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ORIGINAL ARTICLE

Enhanced Recovery After Surgery (ERAS) protocol attenuates stress and accelerates recovery in patients after radical resection for colorectal cancer: Experience at Clínica Universitaria Colombia

Protocolo de recuperación mejorada después de cirugía (ERAS) atenúa el estrés y acelera la recuperación en pacientes después de resección radical por cáncer colorrectal: Experiencia en Clínica Universitaria Colombia

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Abstract

Introduction. The Enhanced Recovery After Surgery (ERAS) protocol is a multimodal, multidisciplinary approach to care, the purpose of which is to reduce the perioperative stress of surgery, decrease morbidity, and shorten hospital stay. This study aimed to describe the clinical outcomes of patients undergoing surgery for colorectal cancer, identifying the main complications and perioperative factors related to early discharge.

Methods. Consecutive patients undergoing colorectal surgery between 2020 and 2023 were analyzed, who followed the institutional ERAS protocol. Clinical characteristics, perioperative factors, postoperative outcomes, and overall protocol adherence rate were evaluated.

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Results. A total of 456 patients underwent colorectal surgery, 51% male, with a mean age of 60 years. Most interventions were performed laparoscopically (78%), with a conversion rate of 14.5%. Postoperative complications included anastomotic leak (4.6%), followed by bleeding, intra-abdominal infection, and intestinal obstruction. The average hospital stay was 4 days and mortality was 2.8%. The overall adherence rate to the ERAS protocol was 84.7%.

Conclusions. The combined approach of laparoscopic surgery and ERAS protocol is feasible, safe, and associated with a shorter hospital stay. Implementation and adherence to the ERAS protocol not only improves postoperative outcomes, but also highlights the importance of accessing solid data, allowing for improved local perioperative care.

Keywords: colorectal neoplasms; colorectal surgery; laparoscopy; minimally invasive surgical procedures; enhanced recovery after surgery; length of stay.

Resumen

Introducción. El conjunto de estrategias de recuperación mejorada después de la cirugía (ERAS, por sus siglas en inglés) constituye un enfoque de atención multimodal y multidisciplinario, cuyo propósito es reducir el estrés perioperatorio de la cirugía, disminuir la morbilidad y acortar la estancia hospitalaria. Este estudio tuvo como objetivo describir los resultados clínicos de pacientes sometidos a cirugía por cáncer colorrectal, identificando las complicaciones principales y los factores perioperatorios relacionados con el alta temprana.

Métodos. Se analizaron los pacientes consecutivos sometidos a cirugía colorrectal entre los años 2020 y 2023, todos los cuales siguieron el protocolo ERAS institucional. Se evaluaron las características clínicas, los factores perioperatorios, los desenlaces postoperatorios y la tasa global de adherencia al protocolo.

Resultados. Un total de 456 pacientes fueron sometidos a cirugía colorrectal, el 51% de sexo masculino, con edad media de 60 años. La mayoría de las intervenciones se realizaron por laparoscopia (78 %), con una tasa de conversión del 14,5 %. Las complicaciones postoperatorias incluyeron fuga anastomótica (4,6 %), sangrado, infección intraabdominal y obstrucción intestinal. La estancia hospitalaria promedio fue de 4 días y la mortalidad del 2,8 %. La tasa global de adherencia al protocolo ERAS fue del 84,7 %.

Conclusiones. El enfoque combinado de cirugía laparoscópica y protocolo ERAS es factible, seguro y se asocia con una estancia hospitalaria más corta. La implementación y adherencia al protocolo ERAS no solo mejora los resultados postoperatorios, sino que también resalta la importancia de acceder a datos sólidos, permitiendo mejorar la atención perioperatoria local.

Palabras clave: neoplasias colorrectales; cirugía colorrectal; laparoscopía; procedimientos quirúrgicos mínimamente invasivos; recuperación mejorada después de la cirugía; tiempo de internación.

Introduction

With the purpose of achieving radical surgical resection of the primary tumor, colorectal surgery has undergone an evolution that has culminated today with the implementation of robotic surgery. In this context, laparoscopic surgery plays a crucial role and is solidly established in the treatment of colorectal oncological pathology [1,2].

Surgical intervention in the treatment of patients with colorectal cancer has positively influenced the increase in overall survival and disease-free survival. However, it has historically been associated with the appearance of postoperative complications that consistently extend hospital stay, increase care costs, affect quality of life, and increase mortality. Consequently,

strategies have been implemented aimed at improving short-term results. These strategies involve a series of activities that seek to carry out multimodal prehabilitation with the purpose of improving physiological reserve, anticipating the foreseeable adverse effects associated with major surgical procedures, thus allowing optimization of postoperative recovery time and preserving functional capacity [3,4].

The care of the surgical patient presents a significant challenge that covers various stages, from the outpatient consultation to hospitalization, passing through the preoperative units, the operating room and the postoperative recovery center. With the aim of optimizing this process and ensuring a prompt and effective recovery of the patient, specific strategies have been implemented, such as the Enhanced Recovery After Surgery (ERAS) protocol [5].

The care process is divided into several stages, beginning with pre-admission and progressing through preoperative, intraoperative, and postoperative care. Each of these phases encompasses a series of components that, when acting together, mitigate the body's response to surgical stress. This comprehensive approach requires the active collaboration of a multidisciplinary team made up of anesthesiologists, surgeons, nurses, physical therapists and nutritionists. Furthermore, it is essential to involve the patient and their family as active participants in the recovery process [6].

The main purpose of these strategies is to preserve homeostasis by reducing the rate of protein catabolism and preventing cellular dysfunction. These objectives are achieved by maintaining optimal blood glucose levels, effectively managing pain at rest, promoting prompt restoration of intestinal function to mitigate postoperative ileus, early initiation of oral feeding, promoting healing and, as a consequence, allowing early and safe hospital discharge. This approach not only affects the quality of care and the patient's life, but also has a significant impact on the costs associated with health care [7,8].

The purpose of this study was to describe the clinical outcomes of patients who underwent surgery for colorectal cancer after implementation of the ERAS multimodal prehabilitation protocol at our institution. Determining the most relevant complications, analyzing the perioperative factors associated with early discharge and evaluating the level of adherence to the protocol.

