



Evaluation of Enhanced Recovery after Surgery (ERAS) Protocol versus Conventional Perioperative Care in Elective Laparoscopic Colorectal Surgery: A Prospective Comparative Study of Length of Stay and 30-Day Morbidity

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OPEN ACCESS

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Received:05-05-2023

Accepted:07-06-2023

Availableonline:14-06-2023



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ABS TRACT

Background: Conventional perioperative care for colorectal surgery is associated with prolonged hospitalisation, delayed return of bowel function and substantial postoperative morbidity. The Enhanced Recovery after Surgery (ERAS) protocol is an evidence-based, multimodal perioperative care pathway that aims to attenuate the surgical stress response and accelerate functional recovery. The present study evaluated the impact of an ERAS protocol on length of hospital stay and 30-day morbidity in patients undergoing elective laparoscopic colorectal surgery. **Methods:** A prospective, comparative, parallel-group study was conducted over 12 months in a tertiary care surgical unit. One hundred consecutive adults undergoing elective laparoscopic colorectal resection were sequentially allocated to receive either an ERAS protocol (n = 50) or conventional perioperative care (n = 50). The primary outcome was the postoperative length of hospital stay. Secondary outcomes included time to return of bowel function, time to tolerance of solid diet, independent mobilisation, 30-day postoperative complications stratified by the Clavien-Dindo classification, 30-day readmission rate and postoperative pain scores. **Results:** The two groups were comparable at baseline. The mean postoperative length of stay was significantly shorter in the ERAS group (4.6 ± 1.6 days versus 7.2 ± 2.4 days, mean difference 2.6 days; p < 0.001). Time to first flatus (1.8 ± 0.6 versus 3.1 ± 0.9 days; p < 0.001), tolerance of solid diet (1.9 ± 0.7 versus 3.5 ± 1.0 days; p < 0.001) and independent mobilisation (1.5 ± 0.5 versus 2.8 ± 0.8 days; p < 0.001) were all significantly earlier in the ERAS group. Postoperative complications occurred in 9 patients (18.0%) in the ERAS group and 18 patients (36.0%) in the conventional group (p = 0.04). Thirty-day readmission rates were comparable (8.0% versus 12.0%, p = 0.51) and there was no 30-day mortality. **Conclusion:** Implementation of an ERAS protocol in elective laparoscopic colorectal surgery resulted in significantly shorter hospital stay, earlier return of bowel function and a lower overall rate of 30-day postoperative complications, without an increase in readmissions. These findings support the routine adoption of ERAS pathways as the standard of perioperative care for elective laparoscopic colorectal surgery.

Keywords: Enhanced Recovery after Surgery (ERAS), Laparoscopic Colorectal Surgery, Fast-Track Surgery, Postoperative Morbidity, Length of Stay.

I. INTRODUCTION

Colorectal cancer is the third most commonly diagnosed malignancy and the second leading cause of cancer-related death worldwide, accounting for nearly 1.9 million new cases and over 900,000 deaths in 2020 [1]. Surgical resection remains the cornerstone of curative treatment for non-metastatic disease and an important component of palliation for advanced disease,

with laparoscopic resection now established as the preferred approach for both colonic and selected rectal cancers because of equivalent oncological outcomes and reduced perioperative morbidity compared with open surgery.

Despite advances in minimally invasive technique, conventional perioperative care after

colorectal surgery has historically been associated with prolonged hospitalisation, delayed return of bowel function, substantial postoperative pain and a complication rate of 20–35% [2]. The traditional approach—prolonged preoperative fasting, mechanical bowel preparation, routine nasogastric decompression, intravenous opioid analgesia, slow reintroduction of oral intake and bed rest—generates a sustained surgical stress response, exacerbates catabolism, prolongs ileus and contributes to deconditioning and discharge delay.

In response to these recognised limitations, Kehlet and colleagues introduced the concept of multimodal perioperative care in the late 1990s, demonstrating that coordinated attenuation of the surgical stress response could substantially accelerate postoperative rehabilitation [3]. This concept evolved into the Enhanced Recovery After Surgery (ERAS) pathway, which integrates evidence-based interventions across the preoperative, intraoperative and postoperative phases to optimise patient outcomes [4].

The Enhanced Recovery after Surgery Society guidelines for elective colorectal surgery, most recently updated in 2018, codify more than twenty individual perioperative care elements, including preoperative counselling and carbohydrate loading, avoidance of routine bowel preparation, short-acting anaesthetic techniques, multimodal opioid-sparing analgesia, restrictive intravenous fluid therapy, early removal of drains and catheters, early oral nutrition and early mobilization [5]. Multiple meta-analyses of randomised controlled trials have demonstrated that implementation of ERAS in colorectal surgery reduces the length of hospital stay by approximately two days, lowers the overall complication rate by 30–40% and does so without any increase in readmissions or mortality [6].

