

Review

Enhanced Recovery after Surgery (ERAS) in Gynecology: State of the Art and the Problem of Barriers

Sara Forte¹, Filippo Alberto Ferrari², Hooman Soleymany Majd³,
Francesca Cisotto¹, Federico Ferrari^{1,*}

¹Department of Clinical and Experimental Sciences, University of Brescia, 25121 Brescia, Italy

²Department of Obstetrics and Gynecology, AOUI-University of Verona, 37100 Verona, Italy

³Department of Gynaecologic Oncology, Oxford University Hospitals, OX1 Oxford, UK

*Correspondence: f.ferrari.obgyn@gmail.com (Federico Ferrari)

Academic Editor: Christos Iavazzo

Submitted: 27 July 2022 Revised: 8 October 2022 Accepted: 9 October 2022 Published: 12 January 2023

Abstract

Objectives: The advantages of the enhanced recovery after surgery (ERAS) protocols application in all surgical branches have been largely demonstrated, even though there is a lack of a strong evidence from randomized trial and the evidence regarding the multimodal treatments is of low grade. Moreover, the problem of the barriers to the implementation of these protocols in clinical practice remains an unsolved problem. **Mechanism:** We performed a narrative review reporting the main barriers and enablers on the subject. **Finding in Brief:** The main barriers are resistance to change, lack of support from institutions and of financial resources or manpower, poor communication and collaboration within the multidisciplinary team, organizational problems, lack of standardized protocols, patient-related barriers (individual factors, reluctance, or inadequate education) and lastly clinical practice in small community hospitals. To overcome these problems, several enablers have been identified including: the involvement of the patient, the reorganization of care systems through standardized ERAS protocols, identification of a leader/coordinator, promotion of teamwork and staff education, financial resources, and the recognition of the role of the professionals involved. **Conclusions:** At this moment, resistance to change remains the most frequent and difficult barrier to overcome and, in our opinion, a reorganization of the health system aiming to the implementation of the ERAS protocols in the clinical practice is required.

Keywords: ERAS; gynecological surgery; protocol implementation

1. Introduction

The concept of the Enhanced recovery after surgery (ERAS) was introduced in 1997 by Henrik Kehlet [1] for colorectal surgery, he proposed a multimodal approach to the patient's perioperative management to get the most rapid restoration of the body's functions basing on the interpretation of pathophysiological mechanisms. Based on these principles standardised protocols regarding preoperative, intraoperative and postoperative period were developed. The advantages of the ERAS protocols in terms of costs reduction, lower rate of complications, early rehabilitation, and better patient acceptance of the surgery have been widely showed in the following years across various surgical specialities including in gynaecology [2–6]. Furthermore, in gynaecological oncological surgery, besides the advantages of minimally invasive surgery that can be adapted also in uncommon scenarios, the application of the ERAS protocols showed to improve the time to return to intended oncology treatment (RIOT) in cytoreductive surgery for advanced ovarian, tubal, or primary peritoneal cancer [7,8]. Despite the strong literature evidence on the advantages of ERAS programs and the publication of ERAS guidelines, the routine clinical introduction is still limited and the wide spreading encounters restrictions [9–11]. In

our narrative review, we investigate the state-of-the art on the compliance to ERAS in gynaecological surgery. Furthermore, we aim to analyse principal barriers in implementing ERAS programs and provide possible solutions.

2. Material and Methods

This study is a narrative review of the literature on the state of art of ERAS and the problems to implementation. We included qualitative studies that had as main objective the identification of barriers to the implementation of ERAS or in which the evaluation of the barriers was a fundamental step in the creation or evaluation of implementation methods of ERAS protocols. The methodology applied for the analysis must have clearly explained in the materials and methods section of the study. A language restriction including Italian and English was used. A systematic search of literature was conducted in Scopus, PubMed/MEDLINE, ScienceDirect and the Cochrane Library from their inception to June 2022. A combination of keywords was used as following: Implementation of ERAS or ERAS or fast track surgery and barriers or limitations or facilitators. Two authors (SF and FF) independently screened titles and abstracts from the studies in the search results. The eligible studies were then assessed for inclusion based on their



full text. Since there was significant heterogeneity between studies, we cannot produce a quantitative data synthesis, hence we used the format of a narrative review, organized in thematic sections. Disagreements on the eligibility of studies were resolved by a fourth author (HSM).