Methods

Population

A retrospective cohort study was conducted that included adult patients undergoing elective primary colorectal surgery due to colon cancer by the colorectal surgery group at the Clínica Universitaria Colombia in Bogota, Colombia. The analysis period spanned from December 2020 to June 2023. The inclusion criteria were established as age equal to or greater than 18 years and the diagnosis of colorectal cancer requiring elective surgery, with or without anastomosis. On the other hand, those patients who needed emergency surgical management due to bleeding, acute obstruction or perforation were excluded, as well as those with colorectal tumors considered inoperable and those who were not included in the multimodal prehabilitation protocol.

Institutional ERAS protocol

All patients were treated according to the standardized Enhanced Recovery After Surgery (ERAS) protocol, which encompasses 25 interventions during the perioperative period. The fundamental elements of this program include preoperative counseling, non-preparation of the right colon, provision of carbohydrate-rich beverages one day before and on the morning of surgery, goal-guided fluid administration, monitoring of body temperature during surgery, avoid drains and nasogastric tubes, application of multimodal analgesia, early mobilization, initiation of thromboprophylaxis and the oral route in the early postoperative period. It should be noted that, within the institutional protocol, preoperative thromboprophylaxis was not included (Figure 1).

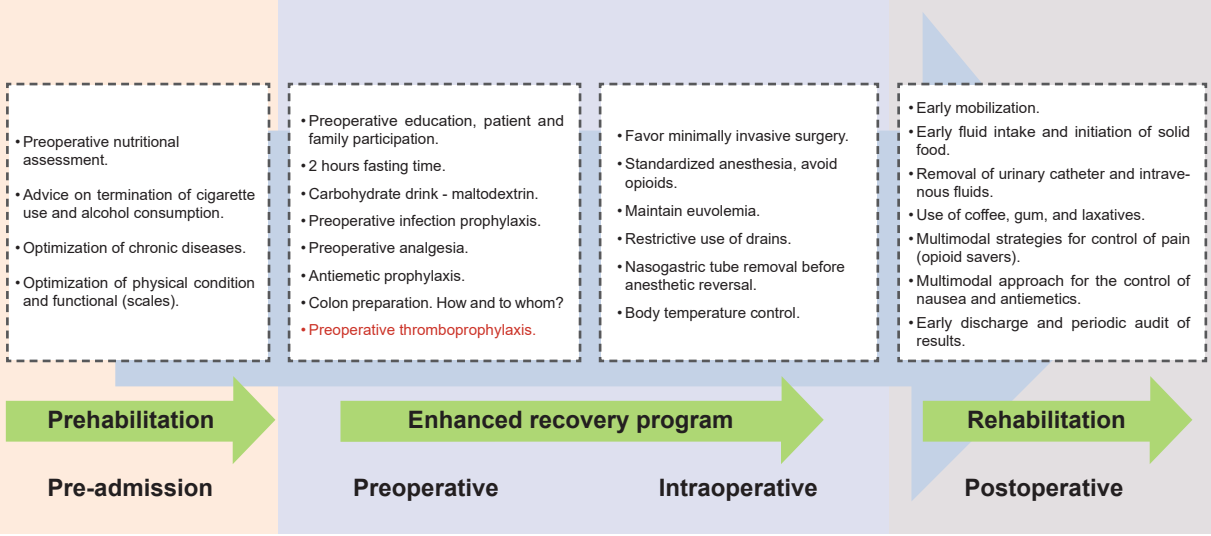

Figure 1. General principles of ERAS for colorectal surgery[1]. Source: Authors' own elaboration.

The surgical approach, whether laparoscopic or open, was determined considering the patient's history. The decision on the use of drains was left to the discretion of the surgeon taking into account the intraoperative findings, with the intention of avoiding their application prophylactically. Intestinal anastomoses were performed manually or using mechanical devices, depending on the availability of the necessary equipment. Criteria for hospital discharge included resumption of intestinal transit, adequate pain management with oral analgesia, tolerance to solid foods, no need for intravenous fluids, ability to move independently, and general condition appropriate for hospital discharge.

Data management

The information for each patient was collected prospectively, covering clinical variables, medical and anesthetic history, as well as all interventions established in the ERAS protocol for colorectal surgery. During the preoperative period, nutritional status was assessed using clinical criteria and anthropometric measurements. In addition, the weight loss experienced during the six months prior to the surgical procedure and the patient's nutritional intake were taken into account.

Perioperative morbidity and mortality data were analyzed, the length of hospital stay and compliance with the protocol were recorded. In order to establish the relationship between the variables and the percentage of adherence to the ERAS protocol, compliance greater than 80% was defined as optimal, and compliance below 80% was defined as non-optimal. All patients were followed from admission to hospital discharge and subsequently on an outpatient basis during the first 30 days.

The information was recorded in the ERAS Interactive Audit System (EIAS) interface, following the guidelines established by the ERAS® Society for best practices. This system acts as a quality backup, guaranteeing compliance with the protocol.

Statistical analysis

The data were subjected to analysis using the statistical software R v.4.3.1. The qualitative variables were characterized through relative and absolute frequencies, while the quantitative variables were presented through measures of central tendency and dispersion. Specifically, they were described using the mean and standard deviation, or the median and confidence interval, and survival graphs were generated using the Kaplan-Meier method.

Results

Clinical characteristics of the patients

A total of 456 patients who underwent colorectal surgery were included, with 51.1% being male, and an average age of 60 years, with an interquartile range (IQR) of 52 to 72 years (Table 1). Of this group, 246 patients were diagnosed with colon cancer, while 210 were diagnosed with rectal cancer. The main comorbidities recorded included heart disease (11.6%), diabetes mellitus (10.6%), and lung disease (9.2%). Active smoking was observed in 13 patients (2.9%), and after receiving preoperative counseling and education, 2% quit this habit before the surgical procedure. Regarding neoadjuvant chemotherapy, 24% received systemic treatment in the last 6 months and 16% received radiotherapy.

