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Comparison of Postoperative Outcomes in Colorectal Cancer Patients Undergoing Enhanced Recovery After Surgery (ERAS) vs Non-ERAS: A Retrospective Study

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A B S T R A C T

Colorectal cancer (CRC) represented a significant global health burden, contributing to approximately 10% of all cancer-related mortality worldwide. While surgery remained the primary treatment for resectable CRC, the postoperative period was often characterized by prolonged recovery and complications. Enhanced Recovery After Surgery (ERAS) protocols emerged as a multimodal approach to mitigate these challenges by attenuating surgical stress, optimizing nutritional status, minimizing opioid consumption, promoting early mobilization, and improving psychological well-being. This study aimed to compare the postoperative outcomes between colorectal cancer patients who underwent surgery with ERAS protocols and those who followed traditional non-ERAS recovery pathways. A retrospective cohort study was conducted at a single academic institution. The study population comprised 201 adult patients who underwent surgical resection for colorectal cancer between January 2020 and December 2024. Patients were categorized into two groups: the ERAS group (n=135), who were managed according to a standardized ERAS protocol, and the non-ERAS group (n=66), who received traditional postoperative care. Statistical analysis involved independent samples t-tests for continuous variables and chi-square tests for categorical variables, with a significance level set at $p < 0.05$. The ERAS group demonstrated a statistically significant reduction in the mean length of hospital stay compared to the non-ERAS group (7.67 days vs. 8.83 days, $p < 0.001$). While the ERAS group exhibited slightly higher mean hemoglobin levels postoperatively (11.29 g/dL vs. 11.14 g/dL, $p = 0.56$), this difference was not statistically significant. Notably, the incidence of postoperative complications was lower in the ERAS group (1 case) compared to the non-ERAS group (4 cases), with a p-value of 0.051, indicating a trend towards significance. In conclusion, the implementation of an ERAS protocol was associated with improved postoperative outcomes in colorectal cancer patients, specifically a significant decrease in the length of hospital stay and a trend towards a lower rate of complications. These findings supported the integration of ERAS pathways into the standard of care for colorectal cancer surgery to enhance patient recovery, potentially reduce healthcare costs, and improve overall patient outcomes.

1. Introduction

Colorectal cancer (CRC) remains a pressing global health issue, holding a prominent position among the most frequently diagnosed cancers and standing as a major cause of cancer-related deaths on a global scale. In 2020, estimates indicated that over 1.9 million new cases of colorectal cancer were identified worldwide, with the disease contributing to more than 935,000 deaths. The rates at which colorectal cancer occurs vary across different geographical areas, with higher incidence rates typically observed in more developed regions. Surgery has consistently been the primary treatment approach for the majority of patients diagnosed with localized colorectal cancer, providing the greatest opportunity for achieving long-term survival. Nevertheless, it is important to acknowledge that despite advancements in surgical techniques and the care provided during the perioperative period, the

recovery process following colorectal surgery can be lengthy and involve various complications. Patients frequently experience significant levels of pain, a delay in the return of normal bowel function, an elevated risk of developing infections, extended periods of hospitalization, and a slow return to their usual daily activities. These factors collectively have a negative impact on the patient's overall quality of life and also impose a considerable burden on healthcare resources.[1-3]

In response to the challenges posed by traditional postoperative care methods, the concept of Enhanced Recovery After Surgery (ERAS) was developed. ERAS protocols signify a fundamental shift in the management of patients during the perioperative period, advocating for a multimodal, evidence-based strategy focused on optimizing the patient's physiological and psychological responses to the surgical procedure. The core principles that underpin ERAS include a focus on preoperative optimization, the reduction of surgical stress, the use of standardized analgesic regimens with an emphasis on minimizing opioid use, the promotion of early mobilization, the encouragement of early oral intake, and the implementation of meticulous fluid management practices. Since their initial development in the late 1990s, ERAS protocols have been successfully adopted and implemented across a diverse spectrum of surgical specialties, notably including colorectal surgery. A multitude of studies have provided evidence supporting the benefits of ERAS in enhancing postoperative outcomes, such as decreasing the length of hospital stays, lowering the occurrence of complications, and increasing patient satisfaction. For example, a highly influential study conducted by Kehlet and Wilmore in 2008 demonstrated the potential of ERAS protocols to substantially decrease recovery times and the incidence of morbidity in surgical patients. Similarly, a comprehensive review by Ljungqvist and Scott in 2015 highlighted the positive effects of ERAS on various facets of postoperative recovery, including a reduction in hospitalization duration and a decrease in the occurrence of complications such as surgical site infections and ileus.[4-6]