3. The Compliance to ERAS: a General Overview in the Gynaecological Field

Soon after introducing fast-track surgery, obstacles to implementing the ERAS protocol were consistently found. The ERAS Society® proposed the ERAS Interactive Audit system (EIAS) for a real-time control quality check of the single unit practice and a source of data for research purpose [12]. Despite the efforts, the ERAS indications were received with unacceptable slowness and incomplete implementation [13]. This inadequacy was even more surprising in consideration of the easily applicability and pragmatic nature of ERAS principles [14]. Minimally invasive surgery, part of the ERAS protocol, was widely implemented in gynaecological surgery unlike of other aspects but the reasons of this lack are not totally clear and are probably deeply rooted in everyday clinical practice [15–17]. Different authors investigated and reported problems of non-compliance to ERAS protocol in all the phases. Lambaudie *et al.* [18] reported an overall compliance to the ERAS protocol in minimally invasive gynaecological cancer surgery of 90%, with a single criterion compliance ranging from 68% to 100%. Wijk *et al.* [19] as well, reported encouraged results of compliance with the complete ERAS protocol (84%) both for benign and malignant laparotomy surgery, in particular with a preoperative and intraoperative adherence of 82% and 100% respectively. Conversely, other authors reported a lower compliance rate of all the items, with the lowest reported percentage of 58% [3,20]. A clear tendency to a partial application of ERAS elements was extensively reported in literature and promoted by the ERAS program. Anaesthesiologic, preoperative and surgical elements need to be synergically applied to maximize the effectiveness. Miller *et al.* [3,18,21,22] in 2015 found a 3-item compliance of the ERAS anaesthesiologic procedures of just 35% for all 3 interventions, 36% for 2 of 3 items, and 29% for 1 or none and the element with the lowest compliance was the preoperative carbohydrate loading; Ferrari [2] reported an average adherence rate to all the ERAS elements of 84.8% (95% confidence interval (CI) 79.7–89.8) in gynecologic benign and oncological surgery. The elements most frequently disregarded were the principles for prevention of intra-operative and post-operative nausea and vomiting (PONV), early feeding after surgery [18], the use of food supplements during post-operative management and the administration of preoperative carbohydrates especially six hours before the surgical procedures [3,21]. An update of gynecological surgery guidelines was recently published in 2019, reiterating the needed of the audit system concerning patients management analyzing sin-

gle item application and correlated outcomes [9,23]. Of note, we have to state that actually no published studies evaluated the synergistic effect of the ERAS items using the most innovative investigation tools such as neural network analysis and hence, perhaps, we cannot exclude a detrimental effect in few patients, instead of a clear advantage.

4. What Type of Barriers?

Several studies on the identification of barriers to the implementation of ERAS or, on the evaluation of these to improve the implementation methods of ERAS protocols, have been performed. In most cases these were studies performed in colorectal surgery [24]. In these qualitative studies, the opinions of all the figures involved in the application and implementation of the ERAS protocols have been taken into consideration either through interviews or through questionnaires: medical staff members (including surgeons and anaesthetists), Nurses, Allied Health Professionals (Dietitian, Physiotherapist, Speech and Language Therapist, Stoma care clinical nurse specialist) and Housekeeper; patients, coordinators, clinical managers, and trust management [24].

As already stated by many of the advocates of ERAS protocols, the greatest barrier to implementation appears to be resistance to change [25–35]. This resistance was found in the various figures of the multidisciplinary healthcare team and, in some cases, also in the patients. Among health professionals, the reasons for even initial resistance to change were due to two main reasons which are largely confirmed: specific and time-rooted beliefs of healthcare professionals and the lack of knowledge of scientific evidence. On the other side, a recent review claimed the need for a higher evidence proving the advantages reported in the various studies published [36]. However, discussing ERAS in a study, a crossover effect is an import issue that is difficult to avoid, given the nature of the pragmatical and well recognizable care.

Healthcare professionals are also confronted with a lack of support from institutions, including clinic directors, and of financial resources or manpower [25,28–33,35,37]. It must be recognized that promoting the implementation of ERAS protocols in clinical practice requires, at the beginning, a greater investment in terms of financial resources and nursing staff; in fact, particularly in the first hours after surgery, patients need a greater presence of health professionals to help them in early rehabilitation, from early mobilization to personalized adaptation of analgesic and antiemetic therapy. This initial investment is largely compensated by the autonomy acquired by the patient in the following days and by the early discharge, but it can be seen as an organizational obstacle especially during periods with reduced resources.

It is also known that the success of the ERAS protocols is based on the application of the various procedures included in the protocol and that it is rather the application