In the histopathological analysis of the surgical specimens, it was observed that according to the TNM classification, 40.1% of the patients had stage II colon cancer, while stage III was recorded in 32.1% (Figure 2). In the case of patients with rectal cancer, stage III was predominant, affecting 35.3%, followed by stage II, which affected 33.5%. Figure 3 details the distribution of stages, differentiating between colon and rectal cancer, and it is observed that this trend is maintained in the proportion for both colon and rectal cancer.

Table 1. Sociodemographic characteristics of the patients (n=456).

Sociodemographic variables		
Age in years (mean, SD)	63	(52-72)
Sex (n, %)		
Male	231	50.7%
Female	225	49.3%
History (n, %)		
Smoking	13	2.9%
Diabetes mellitus	46	10.1%
Heart disease	53	11.6%
Lung disease	42	9.2%
Previous intervention	323	70.8%
Pre-surgical interventions (n, %)		
Pre-procedural education	452	99.1%
Previous chemotherapy	108	23.7%
Previous radiotherapy	73	16%

SD: standard deviation. Source: Authors' own elaboration.

Nutrition and metabolism index

Protein-calorie malnutrition was diagnosed in 40.7% of the patients, while 16.4% had nutritional risk. Both groups benefited from nutritional support during the preoperative period and throughout hospitalization. 57% required additional nutritional supplementation, through oral supplements, enteral or parenteral nutrition (Table 2). At the time of surgery, 34.4% were categorized as having normal nutritional status and 90.5% of patients received immunonutrition as an integral part of the protocol.

Intraoperative variables

Regarding anesthetic-surgical risk classification, patients were categorized according to the physical status classification system of the American Society of Anesthesiologists (ASA) as follows: ASA I 2.4%, ASA II 22%, ASA III 75% and ASA IV 0.7%. Additionally, presurgical carbohydrate loading and antibiotic prophylaxis were implemented in all patients (Table 3).

The laparoscopic approach was selected for the majority of cases (78%), although a conversion rate of 15% was recorded. The median surgical time was 127 minutes (IQR 120-186 minutes). To perform the anastomosis, a circular stapler was used in 65% of cases of colorectal anastomosis, followed by a linear stapler (26%) for colo-colonic or ileo-colic anastomoses. The average intraoperative bleeding was 150 ml (IQR 100-200).

Recovery

In the postoperative phase, active intestinal transit was promoted through the use of chewing gum and laxatives, promoting intestinal activity. The average time to the first flatus was one day (± 0.12) in 523 patients. The first stool occurred in 523 patients with a median of 2 days (± 0.4). The urinary catheter was removed in an average of 2.61 days (± 0.42) (Figure 4).

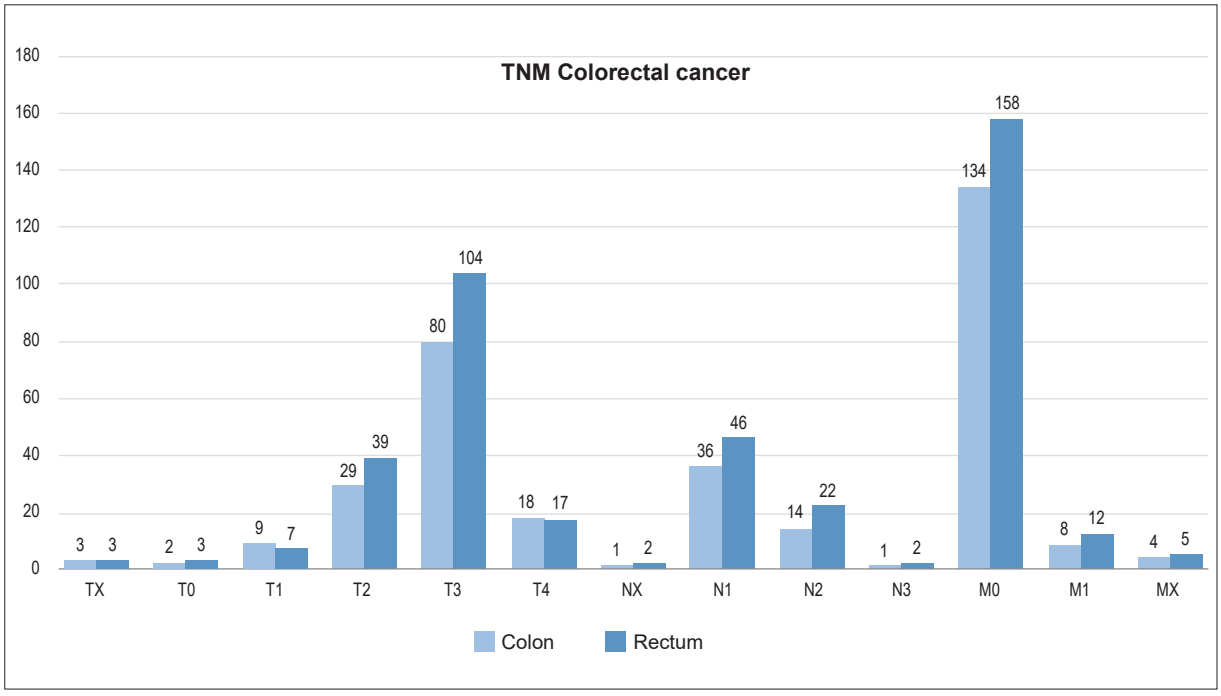

Figure 2. TNM staging for colorectal cancer. Source: Authors' own elaboration.