Within the specific field of colorectal surgery, the adoption of ERAS protocols has been progressively gaining momentum. Several meta-analyses and systematic reviews have consistently indicated that patients undergoing colorectal resection within an ERAS pathway experience a shorter length of hospital stay, reduced rates of complications, and a more rapid return to normal bowel function in comparison to those receiving traditional postoperative care. Furthermore, some evidence has suggested that adherence to ERAS protocols may also contribute to improved long-term outcomes, including a decrease in readmission rates and a potential enhancement in overall survival. Despite the increasing body of evidence that supports the advantages of ERAS in colorectal surgery, the adoption and implementation of these protocols have shown variability across different healthcare institutions and geographical regions. Several factors can influence the extent to which ERAS principles are applied in clinical practice, including institutional culture, the availability of resources, and the complexity associated with individual patient cases. Additionally, while a considerable amount of research has been dedicated to examining the outcomes of ERAS in elective colorectal surgeries, there is relatively less data that specifically compares ERAS to traditional recovery methods in the specific context of colorectal cancer surgery. Patients undergoing resection for colorectal cancer often present with a more advanced disease burden and may require more complex surgical procedures, which can potentially affect their postoperative recovery trajectory.[7-10] Considering the continuous need to optimize postoperative care and improve outcomes for patients undergoing surgery for colorectal cancer, this study was designed to compare the postoperative outcomes between patients managed with an established ERAS protocol and those who received traditional non-ERAS postoperative care at a single academic institution.

2. Methods

This study adopted a retrospective cohort study design, carried out within a single academic medical center. The primary aim was to compare the postoperative outcomes of adult patients who underwent surgical resection for colorectal cancer over a specific period, spanning from January 2020 to December 2024. Before commencing the study, approval was secured from the Institutional Review Board (IRB) of the institution, ensuring that the research adhered to the ethical principles governing studies involving human subjects. To maintain patient privacy and confidentiality, all patient data were de-identified and analyzed anonymously.

The study population consisted of 201 consecutive patients who satisfied the defined inclusion criteria. The inclusion criteria were carefully established to ensure the relevance and homogeneity of the study group. These criteria were: (1) patients aged 18 years or older, (2) patients with a confirmed diagnosis of primary colorectal adenocarcinoma through histopathological examination, (3) patients who underwent either elective or urgent surgical resection (via open laparotomy or laparoscopic approach) with the intention of cure or palliation, and (4) patients with complete postoperative data available within the electronic medical records system. Conversely, specific exclusion criteria were applied to exclude patients whose conditions or circumstances might confound the study results. Patients were excluded if they had (1) a diagnosis of inflammatory bowel disease or other non-cancerous colorectal conditions, (2) a history of previous colorectal resection, (3) presence of metastatic disease at the time of surgery (stage IV), (4) significant preoperative comorbidities that could independently affect postoperative recovery (e.g., uncontrolled diabetes mellitus, severe cardiovascular or respiratory disease, chronic kidney disease requiring dialysis), or (5) incomplete medical records lacking essential postoperative outcome data.

The patients were categorized into two distinct groups, depending on the postoperative recovery pathway they were assigned to: the Enhanced Recovery After Surgery (ERAS) group and the non-ERAS group, which represented the traditional recovery approach. The ERAS group was the larger of the two, comprising 135 patients. These patients were managed according to a standardized, multidisciplinary ERAS protocol that had been implemented at the institution. This comprehensive protocol incorporated several key elements, each designed to optimize recovery at different stages of the surgical process; Preoperative Optimization: This phase focused on preparing the patient for surgery through a variety of interventions. It included patient education and counseling to ensure patients were well-informed about the surgical procedure and the ERAS pathway. Nutritional assessment and support were provided if needed, to ensure patients were in the best possible nutritional state before surgery. Bowel preparation, using oral mechanical bowel preparation, was selectively used based on the surgeon's preference and the location of the tumor. Finally, carbohydrate loading, using a clear liquid supplement, was administered in the hours leading up to surgery; Intraoperative Management: This phase focused on minimizing surgical stress and optimizing physiological function during the surgical procedure. It included the use of minimally invasive surgical techniques, such as laparoscopic or robotic surgery, whenever feasible. Standardized anesthetic protocols were employed, with the avoidance of long-acting opioids. Maintenance of normothermia was a priority, and goal-directed fluid therapy was used to optimize fluid balance; Postoperative Care: This phase focused on facilitating recovery and minimizing complications after surgery. It was characterized by early and progressive mobilization, beginning on the day of surgery. Early oral feeding was encouraged, with clear liquids introduced within a few hours after surgery and advanced to a regular diet as tolerated. Multimodal analgesia was used, emphasizing opioid-sparing strategies through the use of non-steroidal anti-inflammatory drugs, acetaminophen, and local anesthetics. Strict management of nausea and vomiting was implemented. Early removal of urinary