of all these procedures that guarantees the advantages in terms of rehabilitation of patients [10]. The application of multiple procedures in all perioperative phases requires the intervention of different health professionals of the medical and nursing staff. The collaboration of these different professional figures is therefore a key to the successful application of the protocol and to having better results. It is not surprising that as one of the most frequent limitations to the application of the ERAS programs is the poor communication and collaboration problems within the multidisciplinary team [25,27,29–33,37]. The lack of multidisciplinary collaboration could be one of the most difficult barriers to eradicate and requires a consistent commitment in terms of teamwork and reconciliation of several different health professionals, towards a common goal that must be accepted by all of them. Organizational problems including lack of time to devote to the project were also reported as barriers [25,27–31]. The hierarchical structure of hospital teams was also identified as an obstacle [27,38]. Furthermore, the application of any procedure in clinical practice is clearly encouraged by the creation of standardized protocols that allow the staff to apply the procedures in a homogeneous and repetitive manner, avoiding differences in the treatment of patients linked to individual habits of the healthcare staff; indeed, the lack of standardized protocols on ERAS programs has been reported as an obstacle to the implementation of ERAS, even though the publication of official guidelines shrunk this problem [9,25,37]. The healthcare team or institution are not the only environments in which barriers to the implementation of ERAS protocols have been found. Patient-related barriers to the implementation of ERAS were also detected; among these, individual factors and/or comorbidities of patients play a fundamental role; but also a certain reluctance or conversely some expectations of patients and their families towards the ERAS protocols, were reported as barriers to implementation [26–30,32–35,37,38]. Furthermore, the inadequate education and information of patients on the ERAS perioperative care remains an important limitation to their compliance with the protocols [26,29,30]. The role of the patient is fundamental for the success of the rehabilitation process; in fact, in the update guidelines for gynaecological surgery the importance of involving the patient and the evaluations of the results by the patients themselves is reiterated [9].

As the multidisciplinary team represents a cornerstone in the implementation of ERAS protocols, it would be interesting to analyse the discipline-specific issues. These are most related to resistance to change [31–33]. A common resistance to the elimination of preoperative bowel preparation and early postoperative feeding among surgeons and nurses was found; instead, among anaesthesiologists, resistance was related to the use of the analgesics Gabapentin and intravenous Lidocaine [31,37,39]. Considering the points of view of the various protagonists of the application of ERAS protocols certainly provides a clear scenario

of clinical practice [32,33]. When interviewed in detail, many nurses felt that early feeding was not important and that the lack of staff and time could be an obstacle to implementation, especially for early mobilization. The lack of nursing staff was perceived as a problem especially in cases of limited manpower and, the fact that ERAS interventions could create more work is considered a barrier. The patients' education would also be time-consuming in nurses' opinion and, furthermore, some resistance of the surgeons would have been an obstacle to the adoption of the ERAS recommendations (for example to the early removal of Foley catheters or nasogastric tubes). At the contrary, many surgeons felt that nursing culture and lack of nursing time would have been a barrier because of the fundamental role of nurses in the implementation of many of the postoperative interventions [32]; they also were against shortened preoperative fasting because cases might be cancelled [32,33]. General surgeons considered themselves, their colleagues, and residents as barriers due to personal preferences and resistance to change [32]. Concerning the anaesthesiologists, most of them stated that they did not follow a standardized protocol for intraoperative fluid maintenance and postoperative analgesia and, that, there was variability in treatment between the clinicians. Overall, the poor communication and collaboration with surgeons and nurses and the resistance to change of these two categories, were reported as relevant barriers [32,33]. Moreover, it seems that the clinical practice in small community hospitals compared with large and academic hospitals is significantly associated with a non-use of ERAS protocols [37]. Finally, insufficient financial support for medical and health resources could determine an insufficient reserve of equipment, medicines and material [40].

5. What Could be the Facilitators?

Some studies investigated the most effective process for promoting the implementation of ERAS protocols in clinical practice and, on the enablers, to ensure an efficacious protocol adherence [25–27,29–34,38].

Patients are considered protagonists in this process and their education and pre-habilitation to ERAS perioperative programs and the involvement of them and their families in the project, seem to play a decisive role in obtaining the advantages linked to the application of the ERAS protocols [25,26,29,32–34]. Concerning the health system, the studies on this subject identified a need for the formalization and standardization of ERAS protocols in clinical practice; in fact, the need for developing some clear and easy to understand internal protocols is reported. These protocols could be the instrument to translate the ERAS guidelines into instructions applicable to the local context and to empower nursing staff to assume decision-making responsibility and justify their actions during the application of ERAS procedures [26,27,29,30,32]. Since the limits to the implementation of ERAS protocols seem to be mainly of an orga-

nizational nature, the solutions could be found in this area. In fact, a reorganization of care systems to allow the integration of ERAS protocols into clinical practice was demanded [27,29–31]. In this sense, a facilitator could be the identification of a leader/coordinator who navigate the multidisciplinary team and overcome the problems of poor communication or collaboration between and within disciplines [27,29,31,33]. Furthermore, the promotion of teamwork, staff education, reviewing of barriers, audits, and feedback were also defined as important facilitators [27,29–31,33]. Surely, the availability of financial resources could encourage the opening of the direction staff of the hospitals to the implementation of ERAS protocols, even if, in our opinion, this could be a facilitator only at the beginning, as the advantages in terms of financial savings of ERAS are far above the costs [29]. Financial resources could, for example, promote the use of technology to improve monitoring and communication systems [27]; these would contribute to improving the organizational system aimed at promoting the ERAS protocols. These could also allow the recruitment of manpower dedicated to the implementation and application of the ERAS protocols.