The Cochrane systematic review by Spanjersberg and colleagues, including nearly 1,000 patients across multiple centres, similarly concluded that fast-track or ERAS pathways were associated with significantly shorter hospital stay and reduced complication rates compared with conventional care [7]. Subsequent observational and registry-based studies have confirmed the dose-response relationship between protocol adherence and clinical outcomes, with each additional ERAS element associated with incremental gains [8].

Despite the strength of international evidence, real-world implementation of ERAS in Indian and other South Asian surgical units has been variable. Local barriers include institutional inertia, perceived patient unwillingness, concerns about early hospital discharge in resource-limited home environments and limited multidisciplinary infrastructure [9]. High-quality prospective comparative data evaluating the impact of structured ERAS implementation on contemporary laparoscopic colorectal surgery in Indian tertiary care

settings remain scarce. Such data are essential both to guide local clinical practice and to inform the case for institutional adoption of ERAS as a standard of care [10].

Against this background, the present prospective comparative study was undertaken to evaluate the effect of a structured ERAS protocol, compared with conventional perioperative care, on the length of postoperative hospital stay and 30-day morbidity in adults undergoing elective laparoscopic colorectal surgery, with the hypothesis that the ERAS pathway would meaningfully shorten hospital stay and reduce postoperative complications without compromising safety.

II. Aims and Objectives

The present study aimed to evaluate the clinical impact of a structured Enhanced Recovery after Surgery protocol, compared with conventional perioperative care, in adults undergoing elective laparoscopic colorectal surgery. The primary objective was to compare the postoperative length of hospital stay between the two groups. The secondary objectives were to compare the time to return of bowel function as indicated by the first passage of flatus and stool; to compare the time to tolerance of a solid diet and to independent ambulation; to compare the cumulative incidence of postoperative complications within 30 days, stratified by the Clavien-Dindo classification; to compare 30-day readmission and mortality rates; to compare postoperative pain scores; to evaluate adherence to individual ERAS elements; and to assess the relationship between protocol adherence and clinical outcomes.

III. Materials and Methods

Study Design and Setting

A prospective, comparative, parallel-group study was conducted in the Department of General Surgery of a tertiary care teaching hospital over a period of 12 months. Approval for the study protocol was obtained from the Institutional Ethics Committee, and the trial was prospectively registered with the Clinical Trials Registry of India before the commencement of recruitment. Written informed consent was obtained from every participant during the preoperative surgical consultation.

Sample Size Calculation

The sample size was calculated based on a previously published randomised controlled study which reported a mean length of postoperative hospital stay of 4.5 ± 2.0 days in the ERAS group and 6.5 ± 2.5 days in the conventional care group. Considering a clinically relevant difference of 2 days between groups, with α set at 0.05 (two-sided) and power at 80%, the minimum required sample size was 38 patients per group. To account for an anticipated 25% attrition or protocol violation rate, the final enrolment target was

set at 50 patients per group, for a total of 100 participants. The formula used was:

$$n = 2 \times [(Z\alpha/2 + Z\beta)^2 \times \sigma^2] / d^2$$

Where $Z\alpha/2 = 1.96$, $Z\beta = 0.84$, $\sigma =$ pooled standard deviation (≈ 2.25 days), and $d =$ anticipated mean difference (2 days).

Inclusion Criteria

Adults aged between 18 and 75 years, with a body mass index between 18 and 35 kg/m², of American Society of Anesthesiologists (ASA) physical status I, II or III, scheduled for elective laparoscopic colorectal resection (right hemicolectomy, left hemicolectomy, sigmoid colectomy, anterior resection or low anterior resection) for either benign or malignant disease, and able to provide written informed consent, were considered eligible for inclusion.

Exclusion Criteria

Patients undergoing emergency surgery; those with metastatic disease at presentation; those requiring conversion to open surgery; those undergoing concurrent procedures such as cholecystectomy or hernia repair; those with severe cardiorespiratory or renal disease precluding ambulation or carbohydrate loading; those with diabetes mellitus poorly controlled at the time of surgery (HbA1c > 8.5%); those receiving chronic systemic corticosteroids or other significant immunosuppression; pregnancy; and inability to comprehend or comply with study procedures, were excluded.