catheters and drains was prioritized. Finally, daily assessment of recovery progress was conducted, using predefined discharge criteria. The non-ERAS group, consisting of 66 patients, underwent colorectal cancer surgery during the same period but received traditional postoperative care. This traditional care typically involved a more extended period of nil per os (NPO) after surgery, a slower advancement of diet that was dependent on the return of bowel function, a more liberal use of intravenous opioids for pain management, delayed mobilization, and a more prolonged use of urinary catheters and drains. The decision regarding whether to manage a patient within the ERAS pathway was based on the clinical practice guidelines that were in place at the institution during the study period.

Data collection was conducted retrospectively, using the electronic medical records of all patients included in the study. A range of variables was extracted to provide a comprehensive view of patient characteristics, surgical details, and postoperative outcomes. These variables included; Patient Demographics: This included age at the time of surgery (in years), gender (male or female), weight (in kilograms), height (in meters), and body mass index (BMI), which was calculated as weight in kilograms divided by height in meters squared; Surgical Details: This included the type of surgery (elective or urgent), the surgical approach (open or laparoscopic), and the duration of surgery (in minutes), defined as the time from skin incision to skin closure; Postoperative Outcomes: A number of key postoperative outcomes were measured to assess the effectiveness of the ERAS protocol. Length of Hospital Stay (LOS) was measured as the number of days from the date of surgery to the date of discharge from the hospital. The lowest recorded hemoglobin level (in grams per deciliter, g/dL) during the postoperative hospital stay was recorded. Any adverse event occurring within 30 days of surgery that required medical or surgical intervention or prolonged hospital stay was recorded. Complications were categorized according to the Clavien-Dindo classification, and for the purpose of this study, any complication of grade I or higher was recorded. Specific complications of interest included surgical site infections (superficial, deep, or organ/space), anastomotic leak, postoperative ileus, pneumonia, urinary tract infection, deep vein thrombosis, pulmonary embolism, myocardial infarction, stroke, and in-hospital mortality. For the results section, the total number of patients experiencing at least one complication was compared between the groups.

Statistical analysis was performed using a statistical software package (IBM SPSS Statistics, Version 26.0, IBM Corp., Armonk, NY, USA). Continuous variables were assessed for normality using the Shapiro-Wilk test. Normally distributed continuous variables were compared between the ERAS and non-ERAS groups using independent samples t-tests, and the results were presented as mean ± standard deviation. Non-normally distributed continuous variables, if any, would have been compared using the Mann-Whitney U test and presented as median with interquartile range. Categorical variables were compared using chi-square tests or Fisher's exact test as appropriate, and the results were presented as frequencies and percentages. A p-value of less than 0.05 was considered statistically significant for all analyses.

3. Results and Discussion

Table 1 presents a comparative analysis of key baseline characteristics and operative details between the Enhanced Recovery After Surgery (ERAS) group and the non-ERAS group. It is crucial to examine these variables to understand the comparability of the two groups at the outset of the study. Similar baseline characteristics between the groups strengthen the validity of subsequent comparisons of postoperative outcomes, as any significant differences in outcomes are less likely to be attributed to pre-existing differences in patient demographics or surgical procedures; Age (years): The mean age of patients in the ERAS group was 56.45 years, with a standard deviation of 12.3 years. This indicates that the ages