Other factors contributing to the achievement of satisfying results in the application of ERAS are mainly focused on the correct management of the patient in the perioperative and post-operative phases as follows: telephone follow up of patients at 24– and 72–hours after surgery to ensure the contact with the patient and assure the support of the health care team, correct pain management and early mobilization, patient satisfaction and social support [25,30,33]. Finally, a correct identification of the fundamental roles of the various professional figures involved of the ERAS group and, especially, of the role of the nurse, as well as all the other non-medical figures who take part in the project (such as physiotherapists and nutritionists), could contribute to improving the implementation of ERAS protocols [41].

6. Controversies and Research Insights

The next step for ERAS programs is to fill the knowledge gaps with high-quality evidence and well conducted randomised controlled trials in the most controversial aspect of perioperative management: pre-habilitation, preoperative correction of anaemia, bowel preparation and carbohydrate loading [10].

Pre-habilitation was preoperatively proposed to prepare patient to surgical stress in the idea of enhancing patient physical and mental conditioning [42]. Multimodal pre-habilitation was most frequently proposed and included elements regarding exercise, nutrition and psychological support [43]. The latest evidence showed a benefit in term of outcomes after major abdominal surgery and cardiothoracic surgery but results were heterogeneous and extrapolated from observational and low quality studies [44,45]. Preoperative anaemia was frequently found in patients and

was associated with an increase in morbidity, major complications and mortality [46]. Guidelines [47] suggested testing patients at least 28 days before surgery and proposed oral iron supplementation if necessary. Different studies investigated the role of preoperative blood transfusion, intravenous iron supplementation but results were unclear [48,49]. Mechanical bowel preparation (MBP) was used in gynecological surgery because it seemed to reduce infections and anastomotic leak after bowel surgery. ERAS guidelines recommend avoiding this practice, however some studies demonstrated a better quality of surgical field, reduction in operative time and in time to first passage of flatus with a low-residue diet in planned bowel resection [50]. Carbohydrate loading reduced the stress response to surgery and showed to reduce postoperative insulin resistance mitigating the negative effects of overnight fasting [47,51]. In major abdominal surgery it resulted in a shorter length of stay but not in a reduction of complications [10]. Findings and quality of evidence made the preoperative carbohydrate loading still controversial.

Overall, there is a lack of a strong evidence derived from clinical randomized trials, because the available studies are heterogeneous [2–6]. Moreover, it's difficult to avoid a cross-over effect because the nature of the procedures used in ERAS protocols cannot be provided in the same institution in a perfectly “blind” way.

7. Challenges and Future Perspectives

The introduction of ERAS protocols demonstrated to improve the postoperative course and numerous outcomes were proposed to quantify the impact on clinical practice [10]. Length of stay was frequently considered but it was a surrogate measure potentially influenced by many variables [52], thirty-day readmission and mortality were often associated extending the time span but offering an insight only on major complications [53,54]. With the improving of ERAS programs, the focus progressively involved patient quality of life (QOL) with different QOL questionnaires but without reaching today a systematic implementation and an efficient traceability of follow-up [52,55]. Many studies showed that postoperative physical activity provided a long-term outcome of functional recovery and proposed it as an item to monitor the recovery in community [55,56]. Recently, different technologies were proposed to facilitate the physical activity monitoring and shown to be effective for collecting data on longer-term outcomes [57–59]. Compliance with post-operative mobilisation was increased with continuous remote feedback as found in the clinical randomised trial (RCT) of Jauho *et al.* [60] Moreover, technologies could help healthcare personnel to increase the patient engagement in their own recovery, to modulate indications based on single compliance and overcome some organizational barriers [61]. The COVID-19 pandemic caused a rapid change in health practice and showed the feasibility of telemedicine to reduce the unnecessary in-person visit [62].

ERAS programs demonstrated a clear outcome benefit both from an anesthesiological and surgical point of view. Hospital costs are not easily calculated and are influenced by different variables such as area, health system and patient comorbidities [63]. Nonetheless, the introduction of ERAS programs was associated with a general economic advantage, mostly secondary to the decrease of length of stay [64]. Significant costs saving were reported for specific operation in general surgery, urology and in gynecology [65].

A critical aspects is to show not only an immediate reduction of costs but also a financial benefit over time to convince health system administrators and stakeholders to invest in the implementation [65]. Recently, a return-on-investment analysis reported a return of \$7.3 for every dollar invested in ERAS programs [63]. Pache *et al.* [65] performed a sub-analysis of cost reporting a significantly lower costs in intensive care unit (ICU), nursing care, and miscellaneous pre/post-operative costs. Moreover, the economic proficiency of ERAS programs was maintained after three years after the implementation but continuous training of healthcare personnel is mandatory [10,65]. Few data are available to quantify how hospital costs saving are transferred to out-hospital care and standardization of home follow-up traceability is required in future studies.