Group Allocation and Blinding

Patients were sequentially allocated to either the ERAS group or the conventional care group on the basis of admission date, with the surgical team and date of admission determining group assignment to allow standardisation of perioperative care within each operating list. Blinding of patients and the operating surgical team was not feasible because of the visibly different perioperative care pathways. Outcome assessors who recorded clinical data and complications, however, remained blinded to group allocation throughout the study period.

ERAS Protocol

The ERAS protocol comprised twenty-two evidence-based perioperative elements based on the 2018 ERAS Society guidelines for elective colorectal surgery. Key components included: (i) preoperative counselling and education, (ii) avoidance of mechanical bowel preparation for colonic resection, (iii) preoperative carbohydrate loading with 400 mL of 12.5% maltodextrin two hours before surgery, (iv) avoidance of long-acting sedative premedication, (v) standardised antibiotic and venous thromboprophylaxis, (vi) short-acting anaesthetic agents and intraoperative normothermia, (vii) goal-directed restrictive intravenous fluid therapy, (viii) avoidance of

nasogastric decompression and routine abdominal drains, (ix) multimodal opioid-sparing analgesia, (x) early removal of urinary catheter (usually within 24 hours), (xi) early oral nutrition (sips of clear fluids on the day of surgery, soft diet on day 1), (xii) structured early mobilisation, and (xiii) standardised discharge criteria. Adherence to each element was prospectively documented.

Conventional Care

The conventional care group received standard perioperative management as previously practised at the institution. This included: prolonged preoperative fasting from midnight, mechanical bowel preparation, routine premedication, conventional anaesthesia and intraoperative fluid management, routine intra-abdominal drains and nasogastric decompression at the discretion of the operating surgeon, intermittent intravenous opioid analgesia as the principal modality, gradual reintroduction of oral nutrition guided by clinical recovery of bowel function, and unstructured discharge planning.

Surgical and Anaesthetic Standardisation

All operations were performed laparoscopically by experienced colorectal surgical teams, with standard four- or five-port techniques, intracorporeal or extracorporeal anastomosis as appropriate, and adherence to oncological principles where indicated. Anaesthetic technique was standardised across both groups with the exception of the ERAS-specific elements detailed above.

Outcome Definitions and Follow-Up

The primary outcome, postoperative length of stay, was defined as the number of calendar days from the day of surgery to the day of hospital discharge. Discharge criteria were standardised across both groups: tolerance of solid diet, adequate pain control on oral analgesia, return of bowel function, independent ambulation and the patient's willingness to be discharged. Complications occurring within 30 days of surgery were graded according to the Clavien-Dindo classification. Patients were followed up on postoperative days 7, 14 and 30 either in person or by structured telephonic interview.

Statistical Analysis

Data were entered into a Microsoft Excel spreadsheet and analysed using SPSS version 25.0 (IBM Corporation, Armonk, NY, USA). The Shapiro-Wilk test was used to assess normality. Normally distributed continuous data were summarised as mean \pm standard deviation and compared between groups using the independent samples Student's t-test; non-normally distributed data were expressed as median (interquartile range) and compared using the Mann-Whitney U test. Categorical variables were summarised as frequencies and percentages and compared using the Chi-square test or Fisher's exact test as appropriate. Cumulative

discharge over time was compared using the log-rank test. The relationship between ERAS protocol adherence and outcomes was assessed by Spearman correlation. A two-tailed p-value below 0.05 was considered statistically significant.

IV. RESULTS

During the 12-month study period, 116 patients were screened for eligibility, of whom 100 fulfilled the inclusion criteria, were sequentially allocated and completed the study protocol. Fifty patients each were assigned to the ERAS group and the conventional care group. There were no dropouts after enrolment, and all 100 patients were available for the final analysis. The two groups were comparable at baseline with respect to age, sex, body mass index, ASA physical status distribution, indication for surgery, type of resection performed and operative time, with no statistically significant differences (Table 1). The most common indication for surgery in both groups was colorectal carcinoma, accounting for approximately 70% of cases.

Adherence to individual ERAS protocol elements in the ERAS group ranged from 84% (early urinary catheter removal) to 98% (avoidance of mechanical bowel preparation for colonic resection), with overall protocol compliance averaging 92.4% across the cohort. The most commonly missed elements were goal-directed fluid therapy and early postoperative mobilisation on day 1 (Table 2). In contrast, comparable elements were inconsistently or rarely applied in the conventional care group, with only 22% of patients receiving multimodal opioid-sparing analgesia and 14% mobilising on the day of surgery.