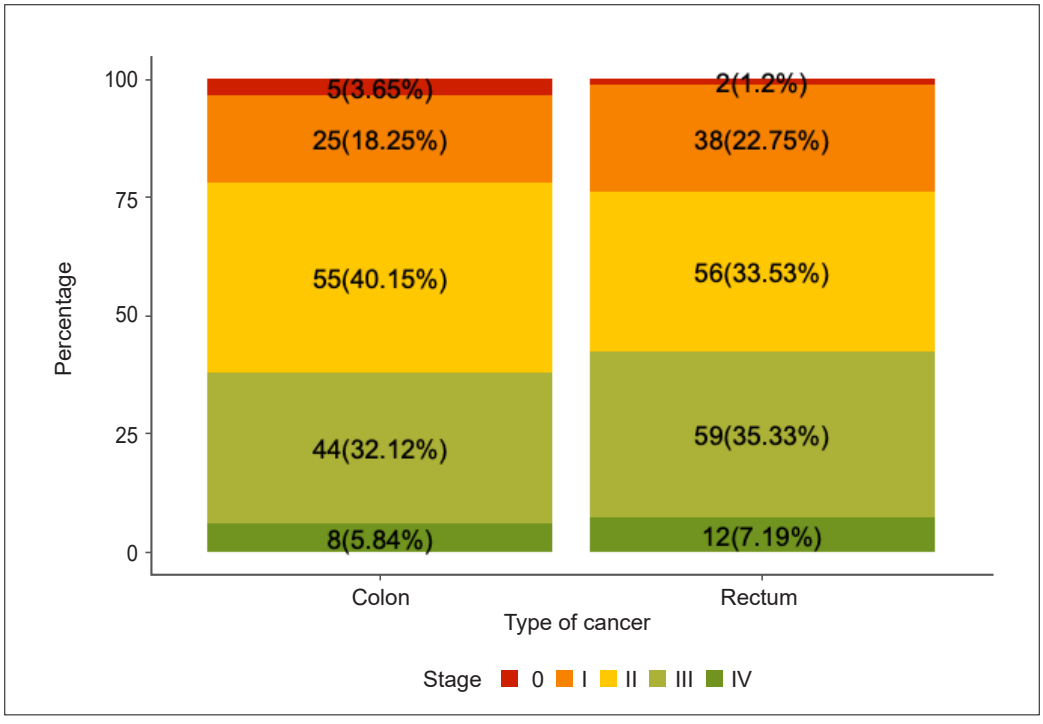

Figure 3. Colorectal cancer stages.

Table 2. Nutritional characteristics of patients undergoing colorectal surgery (n=456).

Nutritional Variables	Frequency	
Nutritional classification		
Normal	157	34.4%
Risk of malnutrition	75	16.4%
Malnutrition	186	40.8%
Not rated	38	8.3%
Preoperative nutritional treatment		
No, just regular foods	195	42.7%
Oral supplements	44	9.7%
Enteral nutrition	62	13.5%
Parenteral nutrition	80	17.5%
Immunonutrition	413	90.6%
Parenteral and oral nutrition	75	16.4%

Nutritional classification based on BMI (Body Mass Index). Source: Authors' own elaboration.

Table 3. Surgical characteristics (n=456).

Intraoperative variables		
ASA Classification (n, %)		
ASA 1	11	2.4%
ASA 2	102	22.4%
ASA 3	340	74.6%
ASA 4	3	0.6%
Approach (n, %)		
Open	102	22%
Laparoscopic	354	78%
Conversion to open surgery (n, %)	66	18.7%
Anastomosis (n, %)	430	94.3%
Ileostomy	108	23.7%
Type of anastomosis (n, %)		
Manual suture	5	1.2%
Circular stapler	279	64.9%
Linear staplers	111	25.8%
Linear stapler and manual suture closure	35	8.1%
Surgical time (median, IQR)	2,6	2.0-3.6
Vasoactive infusion (n, %)	77	16.9%
Intraoperative bleeding (median, IQR)	150	100-200
Abdominal drainage (n, %)	239	52.4%

IQR: Interquartile range; ASA: American Society of Anesthesiologists. Source: Authors' own elaboration.

The average time to start oral administration was 6 hours. Oral tolerance of solid foods was achieved in 442 patients after 3 days. The average hospital stay was 4 days, with a median of 4 at hospital discharge.

Complications

Postoperative complications occurred in 162 patients (35%), mainly grade IIIa (n=80, 49%), according to the modified Clavien-Dindo classification [9] (Table 4). Fifty-three patients (11.6%) needed to undergo a new procedure, the main cause being anastomotic leak (4.6%), followed by bleeding, intra-abdominal infection and intestinal obstruction. The 30-day readmission rate was 11.4%.

During follow-up, a 30-day perioperative mortality rate of 2.8% (13 patients) was recorded, with an average time of 103.95 days (± 15.87) (Figure 5).

Protocol compliance rates

In the analysis of adherence to the strategies that make up the ERAS protocol, an overall compliance of 84.7% was highlighted (Figure 5). In the different phases of care, greater adherence was evident during the intraoperative (85.8%) and postoperative (85.8%) periods, while preoperative compliance reached 80.8%.

Discussion

Traditional perioperative care was based on the transmission of experiences between surgeons over generations, giving rise to diverse practices and limiting the possibility of carrying out audits of perioperative processes. This variability in practices contributed to differences in outcomes between different surgical centers. Given the need to improve perioperative results and have a positive impact on postoperative outcomes, Kehlet & Mogensen [10] developed a perioperative care protocol. This protocol aimed to minimize surgical stress, improving the response to physiological stress triggered by the surgical stimulus. This was achieved by optimizing the clinical, mental, physical and psychological conditions of the patients through the implementation of various strategies throughout the different phases of care [11,12].

Initially implemented in patients undergoing colorectal surgery, this approach has demonstrated optimal results in terms of pain control, early mobilization, recovery of intestinal transit