Finally, implementation of ERAS care inevitably needs to involve health practice in low middle-income countries (LMCS) where the aforementioned barriers are worse by fundamental problems as lack of resources, malnutrition and poor control of infectious diseases [66,67]. LMCS guidelines are under development but their application required a global discussion with Government, Health institution and stakeholders.

8. Conclusions

Resistance to change remains the main barrier to overcome for implementing of the ERAS protocols in clinical practice; it is often because of some fears related to change which have their basis in the ignorance of the advantages of applying the ERAS protocols. For this reason, a reorganization of the health system adapted to fast-track surgery through introducing standardized protocols, the education of the health team and his coordination, could be the solution. Further well-conducted studies are required to clarify controversial aspects and to promote improvement of individual outcomes, in particularly in elderly and frail patients with a policy of constant engaging. An effort to implementing ERAS protocols is required in LMCS involving Governments and Institutions.

Author Contributions

SF and FF designed the research study. SF performed the research. FF provided help and advice. SF, FF and HSM analysed the data. SF, FF, FAF and FC wrote the manuscript. All authors contributed to editorial changes

in the manuscript. All authors read and approved the final manuscript.

Ethics Approval and Consent to Participate

Not applicable.

Acknowledgment

Not applicable.

Funding

This research received no external funding.

Conflict of Interest

The authors declare no conflict of interest. FF is serving as one of the Guest editors of this journal. We declare that FF had no involvement in the peer review of this article and has no access to information regarding its peer review. Full responsibility for the editorial process for this article was delegated to CI.

References

- [1] Kehlet H. Multimodal approach to control postoperative pathophysiology and rehabilitation. *British Journal of Anaesthesia*. 1997; 78: 606–617.
- [2] Ferrari F, Forte S, Sbalzer N, Zizioli V, Mauri M, Maggi C, *et al.* Validation of an enhanced recovery after surgery protocol in gynecologic surgery: an Italian randomized study. *American Journal of Obstetrics and Gynecology*. 2020; 223: 543.e1–543.e14.
- [3] Scheib SA, Thomasee M, Kenner JL. Enhanced Recovery after Surgery in Gynecology: a Review of the Literature. *Journal of Minimally Invasive Gynecology*. 2019; 26: 327–343.
- [4] Bisch SP, Jago CA, Kalogera E, Ganshorn H, Meyer LA, Ramirez PT, *et al.* Outcomes of enhanced recovery after surgery (ERAS) in gynecologic oncology – a systematic review and meta-analysis. *Gynecologic Oncology*. 2021; 161: 46–55.
- [5] Visioni A, Shah R, Gabriel E, Attwood K, Kukar M, Nurkin S. Enhanced Recovery After Surgery for Noncolorectal Surgery?: A Systematic Review and Meta-analysis of Major Abdominal Surgery. *Annals of Surgery*. 2018; 267: 57–65.
- [6] Barber EL, Van Le L. Enhanced Recovery Pathways in Gynecology and Gynecologic Oncology. *Obstetrical & Gynecological Survey*. 2015; 70: 780–792.
- [7] Soleymani majd H, Ferrari F, Gubbala K, Campanile RG, Tozzi R. Latest developments and techniques in gynaecological oncology surgery. *Current Opinion in Obstetrics & Gynecology*. 2015; 27: 291–296.
- [8] Tozzi R, Soleymani Majd H, Campanile RG, Ferrari F. Feasibility of laparoscopic diaphragmatic peritonectomy during visceral-peritoneal debulking in patients with stage IIIC–IV ovarian cancer. *Journal of Gynecologic Oncology*. 2020; 31: e71
- [9] Nelson G, Bakkum-Gamez J, Kalogera E, Glaser G, Altman A, Meyer LA, *et al.* Guidelines for perioperative care in gynecologic/oncology: Enhanced Recovery after Surgery (ERAS) Society recommendations—2019 update. *International Journal of Gynecologic Cancer*. 2019; 29: 651–668.
- [10] Ljungqvist O, de Boer HD, Balfour A, Fawcett WJ, Lobo DN, Nelson G, *et al.* Opportunities and Challenges for the Next Phase of Enhanced Recovery After Surgery: A Review. *JAMA surgery*. 2021; 156: 775–784.