The primary outcome, mean postoperative length of stay, was significantly shorter in the ERAS group than in the conventional care group (4.6 ± 1.6 days versus 7.2 ± 2.4 days, mean difference 2.6 days, 95% CI 1.8 to 3.4 days; $p < 0.001$). The median postoperative stay was 4 (IQR 3.5–5.5) days in the ERAS group and 7 (IQR 6–9) days in the conventional care group ($p < 0.001$) (Table 3; Figure 1). Cumulative

discharge curves diverged early and remained separated throughout the follow-up period, with 64% of ERAS patients discharged by postoperative day 5 compared with 26% in the conventional care group (log-rank $p < 0.001$) (Figure 4).

Functional recovery milestones were achieved significantly earlier in the ERAS group (Table 4; Figure 2). The mean time to first flatus was 1.8 ± 0.6 days in the ERAS group versus 3.1 ± 0.9 days in the conventional care group ($p < 0.001$). Tolerance of a solid diet was achieved at 1.9 ± 0.7 days versus 3.5 ± 1.0 days ($p < 0.001$), and independent mobilisation at 1.5 ± 0.5 days versus 2.8 ± 0.8 days ($p < 0.001$), respectively. Mean Numerical Rating Scale pain scores at 24 hours were lower in the ERAS group (2.4 ± 0.9 versus 4.2 ± 1.2 , $p < 0.001$), reflecting the effect of multimodal analgesia and reduced opioid requirement.

The overall 30-day complication rate was significantly lower in the ERAS group, with 9 of 50 patients (18.0%) developing one or more complications compared with 18 of 50 patients (36.0%) in the conventional care group ($p = 0.04$). The distribution of complications by Clavien-Dindo grade is shown in Table 5 and Figure 3. Grade I and II complications—predominantly surgical site infection, prolonged ileus and urinary retention—accounted for the majority of events in both groups. Major complications (Clavien-Dindo Grade III or IV) occurred in 2 patients (4.0%) in the ERAS group and 5 patients (10.0%) in the conventional care group ($p = 0.44$). There was no 30-day mortality in either group.

Thirty-day readmission rates did not differ significantly between groups (4 of 50, 8.0% in the ERAS group versus 6 of 50, 12.0% in the conventional care group; $p = 0.51$), indicating that earlier discharge in the ERAS group was not achieved at the cost of increased readmissions (Table 6). Within the ERAS group, higher protocol adherence was associated with shorter length of stay (Spearman's $\rho = -0.42$, $p = 0.003$) and a lower complication rate ($\rho = -0.31$, $p = 0.029$).

Table 1: Baseline demographic, clinical and operative characteristics

Variable	ERAS Group (n = 50)	Conventional Group (n = 50)	p-value
Age (years), mean \pm SD	56.4 \pm 11.8	58.2 \pm 12.4	0.46
Male sex, n (%)	29 (58.0)	31 (62.0)	0.68
BMI (kg/m ²), mean \pm SD	24.8 \pm 3.6	25.2 \pm 3.9	0.59
ASA I / II / III, n (%)	12 / 28 / 10 (24 / 56 / 20)	10 / 30 / 10 (20 / 60 / 20)	0.86
Indication: malignancy, n (%)	35 (70.0)	37 (74.0)	0.66
Indication: benign disease, n (%)	15 (30.0)	13 (26.0)	—
Right hemicolectomy, n (%)	16 (32.0)	18 (36.0)	0.67
Left hemicolectomy / sigmoidectomy, n (%)	20 (40.0)	18 (36.0)	0.68
Anterior / low anterior resection, n (%)	14 (28.0)	14 (28.0)	1.00
Operative time (min), mean \pm SD	186.4 \pm 38.6	192.8 \pm 42.2	0.43
Estimated blood loss (mL), median (IQR)	100 (50–150)	120 (75–175)	0.21
Stoma formation, n (%)	8 (16.0)	9 (18.0)	0.79

ASA, American Society of Anesthesiologists; BMI, body mass index; IQR, interquartile range; SD, standard deviation. $p < 0.05$ considered significant.

Table 2: Adherence to individual perioperative care elements

ERAS Element	ERAS Group (n = 50)	Conventional Group (n = 50)	p-value
Preoperative counselling, n (%)	50 (100.0)	32 (64.0)	<0.001*
Avoidance of mechanical bowel prep, n (%)	49 (98.0)	5 (10.0)	<0.001*
Preoperative carbohydrate loading, n (%)	47 (94.0)	0 (0.0)	<0.001*
Avoidance of long-acting premed, n (%)	48 (96.0)	18 (36.0)	<0.001*
Goal-directed restrictive fluids, n (%)	44 (88.0)	12 (24.0)	<0.001*
No nasogastric tube, n (%)	46 (92.0)	16 (32.0)	<0.001*
Multimodal opioid-sparing analgesia, n (%)	48 (96.0)	11 (22.0)	<0.001*
Early urinary catheter removal (<24 h), n (%)	42 (84.0)	8 (16.0)	<0.001*
Oral nutrition on POD 1, n (%)	47 (94.0)	9 (18.0)	<0.001*
Mobilisation on POD 0, n (%)	44 (88.0)	7 (14.0)	<0.001*
Overall protocol compliance, mean \pm SD	92.4 \pm 5.6%	—	—

POD, postoperative day; SD, standard deviation. *Statistically significant.