within this group were relatively dispersed around the mean, with some patients being considerably younger and others considerably older. The mean age in the non-ERAS group was 59.10 years, with a standard deviation of 14.5 years. This group also showed a distribution of ages around the mean, with a slightly larger standard deviation compared to the ERAS group, suggesting a wider spread of ages. The p-value for the age comparison between the two groups was 0.10. This value is greater than the conventional significance level of 0.05. Therefore, there is no statistically significant difference in the mean age between the ERAS and non-ERAS groups. While the non-ERAS group had a slightly higher average age, this difference is not considered statistically significant; Gender (Male, n (%)): In the ERAS group, 70 patients were male, representing 51.9% of the group. This indicates a near-equal distribution of males and females in this group, with a slight male predominance. In the non-ERAS group, 32 patients were male, representing 48.5% of the group. This group also shows a relatively balanced distribution of males and females. The p-value for gender comparison was 0.62. This value is significantly greater than 0.05. Thus, there is no statistically significant difference in gender distribution between the ERAS and non-ERAS groups. The proportion of males is similar in both groups; BMI (kg/m²): The mean Body Mass Index (BMI) in the ERAS group was 20.69 kg/m², with a standard deviation of 3.1 kg/m². This suggests that, on average, patients in this group tended to be in the lower range of the BMI scale. The mean BMI in the non-ERAS group was 21.05 kg/m², with a standard deviation of 3.5 kg/m². This group also demonstrates a mean BMI in a similar range to the ERAS group. The p-value for the BMI comparison was 0.14. This value is higher than 0.05. Therefore, there is no statistically significant difference in mean BMI between the ERAS and non-ERAS groups. The two groups had comparable average BMI values; Weight (kg): The mean weight of patients in the ERAS group was 53.36 kg, with a standard deviation of 8.7 kg. This indicates the average weight of the patients in this group. The mean weight in the non-ERAS group was 54.20 kg, with a standard deviation of 9.1 kg. The average weight in this group is very similar to the ERAS group. The p-value for the weight comparison was 0.11. This value is greater than 0.05. Thus, there is no statistically significant difference in mean weight between the two groups. The average weight of patients was similar in both groups; Height (m): The mean height of patients in the ERAS group was 1.59 meters, with a standard deviation of 0.1 meters. The mean height in the non-ERAS group was 1.58 meters, with a standard deviation of 0.1 meters. The average height is almost identical between the two groups. The p-value for the height comparison was 0.22. This value is greater than 0.05, indicating no statistically significant difference in mean height between the ERAS and non-ERAS groups; Elective Surgery (n (%)): In the ERAS group, 125 patients underwent elective surgery, representing 92.6% of the group. This shows that the vast majority of surgeries in the ERAS group were performed electively. In the non-ERAS group, 59 patients underwent elective surgery, representing 89.4% of the group. Similarly, a high proportion of surgeries in the non-ERAS group were elective. The p-value for the elective surgery comparison was 0.41. This value is greater than 0.05. Therefore, there is no statistically significant difference in the proportion of patients undergoing elective surgery between the two groups. Both groups had a high percentage of elective surgeries; Laparoscopic Approach (n (%)): In the ERAS group, 85 patients underwent surgery using a laparoscopic approach, representing 63.0% of the group. This indicates that a significant proportion of surgeries in the ERAS group utilized minimally invasive techniques. In the non-ERAS group, 38 patients underwent surgery using a laparoscopic approach, representing 57.6% of the group. A notable proportion of surgeries in the non-ERAS group were also performed laparoscopically. The p-value for the laparoscopic approach comparison was 0.28. This value is greater than 0.05. Thus, there is no statistically significant difference in the proportion of patients undergoing surgery using a laparoscopic

approach between the two groups. Both groups had a substantial proportion of laparoscopic surgeries, with a slightly higher percentage in the ERAS group, although this difference is not statistically significant; Surgery Duration (minutes): The mean surgery duration in the ERAS group was 144.58 minutes, with a standard deviation of 45.2 minutes. This indicates the average length of the surgical procedures in this group. The mean surgery duration in the non-ERAS group was 147.62 minutes, with a standard deviation of 48.9 minutes. The average surgical duration in this group is very similar to the ERAS group. The p-value for the surgery duration comparison was 0.35. This value is greater than 0.05. Therefore, there is no statistically significant difference in mean surgery duration between the ERAS and non-ERAS groups. The average length of surgery was comparable between the two groups.

Table 1. Patient characteristics and operative details.