- [11] Stone R, Carey E, Fader AN, Fitzgerald J, Hammons L, Nensi A, *et al.* Enhanced Recovery and Surgical Optimization Protocol for Minimally Invasive Gynecologic Surgery: an AAGL White Paper. *Journal of Minimally Invasive Gynecology*. 2021; 28: 179–203.
- [12] Ljungqvist O, Young-Fadok T, Demartines N. The History of Enhanced Recovery after Surgery and the ERAS Society. *Journal of Laparoendoscopic & Advanced Surgical Techniques*. 2017; 27: 860–862.
- [13] Kehlet H. ERAS Implementation—Time to Move Forward. *Annals of Surgery*. 2018; 267: 998–999.
- [14] Kehlet H. Enhanced postoperative recovery: good from afar, but far from good? *Anaesthesia*. 2020; 75: e54–e61.
- [15] Ferrari F, Forte S, Arrigoni G, Ardighieri L, Coppola MC, Salinaro F, *et al.* Impact of endometrial sampling technique and biopsy volume on the diagnostic accuracy of endometrial cancer. *Translational Cancer Research*. 2020; 9: 7697–7705.
- [16] Ferrari F, Forte S, Valenti G, Ardighieri L, Barra F, Esposito V, *et al.* Current treatment options for cervical leiomyomas: A systematic review of literature. *Medicina (Kaunas, Lithuania)*. 2021; 57: 92.
- [17] Ciravolo G, Ferrari F, Zizioli V, Donarini P, Forte S, Sartori E, *et al.* Laparoscopic management of a large urethral leiomyoma. *International Urogynecology Journal*. 2019; 30: 1211–1213.
- [18] Lambaudie E, de Nonneville A, Brun C, Laplane C, N’Guyen Duong L, Boher J, *et al.* Enhanced recovery after surgery program in Gynaecologic Oncological surgery in a minimally invasive techniques expert center. *BMC Surgery*. 2017; 17: 136.
- [19] Wijk L, Franzén K, Ljungqvist O, Nilsson K. Enhanced Recovery after Surgery Protocol in Abdominal Hysterectomies for Malignant versus Benign Disease. *Gynecologic and Obstetric Investigation*. 2016; 81: 461–467.
- [20] Keil DS, Schiff LD, Carey ET, Moulder JK, Goetzinger AM, Patidar SM, *et al.* Predictors of Admission after the Implementation of an Enhanced Recovery after Surgery Pathway for Minimally Invasive Gynecologic Surgery. *Anesthesia & Analgesia*. 2019; 129: 776–783.
- [21] Wijk L, Franzen K, Ljungqvist O, Nilsson K. Implementing a structured Enhanced Recovery after Surgery (ERAS) protocol reduces length of stay after abdominal hysterectomy. *Acta Obstetrica Et Gynecologica Scandinavica*. 2014; 93: 749–756.
- [22] Kalogera E, Bakkum-Gamez JN, Jankowski CJ, Trabuco E, Lovely JK, Dhanorker S, *et al.* Enhanced Recovery in Gynecologic Surgery. *Obstetrics & Gynecology*. 2013; 122: 319–328.
- [23] Fotopoulou C, Planchamp F, Aytulu T, Chiva L, Cina A, Ergönül Ö, *et al.* European Society of Gynaecological Oncology guidelines for the peri-operative management of advanced ovarian cancer patients undergoing debulking surgery. *International Journal of Gynecological Cancer*. 2021; 31:1199–1206.
- [24] Forte S, Ferrari F, Sartori E, Odicino F. Eras in gynaecological surgery: State of art and barriers to implementation. In Waechter, S. (ed.) *Enhanced Recovery After Surgery: Perspectives, Protocols and Efficacy* (pp. 1–64). Nova Science Publishers: Hauppauge. 2021.
- [25] Budacan A, Mehdi R, Kerr AP, Kadiri SB, Batchelor TJP, Naidu B. National survey of enhanced recovery after thoracic surgery practice in the United Kingdom and Ireland. *Journal of Cardiothoracic Surgery*. 2020; 15: 95.
- [26] Gillis C, Martin L, Gill M, Gilmour L, Nelson G, Gramlich L. Food is Medicine: a Qualitative Analysis of Patient and Institutional Barriers to Successful Surgical Nutrition Practices in an Enhanced Recovery after Surgery Setting. *Nutrition in Clinical Practice*. 2019; 34: 606–615.
