, Zhao S, Zhang N, et al. Effectiveness and safety of ERAS in colorectal surgery: meta-analysis. Wideochir Inne Tech Maloinwazyjne. 2023;18(4):565-577. https://doi.org/10.5114/wiitm.2023.131426
25. Gustafsson UO, Scott MJ, Hubner M, Nygren J, Demartines N, Francis N, et al. Guidelines for perioperative care in elective colorectal surgery: ERAS Society recommendations. World J Surg. 2019;43(3):659-695. https://doi.org/10.1007/s00268-018-4844-y
26. Stenberg E, Dos Reis Falcão LF, O'Kane M, Liem R, Pournaras DJ, Salminen P, et al. ERAS guidelines for bariatric surgery: 2021 update. World J Surg. 2022;46(4):729-751. https://doi.org/10.1007/s00268-021-06394-9
27. Zhou J, Du R, Wang L, Wang F, Li D, Tong G, et al. ERAS in bariatric surgery: systematic review and meta-analysis. Obes Surg. 2021;31(3):1321-1331. https://doi.org/10.1007/s11695-020-05209-5
28. Davey MG, Donlon NE, Fearon NM, Heneghan HM, Conneely JB. Impact of ERAS protocols on bariatric surgery outcomes. Obes Surg. 2024;34(3):778-789. https://doi.org/10.1007/s11695-024-07072-0
29. Trotta M, Ferrari C, D'Alessandro G, Sarra G, Piscitelli G, Marinari GM. Enhanced recovery after bariatric surgery in a high-volume center. Surg Obes Relat Dis. 2019;15(10):1785-1792. https://doi.org/10.1016/j.soard.2019.06.038
30. Lam J, Suzuki T, Bernstein D, Zhao B, Maeda C, Pham T, et al. ERAS protocol for bariatric surgery: discharge on postoperative day 1. Surg Endosc. 2019;33(2):580-586. https://doi.org/10.1007/s00464-018-6368-9
31. Papasavas P, Seip RL, McLaughlin T, Staff I, Thompson S, Mogor I, et al. Randomized trial of ERAS in laparoscopic sleeve gastrectomy. Surg Endosc. 2023;37(2):921-931. https://doi.org/10.1007/s00464-022-09512-3
32. Vukovic N, Dinic L. Enhanced Recovery After Surgery protocols in major urologic surgery. Front Med (Lausanne). 2018;5:93. https://doi.org/10.3389/fmed.2018.00093

33. Nygren J, Thacker J, Carli F, Fearon KC, Norderval S, Lobo DN, et al. ERAS guidelines for rectal/pelvic surgery. World J Surg. 2013;37:285-305. https://doi.org/10.1007/s00268-012-1787-6
34. Cerantola Y, Valerio M, Persson B, Jichlinski P, Ljungqvist O, Hubner M, et al. ERAS guidelines after radical cystectomy. Clin Nutr. 2013;32:879-887. https://doi.org/10.1016/j.clnu.2013.09.014
35. Mattei A, Birkhaeuser FD, Baermann C, Warncke SH, Studer SU. Ureteroileal anastomosis stenting randomized trial. J Urol. 2008;179:582-586. https://doi.org/10.1016/j.juro.2007.09.066
36. Collins JW, Patel H, Adding C, Annerstedt M, Dasgupta P, Khan SM, et al. Enhanced recovery after robot-assisted radical cystectomy. Eur Urol. 2016;70:649-660. https://doi.org/10.1016/j.eururo.2016.05.020
37. Peters A, Siripong N, Wang L, Donnellan NM. ERAS outcomes in minimally invasive gynecologic procedures. Am J Obstet Gynecol. 2020;223(2):234.e1-234.e8. https://doi.org/10.1016/j.ajog.2020.02.008
38. Yilmaz G, Akca A, Aydin N. ERAS versus conventional care in abdominal hysterectomy. J Health Sci Med. 2020;3(4):343-348.