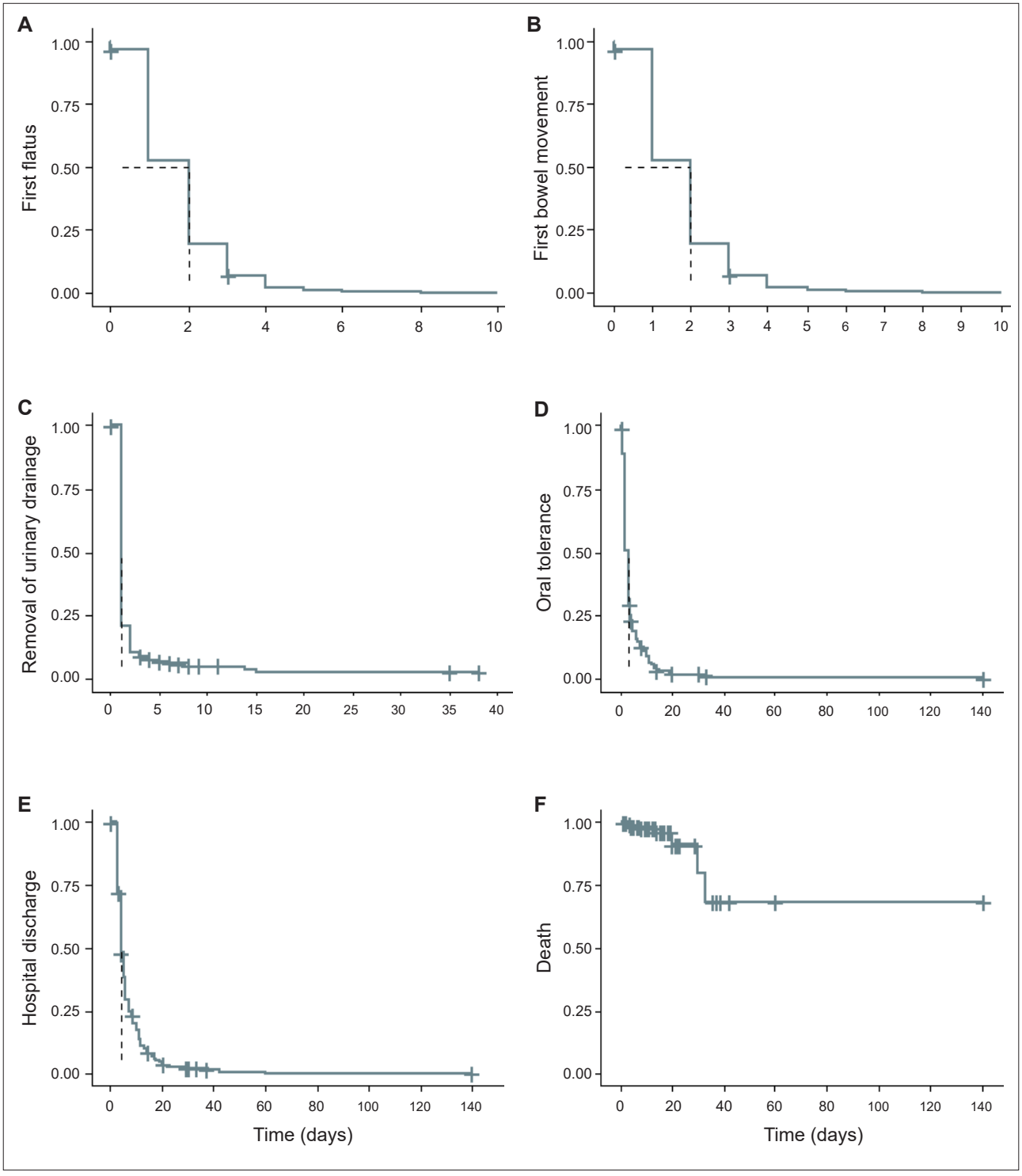

Figure 4. Time to event for first flatus (A), first bowel movement (B), removal of urinary drainage (C), oral tolerance (D), hospital discharge (E) and death (F). UC: Urinary catheter; OT: Oral tolerance. Source: Authors' own elaboration.

Table 4. Postoperative outcomes depending on the location of the neoplasm.

Postoperative outcomes	Colon (n=246)		Rectum (n=210)	
Reintervention (n, %)	53 (11.6%)			
Reason for reintervention (n, %)				
Anastomotic leak	11	4.5%	8	3.8%
Intra-abdominal abscess	1	0.4%	1	0.5%
Bleeding	3	1.2%	0	0%
Suture dehiscence	0	0%	1	0.5%
Intestinal obstruction	1	0.4%	2	1%
Complications*				
Grade I	5	2%	4	1.9%
Grade II	9	3.7%	9	4.3%
Grade IIIa	40	16.3%	40	19%
Grade IIIb	19	7.7%	16	7.6%
Grade IVa	5	2%	5	2.4%
Grade IVb	0	0%	1	0.5%
Grade V	9	2%	4	0.8%
Death (n, %)	13 2.8%			

* Clavien-Dindo classification. Source: Authors' own elaboration.