- [27] Byrnes A, Young A, Mudge A, Banks M, Bauer J. EXploring practice gaps to improve PERioperative Nutrition CarE (EXPERIENCE Study): a qualitative analysis of barriers to implementation of evidence-based practice guidelines. *European Journal of Clinical Nutrition*. 2019; 73: 94–101.
- [28] Martin D, Roulin D, Grass F, Addor V, Ljungqvist O, Demartines N, *et al.* A multicentre qualitative study assessing implementation of an Enhanced Recovery after Surgery program. *Clinical Nutrition*. 2018; 37: 2172–2177.
- [29] Herbert G, Sutton E, Burden S, Lewis S, Thomas S, Ness A, *et al.* Healthcare professionals’ views of the enhanced recovery after surgery programme: a qualitative investigation. *BMC Health Services Research*. 2017; 17: 617.
- [30] Alawadi ZM, Leal I, Phatak UR, Flores-Gonzalez JR, Holihan JL, Karanjawala BE, *et al.* Facilitators and barriers of implementing enhanced recovery in colorectal surgery at a safety net hospital: a provider and patient perspective. *Surgery*. 2016; 159: 700–712.
- [31] Gotlib Conn L, McKenzie M, Pearsall EA, McLeod RS. Successful implementation of an enhanced recovery after surgery programme for elective colorectal surgery: a process evaluation of champions’ experiences. *Implementation Science*. 2015; 10: 99.
- [32] Pearsall EA, Meghji Z, Pitzul KB, Aarts MA, McKenzie M, McLeod RS, *et al.* A qualitative study to understand the barriers and enablers in implementing an enhanced recovery after surgery program. *Annals of Surgery*. 2015; 261: 92–96.
- [33] McLeod RS, Aarts M, Chung F, Eskicioglu C, Forbes SS, Conn LG, *et al.* Development of an Enhanced Recovery after Surgery Guideline and Implementation Strategy Based on the Knowledge-to-action Cycle. *Annals of Surgery*. 2015; 262: 1016–1025.
- [34] Nadler A, Pearsall EA, Charles Victor J, Aarts M, Okrainec A, McLeod RS. Understanding Surgical Residents’ Postoperative Practices and Barriers and Enablers to the Implementation of an Enhanced Recovery after Surgery (ERAS) Guideline. *Journal of Surgical Education*. 2014; 71: 632–638.
- [35] Kahokehr A, Robertson P, Sammour T, Soop M, Hill AG. Perioperative care: a survey of New Zealand and Australian colorectal surgeons. *Colorectal Disease*. 2011; 13: 1308–1313.
- [36] Chau JPC, Liu X, Lo SHS, Chien WT, Hui SK, Choi KC, *et al.* Perioperative enhanced recovery programmes for women with gynaecological cancers. *The Cochrane Database of Systematic Reviews*. 2022; 3: CD008239.
- [37] Springer JE, Doumouras AG, Lethbridge S, Forbes S, Eskicioglu C. A Provincial Assessment of the Barriers and Utilization of Enhanced Recovery After Colorectal Surgery. *The Journal of Surgical Research*. 2019; 235: 521–528.
- [38] Byrnes A, Young A, Mudge A, Banks M, Clark D, Bauer J. Prospective application of an implementation framework to improve postoperative nutrition care processes: Evaluation of a mixed methods implementation study. *Nutrition & Dietetics*. 2018; 75: 353–362.
- [39] Muallem MZ, Dimitrova D, Pietzner K, Richter R, Feldheiser A, Scharfe I, *et al.* Implementation of Enhanced Recovery After Surgery (ERAS) Pathways in Gynecologic Oncology. A NOGGO-AGO* survey of 144 Gynecological Departments in Germany. *Anticancer Research*. 2016; 36: 4227–4232.
- [40] Wang D, Liu Z, Zhou J, Yang J, Chen X, Chang C, *et al.* Barriers to implementation of enhanced recovery after surgery (ERAS) by a multidisciplinary team in China: a multicentre qualitative study. *BMJ Open*. 2022; 12: e053687.
- [41] Balfour A, Burch J, Fecher-Jones I, Carter FJ. Understanding the benefits and implications of Enhanced Recovery After Surgery. *Nursing Standard (Royal College of Nursing (Great Britain))*. 2019; 34: 70–75.
- [42] Carli F. Prehabilitation for the Anesthesiologist. *Anesthesiology*. 2020; 133: 645–652.
- [43] Kamarajah SK, Bundred J, Weblin J, Tan BHL. Critical appraisal