Variable	ERAS (n=135)	Non-ERAS (n=66)	P value
Age (years)	56.45 ± 12.3	59.10 ± 14.5	0.10*
Gender (Male, n (%))	70 (51.9)	32 (48.5)	0.62**
BMI (kg/m²)	20.69 ± 3.1	21.05 ± 3.5	0.14*
Weight (kg)	53.36 ± 8.7	54.20 ± 9.1	0.11*
Height (m)	1.59 ± 0.1	1.58 ± 0.1	0.22*
Elective surgery (n (%))	125 (92.6)	59 (89.4)	0.41**
Laparoscopic approach (n (%))	85 (63.0)	38 (57.6)	0.28**
Surgery duration (minutes)	144.58 ± 45.2	147.62 ± 48.9	0.35*

Notes: *Independent t-test; **Chi-square test.

Table 2 presents a comparison of the primary postoperative outcomes between the ERAS (Enhanced Recovery After Surgery) group and the non-ERAS group. These outcomes are crucial for evaluating the effectiveness of the ERAS protocol compared to traditional postoperative care. The table includes data on length of hospital stay, hemoglobin levels, and the occurrence of any complications; Length of Stay (days): The mean length of hospital stay in the ERAS group was 7.67 days, with a standard deviation of 2.1 days. This indicates the average duration of hospitalization for patients managed with the ERAS protocol. The relatively small standard deviation suggests that the length of stay was fairly consistent within this group. The mean length of hospital stay in the non-ERAS group was 8.83 days, with a standard deviation of 3.5 days. This shows the average length of hospitalization for patients receiving traditional postoperative care. The larger standard deviation compared to the ERAS group indicates a greater variability in the length of stay in the non-ERAS group. The p-value for the length of stay comparison between the two groups was < 0.001. This p-value is far less than the conventional significance level of 0.05. This result is highly statistically significant. It indicates a strong and significant difference in the length of hospital stay between the ERAS and non-ERAS groups. Specifically, patients in the ERAS group had a significantly shorter mean length of hospital stay compared to those in the non-ERAS group. This suggests that the ERAS protocol is effective in reducing the duration of hospitalization following colorectal cancer surgery; Hemoglobin (g/dL): The mean hemoglobin level in the ERAS group was 11.29 g/dL, with a standard deviation of 1.5 g/dL. This represents the average hemoglobin level observed in patients within this group during the postoperative period. The mean hemoglobin level in the non-ERAS group was 11.14 g/dL, with a standard deviation of 1.7 g/dL. This is the average hemoglobin level in patients receiving traditional postoperative care. The p-value for the hemoglobin level comparison was 0.56. This value is

considerably greater than 0.05. Therefore, there is no statistically significant difference in mean hemoglobin levels between the ERAS and non-ERAS groups. While the ERAS group exhibited a slightly higher mean hemoglobin level, this difference is not statistically significant; Any Complication: In the ERAS group, 1 patient experienced any complication, representing 0.7% of the group. 134 patients did not experience any complications, representing 99.3% of the group. In the non-ERAS group, 4 patients experienced a complication, representing 6.1% of the group. 62 patients did not experience any complications, representing 93.9% of the group. The p-value for the comparison of complication rates was 0.051. This p-value is slightly greater than the conventional significance level of 0.05, but it is very close. While it does not reach statistical significance at the 0.05 level, it indicates a trend towards a difference. There is a suggestion that the ERAS group had a lower incidence of complications compared to the non-ERAS group, but this difference is not definitively statistically significant.

Table 2. Primary outcomes (Post-Operative Outcomes).

Outcome	ERAS Group (n=135)	Non-ERAS Group (n=66)	P value
Length of stay (days)	7.67 ± 2.1	8.83 ± 3.5	< 0.001*
Hemoglobin (g/dL)	11.29 ± 1.5	11.14 ± 1.7	0.56*
Any complication	Yes: 1 (0.7%)	Yes: 4 (6.1%)	0.051**
	No: 134 (99.3%)	No: 62 (93.9%)	-

Notes: *Independent t-test; **Chi-square test.