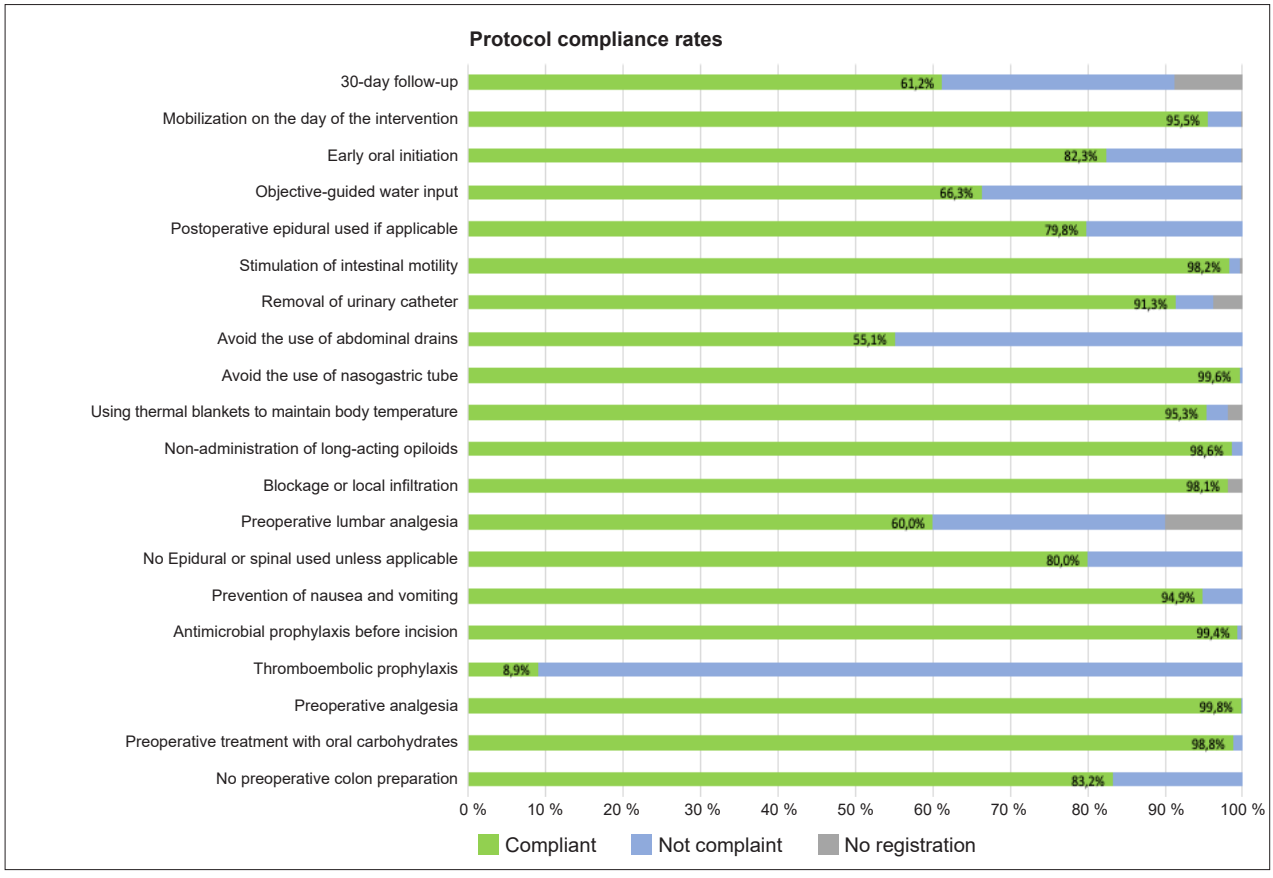

Figure 5. Adherence to the ERAS protocol by strategies. Source: Authors' own elaboration.

and reduction of hospital stay. This initiative has marked a milestone, and in the last 25 years multidisciplinary groups have been established that include anesthesiologists, surgeons, nutritionists, psychologists, physiotherapists and respiratory therapists, among others. These groups have contributed significantly to the creation and implementation of specific protocols that have been adopted in various surgical disciplines [13,14].

The strategies implemented in each phase of the perioperative period, ranging from preoperative to postoperative and rehabilitation, primarily pursue the maintenance of homeostasis. The central objective is to mitigate the metabolic response to stress induced by the surgical intervention. Each of these strategies is based on scientific evidence, seeking effective control of comorbidities, providing information and education to the patient in order to reduce the anxiety associated with the process.

Stopping smoking at least 4 weeks before the procedure contributes positively to the healing process [13,15]. Identification of nutritional risk optimizes preoperative nutritional status, while preprocedural carbohydrate loading minimizes insulin resistance. Additionally, epidural analgesia contributes to effective pain management and anti-inflammatory medications help reduce the inflammatory response. Optimal pain control not only promotes early mobilization, but also decreases insulin resistance. Finally, the early initiation of the oral route ensures the supply of nutrients to the tissues, thus preserving cellular function [5].

Regarding surgical intervention, some clinical trials have demonstrated reduced levels of inflammatory mediators, such as IL-6 and C-reactive protein, in patients who underwent minimally invasive colorectal surgery within an ERAS protocol [14,15]. Minimally invasive techniques have clear advantages and produce less surgical trauma.

In 2011, Vlug et al. [16] published a randomized controlled trial that demonstrated the benefits of laparoscopic surgery within the context of ERAS protocols, highlighting a shorter hospital stay and a reduction in morbidity. These findings were supported by later studies, such as that of Kennedy et al. [17], received a strong recommendation in the 2018 ERAS guidelines in elective colorectal surgery and were a strong recommendation in the 2018 ERAS guidelines in elective colorectal surgery by the Gustafsson group [18]. In our study, 78% of patients were approached by minimally invasive techniques, mainly laparoscopy, with a conversion rate of 15% and an overall complication rate of 35%, mostly classified as Clavien-Dindo IIIa.

In a context of limited hospital resources and increasing medical costs, safely reducing postoperative hospital stay has become an essential approach to optimize healthcare resource utilization. In our study, we observed a mean hospital discharge time of 4 days, a figure consistent with the results obtained in other cohorts [19,20].

Among the perioperative variables associated with failure of early discharge, the Body Mass Index (BMI), the ASA classification and the Charlson comorbidity index [21] stand out, potentially considered the variables most susceptible to modification. In our study, the average BMI was estimated at 25.1% and the nutritional evaluation identified that 40.7% had protein-calorie malnutrition. Additionally, 16.4% of patients were identified as being at nutritional risk and benefited from preoperative nutritional support, while 75% of patients had a preoperative ASA III classification.

Furthermore, factors such as longer surgical time and greater blood loss have been reported in the late discharge group [18]. In our study, we recorded a mean operative time of 127 minutes (IQR 120-186), while the mean intraoperative blood loss was 150 ml (IQR 100-200).

Regarding postoperative results, several studies have indicated that lack of tolerance to early feeding and lack of mobilization on the day of surgery are associated with a prolonged hospital stay [22-24]. In our cohort, intestinal transit was restored on the second day, and the mean time to tolerance to the oral route was 2 days.

Anastomotic leak after colorectal surgery, influenced by various factors, some linked to the patient and others to the surgical technique, represents one of the most feared complications due

to its significant impact on patient outcomes. It is associated with a longer hospital stay and an increase in morbidity and mortality rates. Reported rates of colorectal anastomotic leak range from 0.5% to 20% [25]. Our study showed an overall anastomotic leak rate of 4.6%, in line with the findings of other multicenter studies [26-28].

The 30-day readmission and reintervention rate was 11.4% and 11.6%, respectively. These results are consistent with recent series of enhanced recovery colorectal surgery, in which hospital readmissions ranged from 9% to 13% [24,25].

To allow for accurate timing and interpretation of program effectiveness, it is essential to report compliance with the individual components of each of the strategies. The better the compliance with the protocol, the better the results in terms of complications, duration of primary treatment, total length of stay, and readmissions. Previous research, such as that of Gustafsson and colleagues, has shown that adherence to more than 70% of planned care processes is associated with lower morbidity and shorter length of stay compared with lower adherence [29,30]. In this study, when evaluating compliance with the protocol, an overall adherence of 85% was observed. In all cases, patients received information. However, the perioperative thromboprophylaxis strategy was not implemented in the institutional protocol.