39. Aubrey C, Nelson G. ERAS for minimally invasive gynecologic oncology surgery. Curr Oncol. 2023;30(10):9357-9366. https://doi.org/10.3390/curroncol30100677
40. Temple-Oberle C, Shea-Budgell MA, Tan M, Semple JL, Schrag C, Barreto M, et al. ERAS Society recommendations for breast reconstruction. Plast Reconstr Surg. 2017;139(5):1056e-1071e. https://doi.org/10.1097/PRS.0000000000003242
41. Lombana NF, Mehta IM, Zheng C, Falola RA, Altman AM, Saint-Cyr MH. ERAS protocols in breast plastic surgery. Proc (Bayl Univ Med Cent). 2023;36(4):501-509. https://doi.org/10.1080/08998280.2023.2210036
42. Offodile AC 2nd, Gu C, Boukovalas S, Coroneos CJ, Chatterjee A, Largo RD, et al. ERAS pathways in breast reconstruction. Breast Cancer Res Treat. 2019;173(1):65-77. https://doi.org/10.1007/s10549-018-4991-8
43. Pierzchajlo N, Zibitt M, Hinson C, Stokes JA, Neil ZD, Pierzchajlo G, et al. ERAS pathways for DIEP flap reconstruction. J Plast Reconstr Aesthet Surg. 2023;87:259-272. https://doi.org/10.1016/j.bjps.2023.10.058
44. Dumestre DO, Redwood J, Webb CE, Temple-Oberle C. ERAS protocol and same-day discharge after breast reconstruction. Plast Surg (Oakv). 2017;25(4):249-254. https://doi.org/10.1177/2292550317728036

45. Engelman DT, Ben Ali W, Williams JB, Perrault LP, Reddy VS, Arora RC, et al. ERAS Society recommendations for cardiac surgery. JAMA Surg. 2019;154(8):755-766. https://doi.org/10.1001/jamasurg.2019.1153
46. Diz-Ferreira E, Díaz-Vidal P, Fernández-Vázquez U, Gil-Casado C, Luna-Rojas P, Diz JC. ERAS programs in cardiac surgery: systematic review. J Cardiothorac Vasc Anesth. 2025;39(5):1325-1334. https://doi.org/10.1053/j.jvca.2025.01.036
47. Gregory AJ, Grant MC, Manning MW, Cheung AT, Ender J, Sander M, et al. ERAS cardiac recommendations commentary. J Cardiothorac Vasc Anesth. 2020;34(1):39-47. https://doi.org/10.1053/j.jvca.2019.09.002
48. Ljungqvist O, Hubner M. ERAS—physiology and outcomes. Curr Opin Anaesthesiol. 2018;31(3):292-297.
49. Greco M, Capretti G, Beretta L, et al. Enhanced recovery after surgery programs: meta-analysis. Ann Surg. 2018;267(4):623-636.
50. Wainwright TW, Gill M, McDonald DA, et al. Consensus statement for ERAS in orthopaedics. Acta Orthop. 2020;91(1):3-19.
51. Gillis C, Fenton TR, Sajobi TT, et al. Functional recovery and ERAS. Anesth Analg. 2016;122(3):651-659.
52. Khan SK, Malviya A, Muller SD, et al. Reduced length of stay with ERAS in orthopaedics. J Bone Joint Surg Am. 2017;99(22):1978-1985.
53. Li L, Jin J, Min S, et al. ERAS reduces complications and hospital stay. Medicine (Baltimore). 2017;96:e7626.
54. Zhuang CL, Ye XZ, Zhang XD, et al. ERAS and postoperative ileus reduction. World J Gastroenterol. 2016;22(38):8576-8583.
55. Wick EC, Grant MC, Wu CL. Postoperative multimodal analgesia pain management. Anesthesiology. 2017;127(5):891-902.
56. Beverly A, Kaye AD, Ljungqvist O, et al. Opioid-sparing analgesia within ERAS pathways. J Anaesthesiol Clin Pharmacol. 2017;33(4):449-456.
57. Weimann A, Braga M, Carli F, et al. ESPEN guideline: clinical nutrition in surgery. Clin Nutr. 2017;36(3):623-650.
58. Gillis C, Carli F. Nutrition therapy in ERAS programs. Clin Nutr. 2019;38(2):485-498.
59. Grass F, Slieker J, Jurt J, et al. Impact of nutrition on recovery in ERAS programs. Ann Surg. 2018;267(5):859-867.