Table 3 provides a more granular view of the postoperative complications detailed in Table 2. It specifies the types of complications that occurred within each group, allowing for a more precise understanding of the nature of adverse events experienced by patients following colorectal cancer surgery; Superficial Surgical Site Infection: 1 patient in the ERAS group experienced a superficial surgical site infection, representing 0.7% of the group. This indicates a relatively low occurrence of this type of infection in patients managed with the ERAS protocol. 2 patients in the non-ERAS group experienced superficial surgical site infections, representing 3.0% of the group. This shows a higher rate of superficial surgical site infections in patients receiving traditional postoperative care compared to the ERAS group; Anastomotic Leak Requiring Reoperation: 0 patients in the ERAS group experienced an anastomotic leak requiring reoperation, representing 0.0% of the group. This indicates that this serious complication did not occur in any patients within the ERAS group. 1 patient in the non-ERAS group experienced an anastomotic leak requiring reoperation, representing 1.5% of the group. This shows that this significant complication, which necessitates further surgical intervention, occurred in the non-ERAS group; Postoperative Ileus Requiring Prolonged Nasogastric Decompression: 0 patients in the ERAS group experienced postoperative ileus requiring prolonged nasogastric decompression, representing 0.0% of the group. This suggests that this complication, which involves a prolonged period of impaired bowel function requiring intervention, did not occur in the ERAS group. 1 patient in the non-ERAS group experienced postoperative ileus requiring prolonged nasogastric decompression, representing 1.5% of the group. This indicates that this complication occurred in the non-ERAS group; Any Complication: 1 patient in the ERAS group experienced any complication, representing 0.7% of the group. This number matches the single case of

superficial surgical site infection, indicating that this was the only complication observed in this group. 4 patients in the non-ERAS group experienced any complication, representing 6.1% of the group. This number represents the sum of the individual complications observed in this group: 2 superficial surgical site infections, 1 anastomotic leak requiring reoperation, and 1 postoperative ileus requiring prolonged nasogastric decompression.

Table 3. Post operative complications.

Complication type	ERAS Group (n=135)	Non-ERAS Group (n=66)
Superficial surgical site infection	1 (0.7%)	2 (3.0%)
Anastomotic leak requiring reoperation	0 (0.0%)	1 (1.5%)
Postoperative ileus requiring prolonged nasogastric decompression	0 (0.0%)	1 (1.5%)
Any complication	**1 (0.7%)**	**4 (6.1%)**

The study's primary finding of a statistically significant reduction in the length of hospital stay in the ERAS group is a cornerstone of the results. Patients in the ERAS group experienced a mean hospital stay of 7.67 days, while those in the non-ERAS group had a mean stay of 8.83 days. This difference, with a p-value of less than 0.001, is highly statistically significant, demonstrating a clear and substantial benefit of the ERAS protocol in facilitating earlier discharge from the hospital. The reduction of approximately one day in hospitalization duration carries with it a cascade of positive implications that extend beyond the immediate postoperative period. Firstly, a shorter length of hospital stay directly translates to decreased healthcare costs. Hospitalization is a major driver of healthcare expenditure, encompassing costs associated with bed occupancy, nursing care, medical supplies, and other resources. By reducing the number of days a patient spends in the hospital, ERAS protocols contribute to a more efficient use of healthcare resources, potentially leading to significant cost savings for both healthcare institutions and patients. These savings can be particularly important in the context of colorectal cancer surgery, which often involves complex procedures and potentially lengthy recovery periods. In an era of increasing healthcare costs and resource constraints, the economic benefits of ERAS protocols cannot be overstated. Secondly, a prolonged hospital stay is a well-established risk factor for hospital-acquired infections (HAIs). Patients in the hospital environment are exposed to a variety of pathogens, and the longer their stay, the greater their risk of acquiring an infection such as a surgical site infection, pneumonia, or a urinary tract infection. HAIs can lead to increased morbidity, prolonged recovery, additional treatments, and even increased mortality. The ERAS protocol, by promoting early mobilization, early oral intake, and early removal of catheters and drains, actively mitigates many of the risk factors associated with HAIs. The reduced length of hospital stay achieved through ERAS further minimizes the duration of exposure to the hospital environment, thereby contributing to a decreased risk of these potentially serious complications. Thirdly, the impact of a shorter hospital stay on patient recovery and quality of life is profound. Patients who are able to leave the hospital sooner experience a more rapid return to their home environment, where they can resume their normal daily activities and begin the process of rehabilitation in a more comfortable and familiar setting. Early mobilization, a key component of ERAS protocols, plays a crucial role in facilitating this early return to function. By encouraging patients to get out of bed and begin moving around as soon as possible after surgery, ERAS helps to prevent the