This study describes the effects of the ERAS enhanced recovery protocol in patients with colorectal cancer undergoing surgical resection at Clínica Universitaria Colombia, Bogota, Colombia, over the past 3 years. Although it is important to note that this is a single-center study with inherent limitations, which characterized short-term clinical outcomes, the findings should be considered as hypothesis generating for future research. Strengths of this study include detailed reporting of ERAS components applied and all postoperative medical events recorded. Additionally, compliance rates are based on data collected prospectively through the ERAS Interactive Audit System (EIAS), ensuring compliance with ERAS protocols once strategies are implemented and providing ongoing feedback to the perioperative team.

Conclusions

The current results demonstrate that accelerated recovery programs (ERAS) are feasible and applicable, and may benefit patients by promoting a more rapid return to organ function, facilitating recovery of gastrointestinal function, and improving perioperative nutritional status. It is crucial to strengthen and develop these protocols, since they not only provide fundamental benefits for patients, these being the main pillar, but also present economic advantages for the institutions where they are implemented.

Compliance with ethical standards

Informed consent: Taking into account the retrospective nature of the study, since it was observational, it did not imply any risk for the patients and informed consent was not required. The research protocol was approved by the Research Commission and the institutional Ethics Committee. It was carried out in accordance with the Declaration of Helsinki of the World Medical Association of 1975 and its subsequent amendments, and compliance with Resolution No. 008430 of 1993 of the Ministry of Health of the Republic of Colombia or Resolution 2378 of 2008 of the Ministry of Social Protection.

Conflict of interest: The authors declare no conflicts of interest.

Use of artificial intelligence: The authors declared that they did not use artificial intelligence (AI)-assisted technologies (such as large language models, chatbots, or image creators) in the production of this work.

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Author's contributions

- Conception and design of the study: Ronel Barbosa, Iván Guerrero, Carolina Riscanevo, María Paula Naranjo, Mayra Hernández.
- Acquisition of data: Ronel Barbosa, Iván Guerrero, Carolina Riscanevo, María Paula Naranjo, Mayra Hernández, Leticia Cuello.
- Data analysis and interpretation: Ronel Barbosa, Iván Guerrero, Carolina Riscanevo, María Paula Naranjo y Mayra Hernández, María del Pilar Montilla.

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- Critical review: Ronel Barbosa, Iván Guerrero, Carolina Riscanevo, María Paula Naranjo, Wilmar Martin, Mauricio Chona, Alejandro Velandia, Andrés Lasso, Diego Valbuena, Mayra Hernández.

References

1 Irani JL, Hedrick TL, Miller TE, Lee L, Steinhagen E, Shogan BD, et al. Clinical practice guidelines for enhanced recovery after colon and rectal surgery from the American Society of Colon and Rectal Surgeons and the Society of American Gastrointestinal and Endoscopic Surgeons. Surg Endosc. 2023;37:5-30. https://doi.org/10.1007/s00464-022-09758-x

2 Ripollés-Melchor J, Ramírez-Rodríguez JM, Casans-Francés R, Aldecoa C, Abad-Motos A, Logroño-Egea M, et al. Association between use of enhanced recovery after surgery protocol and postoperative complications in colorectal surgery: The Postoperative Outcomes Within Enhanced Recovery after surgery protocol (POWER) study. JAMA Surg. 2019;154:725-36. https://doi.org/10.1001/jamasurg.2019.0995

3 Artinyan A, Orcutt ST, Anaya DA, Richardson P, Chen GJ, Berger DH. Infectious postoperative complications decrease long-term survival in patients undergoing curative surgery for colorectal cancer: a study of 12,075 patients. Ann Surg. 2015;261:497-505. https://doi.org/10.1097/SLA.0000000000000854

4 Hanna DN, Hawkins AT. Colorectal: Management of postoperative complications in colorectal surgery. Surg Clin North Am. 2021;101:717-29. https://doi.org/10.1016/j.suc.2021.05.016

5 Ljungqvist O, Scott M, Fearon KC. Enhanced Recovery After Surgery: A Review. JAMA Surg. 2017;152:292-8. https://doi.org/10.1001/jamasurg.2016.4952

6 Carli F, Bousquet-Dion G, Awasthi R, Elsherbini N, Liberman S, et al. Effect of multimodal prehabilitation vs postoperative rehabilitation on 30-day postoperative complications for frail patients undergoing resection of colorectal cancer: A randomized clinical trial. JAMA Surg. 2020;155:233-42. https://doi.org/10.1001/jamasurg.2019.5474

7 Weimann A, Braga M, Carli F, Higashiguchi T, Hübner M, Klek S, et al. ESPEN guideline: Clinical nutrition in surgery. Clin Nutr. 2017;36:623-50. https://doi.org/10.1016/j.clnu.2017.02.013

8 Chand M, De'Ath HD, Rasheed S, Mehta C, Bromilow J, Qureshi T. The influence of peri-operative factors for accelerated discharge following laparoscopic colorectal surgery when combined with an enhanced recovery after surgery (ERAS) pathway. Int J Surg. 2016;25:59-63. https://doi.org/10.1016/j.ijsu.2015.11.047

9 Clavien PA, Barkun J, de Oliveira ML, Vauthey JN, Dindo D, Schulick RD, et al. The Clavien-Dindo classification of surgical complications: five-year experience. Ann Surg. 2009;250:187-96. https://doi.org/10.1097/SLA.0b013e3181b13ca2

10 Greer N, Sultan S, Shaukat A, Dahm P, Lee A, MacDonald R, et al. Enhanced Recovery After Surgery (ERAS) programs for patients undergoing colorectal surgery. Department of Veterans Affairs (US). 2017. Accessed on September 10, 2023. Available en: https://www.hsrd.research.va.gov/publications/esp/ERAS-EXEC.pdf

11 Hardy PY, Degesve M, Joris J, Coimbra C, Decker E, Hans G. Impact of preoperative anemia on outcomes of enhanced recovery program after colorectal surgery: A monocentric retrospective study. World J Surg. 2021;45:2326-36. https://doi.org/10.1007/s00268-021-06161-w