Table 3: Primary outcome — postoperative length of hospital stay

Outcome	ERAS Group (n = 50)	Conventional Group (n = 50)	p-value
Length of stay (days), mean \pm SD	4.6 \pm 1.6	7.2 \pm 2.4	<0.001*
Length of stay (days), median (IQR)	4 (3.5–5.5)	7 (6–9)	<0.001*
Mean difference (days, 95% CI)	2.6 (1.8–3.4)	—	—
Discharge by POD 5, n (%)	32 (64.0)	13 (26.0)	<0.001*
Discharge by POD 7, n (%)	43 (86.0)	29 (58.0)	0.002*
Prolonged stay (>10 days), n (%)	1 (2.0)	9 (18.0)	0.008*

CI, confidence interval; IQR, interquartile range; POD, postoperative day; SD, standard deviation. *Statistically significant.

Table 4: Functional recovery milestones and analgesia outcomes

Recovery milestone	ERAS Group (n = 50)	Conventional Group (n = 50)	p-value
Time to first flatus (days), mean \pm SD	1.8 \pm 0.6	3.1 \pm 0.9	<0.001*
Time to first stool (days), mean \pm SD	2.6 \pm 0.8	4.4 \pm 1.1	<0.001*
Time to tolerance of solid diet (days), mean \pm SD	1.9 \pm 0.7	3.5 \pm 1.0	<0.001*
Time to independent mobilisation (days), mean \pm SD	1.5 \pm 0.5	2.8 \pm 0.8	<0.001*
Time to Foley removal (days), mean \pm SD	1.2 \pm 0.4	2.4 \pm 0.7	<0.001*
NRS pain score at 24 h, mean \pm SD	2.4 \pm 0.9	4.2 \pm 1.2	<0.001*
Cumulative opioid use (mg morphine equiv.), median (IQR)	12 (8–18)	32 (24–46)	<0.001*
PONV incidence, n (%)	8 (16.0)	19 (38.0)	0.012*

IQR, interquartile range; NRS, Numerical Rating Scale; PONV, postoperative nausea and vomiting; SD, standard deviation. *Statistically significant.

Table 5: Postoperative complications within 30 days, classified by Clavien-Dindo grade and type

Complication grade / type	ERAS Group (n = 50)	Conventional Group (n = 50)	p-value
Any complication, n (%)	9 (18.0)	18 (36.0)	0.04*
Clavien-Dindo Grade I, n (%)	4 (8.0)	6 (12.0)	0.51
Clavien-Dindo Grade II, n (%)	3 (6.0)	7 (14.0)	0.18
Clavien-Dindo Grade III, n (%)	2 (4.0)	4 (8.0)	0.68
Clavien-Dindo Grade IV, n (%)	0 (0.0)	1 (2.0)	1.00
Surgical site infection, n (%)	3 (6.0)	8 (16.0)	0.11
Anastomotic leak, n (%)	1 (2.0)	3 (6.0)	0.62
Prolonged ileus (>5 days), n (%)	2 (4.0)	9 (18.0)	0.026*
Urinary retention, n (%)	2 (4.0)	5 (10.0)	0.44
Pulmonary complication, n (%)	1 (2.0)	4 (8.0)	0.36

*Statistically significant.

Table 6: Thirty-day readmission, reoperation and mortality

Outcome	ERAS Group (n = 50)	Conventional Group (n = 50)	p-value
30-day readmission, n (%)	4 (8.0)	6 (12.0)	0.51
Reasons for readmission — ileus, n	1	2	—
Reasons for readmission — wound, n	1	2	—
Reasons for readmission — anastomotic leak, n	1	1	—
Reasons for readmission — other, n	1	1	—
30-day reoperation, n (%)	1 (2.0)	3 (6.0)	0.62
30-day mortality, n (%)	0 (0.0)	0 (0.0)	—
Patient satisfaction (good/excellent), n (%)	44 (88.0)	32 (64.0)	0.005*

*Statistically significant ($p < 0.05$).