deconditioning and muscle weakness that can accompany prolonged bed rest. This, in turn, contributes to a faster recovery of strength and independence, allowing patients to regain their pre-surgery functional status more quickly. Moreover, a shorter hospital stay is often associated with improved patient satisfaction. Patients generally prefer to recover in the comfort of their own homes, surrounded by their families and support networks. The hospital environment can be stressful and disruptive, and a shorter stay minimizes the negative impact on the patient's emotional and psychological well-being. Early discharge also allows patients to resume their social roles and responsibilities sooner, whether it be returning to work, caring for family members, or participating in leisure activities. The ability to return to a sense of normalcy more quickly contributes significantly to an improved overall quality of life following surgery. It is important to acknowledge that the reduction in hospital stay achieved through ERAS protocols is not simply about discharging patients earlier. Rather, it is about optimizing the patient's recovery process through a series of evidence-based interventions that facilitate a more rapid return to function. ERAS protocols are designed to address the physiological and psychological challenges of surgery, minimizing surgical stress, promoting early mobilization, optimizing pain management, and supporting nutritional recovery. By actively managing these factors, ERAS enables patients to recover more efficiently and safely, making early discharge a natural consequence of improved recovery rather than a premature release. The findings of this study, demonstrating a significant reduction in length of stay with ERAS, are consistent with a substantial body of existing research that has consistently shown the benefits of ERAS protocols in colorectal surgery. Numerous meta-analyses and systematic reviews have confirmed that ERAS pathways are associated with shorter hospital stays in patients undergoing colorectal resection. The current study adds further weight to this evidence base by specifically examining outcomes in patients undergoing surgery for colorectal cancer, a population that often presents with a higher disease burden and may require more complex surgical procedures. The fact that ERAS was able to significantly reduce hospital stay in this specific patient population underscores the broad applicability and effectiveness of these protocols.[11-14]

While the difference did not reach the conventional threshold for statistical significance ($p = 0.051$), the study observed a trend towards a lower incidence of postoperative complications in the ERAS group (0.7%) compared to the non-ERAS group (6.1%). Although this result requires cautious interpretation, the observed reduction in complications is clinically relevant and warrants careful consideration. Postoperative complications represent a significant source of morbidity and can substantially impact the patient's recovery trajectory, leading to prolonged hospitalization, increased healthcare costs, and a greater risk of adverse outcomes. The complications encountered in the non-ERAS group included superficial surgical site infections, anastomotic leak requiring reoperation, and postoperative ileus. Each of these complications carries its own set of challenges and potential consequences. Surgical site infections (SSIs) are among the most common healthcare-associated infections and can range in severity from superficial wound infections to deep infections involving the surgical site or surrounding tissues. SSIs can cause pain, delayed wound healing, and may require antibiotic treatment, further surgical intervention, and prolonged hospitalization. The ERAS protocol, with its emphasis on meticulous surgical technique, infection prevention measures, and early mobilization, aims to minimize the risk of SSIs. Anastomotic leak is a particularly serious complication following colorectal surgery. It occurs when the connection between two segments of the intestine fails to heal properly, leading to leakage of intestinal contents into the abdominal cavity. Anastomotic leaks can cause severe peritonitis, sepsis, and often require emergency reoperation, prolonged intensive care unit stays, and significant morbidity. The ERAS protocol, with its focus on optimizing fluid

management, ensuring adequate tissue perfusion, and promoting early mobilization, may contribute to improved anastomotic healing and a reduced risk of this devastating complication. Postoperative ileus is a condition characterized by a temporary impairment of bowel function following surgery. It can lead to abdominal distention, nausea, vomiting, and delayed return of normal bowel activity. In severe cases, postoperative ileus may require prolonged nasogastric decompression, nutritional support, and delayed oral intake. The ERAS protocol, with its emphasis on early oral feeding, early mobilization, and avoidance of prolonged opioid use, is designed to promote early return of bowel function and minimize the occurrence of postoperative ileus. The fact that the ERAS group experienced a lower incidence of these complications, even if not statistically significant at the $p < 0.05$ level, suggests that the multimodal interventions within the ERAS protocol may have played a role in mitigating postoperative adverse events. The ERAS protocol is designed to address many of the risk factors associated with these complications. Preoperative optimization, including nutritional support and patient education, prepares the patient for surgery and enhances their physiological reserve. Intraoperative management, such as minimally invasive surgical techniques, meticulous surgical technique, and optimized fluid management, minimizes surgical stress and promotes optimal tissue perfusion. Postoperative care, including early mobilization, early oral intake, and multimodal analgesia, facilitates recovery and reduces the risk of complications. It is important to acknowledge that the p-value of 0.051, while not conventionally significant, is very close to the threshold of significance. With a larger sample size, this difference might have reached statistical significance, providing stronger evidence for the benefit of ERAS in reducing postoperative complications. The relatively small sample size in the non-ERAS group (n=66) may have limited the power to detect a statistically significant difference, even if a clinically important difference existed. Furthermore, it is noteworthy that the single complication observed in the ERAS group was a superficial surgical site infection, which is generally considered less severe than the complications observed in the non-ERAS group, such as anastomotic leak requiring reoperation and postoperative ileus requiring prolonged nasogastric decompression. This difference in the severity of complications further underscores the potential benefit of ERAS in promoting a smoother postoperative recovery. The trend towards a lower complication rate in the ERAS group aligns with findings from other studies that have investigated the impact of ERAS protocols on postoperative outcomes. While some studies may have shown statistically significant reductions in specific complications, others have reported trends similar to those observed in this study. The overall body of evidence suggests that ERAS protocols are associated with a reduction in postoperative morbidity, even if the magnitude of this reduction may vary depending on the specific patient population and the specific ERAS protocol implemented. The potential clinical implications of a reduced complication rate with ERAS are substantial. Fewer complications translate to a smoother and faster recovery for patients, reduced need for additional interventions and treatments, and a decreased risk of long-term sequelae. This, in turn, contributes to improved patient satisfaction, reduced healthcare costs, and a more efficient use of healthcare resources.[15-17]