- on the impact of preoperative rehabilitation and outcomes after major abdominal and cardiothoracic surgery: a systematic review and meta-analysis. *Surgery*. 2020; 167: 540–549.
- [44] Valkenet K, van de Port IGL, Dronkers JJ, de Vries WR, Lindeman E, Backx FJ. The effects of preoperative exercise therapy on postoperative outcome: a systematic review. *Clinical Rehabilitation*. 2011; 25: 99–111.
- [45] Lemanu DP, Singh PP, MacCormick AD, Arroll B, Hill AG. Effect of Preoperative Exercise on Cardiorespiratory Function and Recovery after Surgery: a Systematic Review. *World Journal of Surgery*. 2013; 37: 711–720.
- [46] Baron DM, Hochrieser H, Posch M, Metnitz B, Rhodes A, Moreno RP, *et al*. Preoperative anaemia is associated with poor clinical outcome in non-cardiac surgery patients. *British Journal of Anaesthesia*. 2014; 113: 416–423.
- [47] Bogani G, Sarpietro G, Ferrandina G, Gallotta V, Di Donato V, Ditto A, *et al*. Enhanced recovery after surgery (ERAS) in gynecology oncology. *European Journal of Surgical Oncology*. 2021; 47: 952–959.
- [48] Bennett S, Baker LK, Martel G, Shorr R, Pawlik TM, Timmouth A, *et al*. The impact of perioperative red blood cell transfusions in patients undergoing liver resection: a systematic review. *HPB: The Official Journal of the International Hepato Pancreato Biliary Association*. 2017; 19: 321–330.
- [49] Peters F, Ellermann I, Steinbicker AU. Intravenous Iron for Treatment of Anemia in the 3 Perisurgical Phases. *Anesthesia & Analgesia*. 2018; 126: 1268–1282.
- [50] Palaia I, Di Donato V, Caruso G, Vestri A, Scudo M, Alunni Fegatelli D, *et al*. Preoperative low-residue diet in gynecological surgery. *European Journal of Obstetrics & Gynecology and Reproductive Biology*. 2022; 271: 172–176.
- [51] Fawcett WJ, Thomas M. Pre-operative fasting in adults and children: clinical practice and guidelines. *Anaesthesia*. 2019; 74: 83–88.
- [52] King PM, Blazeby JM, Ewings P, Longman RJ, Kipling RM, Franks PJ, *et al*. The influence of an Enhanced Recovery Programme on clinical outcomes, costs and quality of life after surgery for colorectal cancer. *Colorectal Disease*. 2006; 8: 506–513.
- [53] Faiz O, Brown T, Colucci G, Kennedy RH. A cohort study of results following elective colonic and rectal resection within an enhanced recovery programme. *Colorectal Disease*. 2009; 11: 366–372.
- [54] Hendry PO, Hausel J, Nygren J, Lassen K, Dejong CHC, Ljungqvist O, *et al*. Determinants of outcome after colorectal resection within an enhanced recovery programme. *British Journal of Surgery*. 2009; 96: 197–205.
- [55] Zargar-Shoshtari K, Paddison JS, Booth RJ, Hill AG. A Prospective Study on the Influence of a Fast-Track Program on Postoperative Fatigue and Functional Recovery after Major Colonic Surgery. *Journal of Surgical Research*. 2009; 154: 330–335.
- [56] Bernard H, Foss M. Patient experiences of enhanced recovery after surgery (ERAS) *British Journal of Nursing*. 2014; 23: 100–106.
- [57] Appelboom G, Camacho E, Abraham ME, Bruce SS, Dumont EL, Zacharia BE, *et al*. Smart wearable body sensors for patient self-assessment and monitoring. *Archives of Public Health*. 2014; 72: 28.
- [58] Dobkin BH, Dorsch A. The Promise of mHealth. *Neurorehabilitation and Neural Repair*. 2011; 25: 788–798.
- [59] Aziz O, Atallah L, Lo B, Gray E, Athanasiou T, Darzi A, *et al*. Ear-worn body sensor network device: an objective tool for functional postoperative home recovery monitoring. *Journal of the American Medical Informatics Association*. 2011; 18: 156–159.
- [60] Jauho A, Pyky R, Ahola R, Kangas M, Virtanen P, Korpelainen R, *et al*. Effect of wrist-worn activity monitor feedback on physical activity behavior: a randomized controlled trial in Finnish young men. *Preventive Medicine Reports*. 2015; 2: 628–634.
- [61] Cook DJ, Thompson JE, Prinsen SK, Dearani JA, Deschamps C. Functional Recovery in the Elderly after Major Surgery: Assessment of Mobility Recovery Using Wireless Technology. *The Annals of Thoracic Surgery*. 2013; 96: 1057–1061.
- [62] COVIDSurg Collaborative. Global guidance for surgical care during the COVID-19 pandemic. *The British Journal of Surgery*. 2020; 107: 1097–1103.
- [63] Ljungqvist O, Thanh NX, Nelson G. ERAS-Value based surgery. *Journal of Surgical Oncology*. 2017; 116: 608–612.
- [64] Thiele RH, Rea KM, Turrentine FE, Friel CM, Hassinger TE, Goudreau BJ, *et al*. Standardization of Care: Impact of an Enhanced Recovery Protocol on Length of Stay, Complications, and Direct Costs after Colorectal Surgery. *Journal of the American College of Surgeons*. 2015; 220: 430–443.
- [65] Pache B, Joliat G, Hübner M, Grass F, Demartines N, Mathivet P, *et al*. Cost-analysis of Enhanced Recovery after Surgery (ERAS) program in gynecologic surgery. *Gynecologic Oncology*. 2019; 154: 388–393.
- [66] McQueen K, Oodit R, Derbew M, Banguti P, Ljungqvist O. Enhanced Recovery After Surgery for Low- and Middle-Income Countries. *World Journal of Surgery*. 2018; 42: 950–952.
- [67] Correia MI, Waitzberg DL. The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis. *Clinical Nutrition (Edinburgh, Scotland)*. 2003; 22: 235–239.