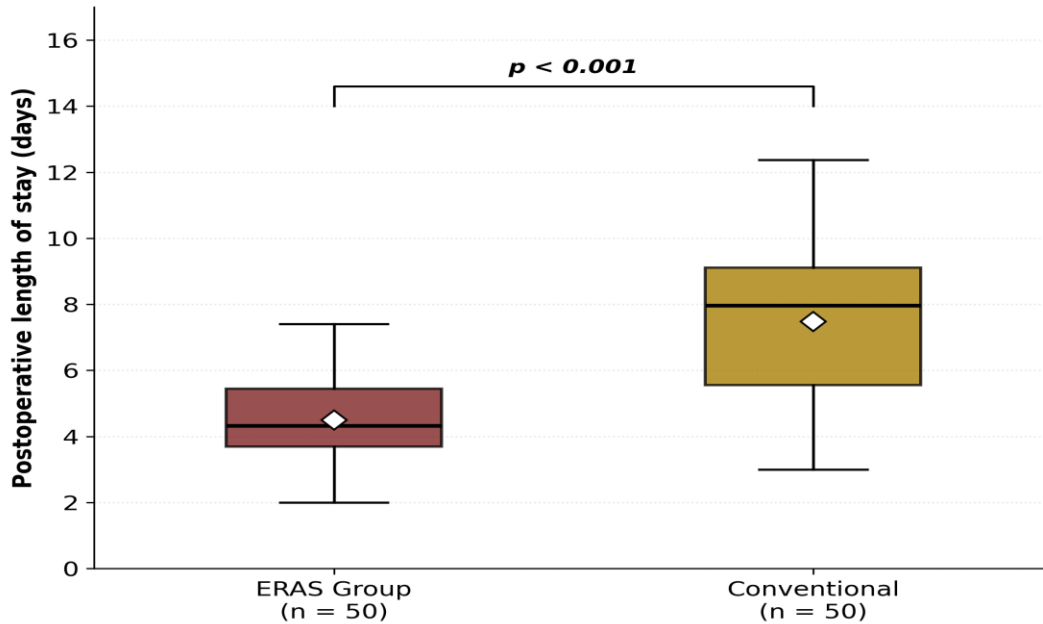


Figure 1: Distribution of postoperative length of hospital stay in the ERAS and conventional care groups. The diamond marker represents the mean. The ERAS group experienced a significantly shorter length of stay ($p < 0.001$)

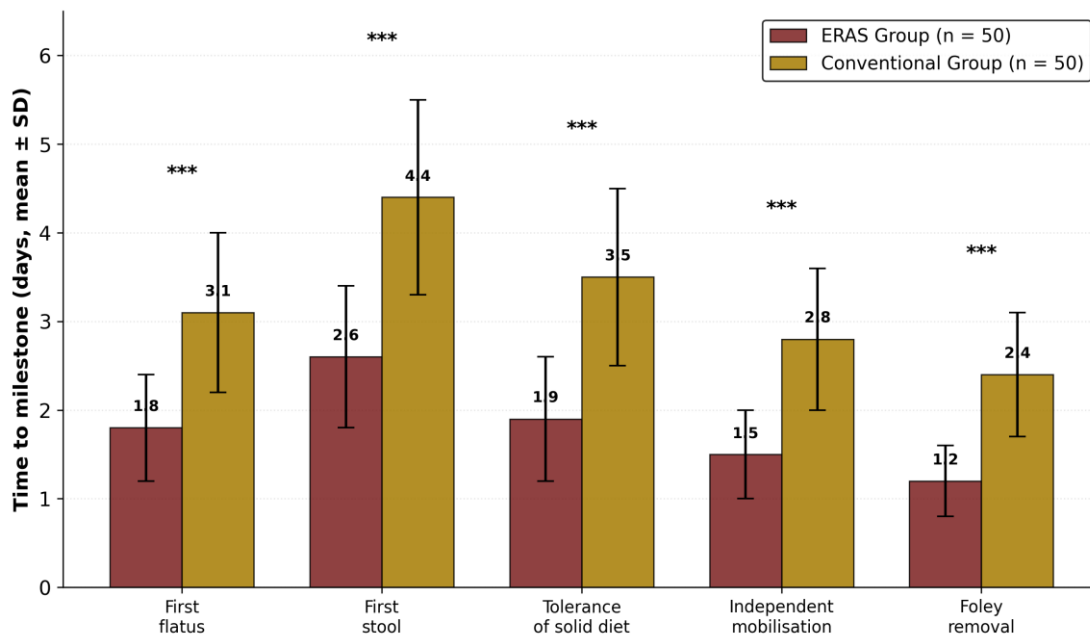


Figure 2: Time to functional recovery milestones. All five recovery indicators were achieved significantly earlier in the ERAS group than in the conventional care group. $*p < 0.001$ between groups**