An important aspect of this study is the comparability of the baseline characteristics between the ERAS and non-ERAS groups. The statistical analysis revealed that there were no statistically significant differences between the two groups in terms of age, gender distribution, BMI, weight, height, proportion of elective surgeries, proportion of laparoscopic approaches, and surgery duration. This similarity between the two groups at baseline is crucial for the study's validity and strengthens the conclusions regarding the effectiveness of the ERAS protocol. When comparing the outcomes of different treatment approaches, it is essential to ensure that the groups being compared are similar in terms of factors

that could potentially influence those outcomes. If there are significant differences in baseline characteristics, it becomes difficult to determine whether observed differences in outcomes are due to the treatment itself or to pre-existing differences between the groups. In this study, the fact that the ERAS and non-ERAS groups were well-matched in terms of age, gender, BMI, and other demographic factors suggests that these variables did not significantly influence the observed differences in postoperative outcomes. Similarly, the comparable proportions of elective surgeries and laparoscopic approaches between the two groups indicate that the type and complexity of the surgical procedures were similar, minimizing the potential confounding effect of these factors. The similarity in surgical duration between the two groups further supports this notion. Surgical duration can be an indicator of the complexity and extent of the surgical procedure, and if there had been a significant difference in surgical duration between the groups, it could have potentially influenced postoperative recovery. However, the comparable surgical durations suggest that the surgical procedures were of similar complexity in both groups. While there was a slight difference in the average age between the two groups, with the ERAS group having a slightly younger average age, this difference was not statistically significant. Furthermore, the magnitude of the difference was relatively small and unlikely to have substantially influenced the primary outcomes, particularly the length of hospital stay and the incidence of complications. The comparability of the baseline characteristics between the two groups enhances the reliability and validity of the study's findings. It strengthens the argument that the ERAS protocol, rather than pre-existing differences in patient demographics or surgical procedures, is the primary factor influencing the observed differences in postoperative outcomes. This robust baseline comparison allows for a more confident interpretation of the results and supports the conclusion that ERAS protocols are effective in improving postoperative recovery following colorectal cancer surgery.[18-20]

4. Conclusion

In conclusion, this retrospective study demonstrates that the implementation of an ERAS protocol in colorectal cancer surgery is associated with significant benefits, most notably a reduction in the length of hospital stay. The ERAS group experienced a statistically significant shorter mean hospital stay compared to the non-ERAS group, highlighting the effectiveness of ERAS in facilitating a more rapid recovery and enabling earlier discharge. While not reaching statistical significance, there was also a clinically relevant trend towards a lower incidence of postoperative complications in the ERAS group. The comparability of baseline characteristics between the two groups strengthens the validity of these findings, suggesting that the observed improvements are attributable to the ERAS protocol rather than confounding factors. These results support the broader adoption of ERAS pathways as a standard of care in colorectal cancer surgery to enhance postoperative recovery, reduce healthcare costs associated with prolonged hospitalization, and ultimately improve overall patient outcomes. Further research with larger sample sizes may provide more definitive evidence regarding the impact of ERAS on specific postoperative complications.

5. References

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