12 Kehlet H, Mogensen T. Hospital stay of 2 days after open sigmoidectomy with a multimodal rehabilitation programme. Br J Surg. 1999;86:227-30. https://doi.org/10.1046/j.1365-2168.1999.01023.x

13 Schwenk W. Optimized perioperative management (fast-track, ERAS) to enhance postoperative recovery in elective colorectal surgery. GMS Hyg Infect Control. 2022;17:Doc10. https://doi.org/10.3205/dgkh000413

14 Fagard K, Wolthuis A, D'Hoore A, Verhaegen M, Tournoy J, Flamaing J, et al. A systematic review of the intervention components, adherence and outcomes of enhanced recovery programmes in older patients undergoing elective colorectal surgery. BMC Geriatrics. 2019;19:157. https://doi.org/10.1186/s12877-019-1158-3

15 Mari G, Crippa J, Costanzi A, Mazzola M, Rossi M, Maggioni D. ERAS protocol reduces IL-6 secretion in colorectal laparoscopic surgery: Results from a randomized clinical trial. Surg Laparosc Endosc Percutan Tech. 2016;26:444-8. https://doi.org/10.1097/SLE.0000000000000324

16 Vlug MS, Wind J, Hollmann MW, Ubbink DT, Cense HA, Engel AF, et al. Laparoscopy in combination with fast track multimodal management is the best perioperative strategy in patients undergoing colonic surgery: a randomized clinical trial (LAFA-study). Ann Surg. 2011;254:868-75. https://doi.org/10.1097/SLA.0b013e31821fd1ce

17 Kennedy RH, Francis EA, Wharton R, Blazeby JM, Quirke P, West NP, et al. Multicenter randomized controlled trial of conventional versus laparoscopic surgery for colorectal cancer within an enhanced recovery programme: EnROL. J Clin Oncol. 2014;32:1804-11. https://doi.org/10.1200/JCO.2013.54.3694

18 Gustafsson UO, Hausel J, Thorell A, Ljungqvist O, Soop M, Nygren J, Enhanced Recovery After Surgery Study Group. Adherence to the enhanced recovery after surgery protocol and outcomes after colorectal cancer surgery. Arch Surg. 2011;146:571-7. https://doi.org/10.1001/archsurg.2010.309

19 Keller DS, Bankwitz B, Woconish D, Champagne BJ, Reynolds HL, Stein SL, et al. Predicting who will fail early discharge after laparoscopic colorectal surgery with an established enhanced recovery pathway. Surg Endosc. 2014;28:74-9. https://doi.org/10.1007/s00464-013-3158-2

20 Charlson ME, Carrozzino D, Guidi J, Patierno C. Charlson comorbidity index: A critical review of clinimetric properties. Psychother Psychosom. 2022;91:8-35. https://doi.org/10.1159/000521288

21 Levy BF, Scott MJP, Fawcett WJ, Rockall TA. 23-hour-stay laparoscopic colectomy. Dis Colon Rectum. 2009;52:1239-43. https://doi.org/10.1007/DCR.0b013e3181a0b32d

22 Lawrence JK, Keller DS, Samia H, Ermlich B, Brady KM, Nobel T, et al. Discharge within 24 to 72 hours of colorectal surgery is associated with low readmission rates when using Enhanced Recovery Pathways. J Am Coll Surg. 2013;216:390-4. https://doi.org/10.1016/j.jamcollsurg.2012.12.014

23 Crippa J, Calini G, Santambrogio G, Sassun R, Siracusa C, Maggioni D, et al.; AIMS Academy Clinical Research Network. ERAS protocol applied to oncological colorectal mini-invasive surgery reduces the surgical stress response and improves long-term cancer-specific survival. Surg Laparosc Endosc Percutan Tech. 2023;33:297-301. https://doi.org/10.1097/SLE.0000000000001181

24 Zhao Y, Qin H, Wu Y, Xiang B. Enhanced recovery after surgery program reduces length of hospital stay and complications in liver resection: A PRISMA-compliant systematic review and meta-analysis of randomized controlled trials. Medicine (Baltimore). 2017;96:e7628. https://doi.org/10.1097/MD.0000000000007628

25 Lv L, Shao YF, Zhou YB. The enhanced recovery after surgery (ERAS) pathway for patients undergoing colorectal surgery: an update of meta-analysis of randomized controlled trials. Int J Colorectal Dis. 2012;27:1549-54. https://doi.org/10.1007/s00384-012-1577-5

26 Adamina M, Kehlet H, Tomlinson GA, Senagore AJ, Delaney CP. Enhanced recovery pathways optimize health outcomes and resource utilization: A meta-analysis of randomized controlled trials in colorectal surgery. Surgery. 2011;149:830-40. https://doi.org/10.1016/j.surg.2010.11.003

27 Ban KA, Berian JR, Ko CY. Does implementation of enhanced recovery after surgery (ERAS) protocols in colorectal surgery improve patient outcomes? Clin Colon Rectal Surg. 2019;32:109-13. https://doi.org/10.1055/s-0038-1676475

28 Francis NK, Mason J, Salib E, Allanby L, Messenger D, Allison AS, et al. Factors predicting 30-day readmission after laparoscopic colorectal cancer surgery within an enhanced recovery programme. Colorectal Dis. 2015;17:O148-O154. https://doi.org/10.1111/codi.13002

29 Sciuto A, Merola G, De Palma GD, Sodo M, Pirozzi F, Bracale UM, et al. Predictive factors for anastomotic leakage after laparoscopic colorectal surgery. World J Gastroenterol. 2018;24:2247-60. https://doi.org/10.3748/wjg.v24.i21.2247

30 Mendivelso FO, Barrios-Parra AJ, Zárate-López E, Navas-Camacho AM, Álvarez AO, Mc Loughlin S, et al. Asociación entre desenlaces clínicos y cumplimiento del protocolo de recuperación mejorada después de la cirugía (ERAS) en procedimientos colorrectales: Estudio multicéntrico. Rev Colomb Cir. 2020;35:601-13. https://doi.org/10.30944/20117582.662