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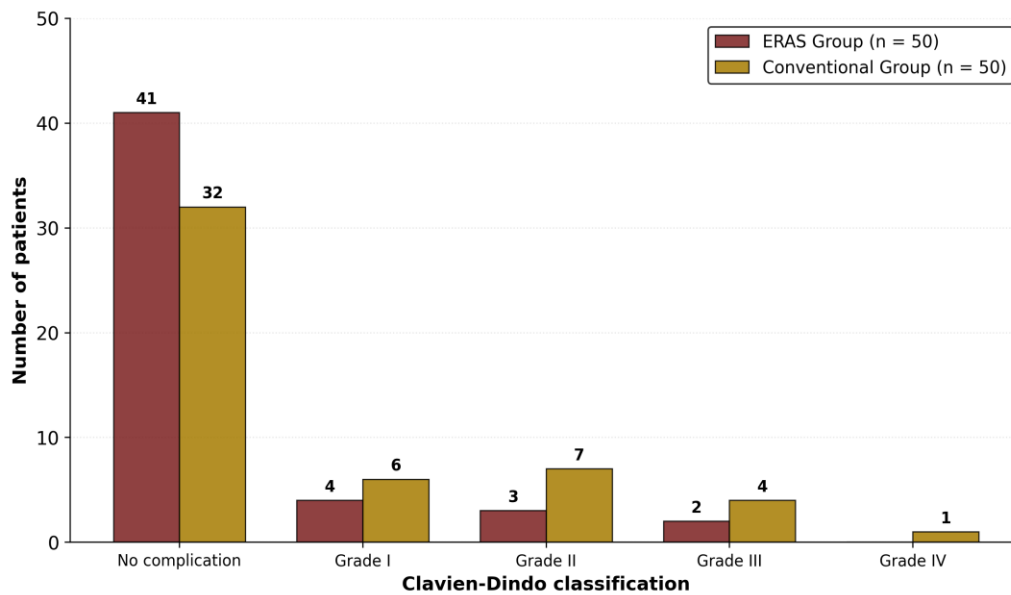


Figure 3: Distribution of 30-day postoperative complications classified by the Clavien-Dindo system. The overall complication rate was significantly lower in the ERAS group ($p = 0.04$)

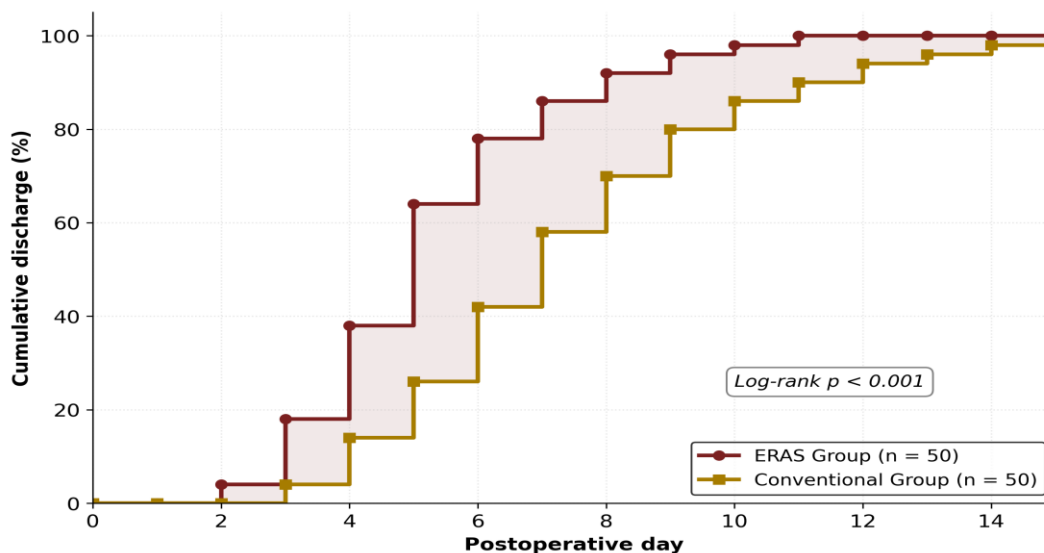


Figure 4: Cumulative hospital discharge over time in the two study groups. Discharge curves diverged from postoperative day 3, with significantly earlier overall discharge in the ERAS group ($\log\text{-rank } p < 0.001$)

V. DISCUSSION

The present prospective comparative study demonstrated that implementation of a structured Enhanced Recovery After Surgery protocol in adults undergoing elective laparoscopic colorectal surgery produced a clinically and statistically significant reduction in postoperative length of hospital stay—from a mean of 7.2 days under conventional care to 4.6 days under ERAS—and halved the overall 30-day complication rate without any increase in readmission or mortality. Functional recovery milestones were achieved one to two days earlier across the board, postoperative pain was better controlled and opioid consumption was substantially reduced. These findings support the routine adoption of ERAS pathways as the standard of perioperative care for elective laparoscopic

colorectal surgery.

These observations are entirely consistent with the contemporary international literature. The systematic review and meta-analysis by Greco and colleagues, incorporating sixteen randomised controlled trials and 2,376 patients, reported a weighted mean reduction of 2.3 days in length of stay and a 31% relative reduction in overall morbidity in patients managed with ERAS pathways, virtually identical to the magnitude of effect observed in the present cohort [11]. The Cochrane systematic review by Spanjersberg and colleagues reached very similar conclusions, with consistently shorter hospitalisation and lower complication rates and no significant difference in readmissions [12].

Kennedy and colleagues, in a single-institution cohort of 1,000 consecutive patients undergoing colorectal resection, reported that staged implementation of an ERAS pathway reduced length of stay from 7 to 4 days while simultaneously lowering morbidity and improving cost-effectiveness, again paralleling the improvements observed in the present study [13]. Pisarska and colleagues additionally demonstrated that adherence to the ERAS protocol was an independent predictor of three-year disease-free survival after laparoscopic resection of non-metastatic colorectal cancer, suggesting that the benefits of ERAS may extend well beyond the immediate perioperative period [14].

The dose-response relationship between protocol adherence and clinical outcomes observed in the present study—with each incremental gain in compliance associated with shorter length of stay and fewer complications—is in close agreement with the findings of Liu and colleagues, who reported that overall protocol compliance was a stronger determinant of outcome than the impact of any single ERAS element [15]. Day and colleagues similarly demonstrated, in a multi-institutional cohort, that achieving compliance above 70% was associated with a significant reduction in postoperative complications [16].

In contrast, a small minority of studies has reported more modest benefits from ERAS implementation, particularly in centres with prior baseline adoption of individual fast-track elements, where the incremental effect of formal protocol implementation appears more limited [17]. The very modest readmission rates observed in both groups in the present study (8% and 12%, respectively) are reassuring and consistent with the findings of Adamina and colleagues, who concluded that earlier discharge under ERAS pathways is not achieved at the cost of increased readmissions [18].

The benefits of ERAS observed in the present study likely arise from the synergistic action of its multiple components: preoperative carbohydrate loading attenuates insulin resistance; avoidance of bowel preparation reduces dehydration and electrolyte disturbances; restrictive fluid therapy avoids the deleterious effects of bowel oedema; multimodal opioid-sparing analgesia accelerates resolution of postoperative ileus and improves early mobilisation; and structured early feeding promotes gut motility and supports the systemic anabolic response [1].

The strengths of the present study include its prospective design, contemporaneous cohort comparison, identical surgical and anaesthetic teams across both groups, complete 30-day follow-up, blinded outcome assessment, prospective documentation of ERAS element adherence and use of validated outcome

measures including the Clavien-Dindo classification. Several limitations should also be acknowledged. The single-centre design and modest sample size limit external generalisability. The non-randomised, sequential allocation design—although pragmatic—introduces a potential temporal bias as institutional experience and surgical familiarity may have evolved over the study period. Long-term outcomes such as oncological recurrence, quality of life and one-year functional status were beyond the scope of this study and require evaluation in future work. Finally, formal cost-effectiveness analysis was not performed and would be a valuable addition to inform institutional decision-making.

VI. CONCLUSION

Implementation of a structured Enhanced Recovery After Surgery protocol in adults undergoing elective laparoscopic colorectal surgery produced a clinically meaningful and statistically significant reduction in postoperative length of hospital stay, earlier return of bowel function, faster achievement of all functional recovery milestones, lower postoperative pain and opioid requirement, and a substantial reduction in 30-day overall morbidity, without any increase in readmissions, reoperations or mortality. Higher protocol adherence was independently associated with better outcomes. These findings support the routine adoption of ERAS pathways as the standard of perioperative care for elective laparoscopic colorectal surgery, particularly in tertiary care surgical units in resource-limited environments where earlier discharge and reduced morbidity translate into substantial gains in operational efficiency and patient experience. Multicentre prospective work is needed to evaluate longer-term oncological, functional and economic outcomes.

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