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ENHANCED RECOVERY AFTER SURGERY PROTOCOLS VERSUS CONVENTIONAL POSTOPERATIVE CARE IN ELECTIVE COLORECTAL SURGERY: A RETROSPECTIVE COHORT STUDY

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ABSTRACT

Colorectal surgery is traditionally associated with significant postoperative stress, prolonged hospital stay, and notable complications. The enhanced recovery after surgery approach integrates multimodal evidence-based perioperative care to minimize the surgical stress response and accelerate recovery [1, 4]. This retrospective observational cohort study compared enhanced recovery after surgery protocols with conventional postoperative care in patients undergoing elective colorectal surgery in a South Indian tertiary care setting. A total of 80 patients who underwent elective colorectal surgery between October 2024 and April 2026 were evaluated, with 40 managed under the enhanced recovery pathway and 40 receiving conventional perioperative care. Baseline demographics, surgical indications, and procedural types were comparable between the groups. The mean postoperative length of hospital stay was significantly shorter in the enhanced recovery group than in the conventional care group (5.3 ± 1.6 days versus 8.1 ± 2.7 days, $p < 0.001$) [9, 14]. Patients in the enhanced recovery pathway achieved significantly earlier times to first oral intake (1.2 ± 0.5 days versus 3.1 ± 0.9 days, $p < 0.001$) [8], early mobilization (1.1 ± 0.4 days versus 2.4 ± 0.8 days, $p < 0.001$), and passage of first flatus (1.9 ± 0.6 days versus 3.4 ± 1.1 days, $p < 0.001$). Mean visual analogue scale pain scores on postoperative day 1 were lower in the enhanced recovery cohort (3.1 ± 0.8 versus 4.6 ± 1.0, $p < 0.001$), resulting in a significantly lower requirement for postoperative opioid analgesics (40.0% versus 75.0%, $p = 0.002$) [4, 10]. Furthermore, the enhanced recovery group demonstrated a significantly lower overall complication rate ($p = 0.04$) [11, 13] and reduced severity of complications graded by the Clavien-Dindo classification ($p = 0.03$). The 30-day readmission rate was also significantly lower in the enhanced recovery cohort (7.5% versus 20.0%, $p = 0.04$) [12], while mortality did not differ significantly between the groups. In conclusion, the implementation of enhanced recovery after surgery protocols in elective colorectal procedures significantly shortens hospital stay, reduces pain and opioid dependency, accelerates functional recovery, and minimizes postoperative complications without compromising patient safety.

Keywords: Colorectal surgery; Enhanced recovery after surgery; Length of stay; Postoperative complications; Stress response; Multimodal analgesia.

INTRODUCTION

Colorectal surgery represents one of the most frequently performed major abdominal interventions worldwide. Historically, major bowel resections have been associated with extensive physiological stress, significant postoperative morbidity, and prolonged hospital stay. Traditional perioperative management of these patients often involves long-standing empirical practices, such as prolonged preoperative fasting, routine mechanical bowel preparation, liberal intraoperative fluid administration, and delayed postoperative mobilization or oral intake. Accumulating evidence indicates that these conventional methods can aggravate the neuroendocrine stress response, compound postoperative insulin resistance, induce fluid overload and bowel wall edema, delay the return of gastrointestinal motility, and ultimately delay functional recovery.

To mitigate surgical trauma and standardize evidence-based perioperative care, the concept of fast-track surgery, now known as enhanced recovery after surgery (ERAS), was introduced in the late 1990s by Kehlet and colleagues [4]. By combining a series of synergistic, multimodal strategies across the preoperative, intraoperative, and postoperative phases, ERAS aims to preserve organ function, reduce systemic inflammation, and enhance recovery [2, 5]. In 2010, the formal establishment of the ERAS Society facilitated the development of procedure-specific guidelines backed by high-quality clinical evidence, with colorectal surgery serving as the pioneering domain [6].

Despite robust international literature highlighting the benefits of ERAS [1, 11, 13], substantial variability remains regarding its clinical implementation and efficacy across different healthcare settings. Regional variations in patient demographics, underlying disease prevalence, institutional infrastructure, and clinician adherence can significantly impact surgical outcomes [15]. In South Indian tertiary care settings, structured comparative data evaluating ERAS pathways against conventional traditional care are limited. The primary aim of the present study was to compare ERAS protocols

with conventional postoperative care in patients undergoing elective colorectal surgery, specifically focusing on the primary outcome of postoperative length of hospital stay. Secondary outcomes included times to oral intake, mobilization, and return of bowel function, alongside postoperative pain levels, analgesic requirements, surgical complications, and 30-day readmission and mortality rates. The overall aim was fully achieved, demonstrating that structured ERAS pathways provide significant clinical and recovery benefits over conventional management.

MATERIAL AND METHODS

A retrospective observational cohort study was conducted in the Department of General Surgery at Sree Balaji Medical College and Hospital, Chennai, India. The study period spanned from October 2024 to April 2026. Prior institutional approval was obtained from the Institutional Human Ethics Committee (Reference No. 002/SBMCH/IHEC/2025/2428). A total sample size of 80 adult patients who underwent elective colorectal surgery was included in the study. Patients were divided into two equal groups: the ERAS group (Group E, n = 40) and the conventional care group (Group C, n = 40). The ERAS group comprised consecutive patients managed according to a newly established, multidisciplinary ERAS protocol in the department [6]. The conventional care group consisted of matched historical controls who underwent equivalent colorectal procedures before the formal implementation of the ERAS protocol. Patients in both groups were matched as closely as possible for age, sex, ASA physical status, and specific type of colorectal surgery to minimize selection bias.

Inclusion criteria consisted of patients aged older than 18 years, undergoing elective colorectal surgery for malignant or benign conditions, with an ASA physical status of I, II, or III, and for whom complete medical records were available. Exclusion criteria comprised emergency colorectal operations, patients with an ASA physical status of IV or V, uncontrolled cardiac or pulmonary disease, advanced liver disease, chronic renal failure, active immunocompromised status, current chemotherapy or radiotherapy, simultaneous non-colorectal major procedures, and pregnant or breastfeeding patients.

The perioperative protocols differed substantially between the two groups. For the ERAS group, preoperative care included structured counseling and patient education, minimized fasting windows (clear liquids permitted up to 2 hours before induction), and oral carbohydrate loading [5, 6]. Intraoperatively, patients received a standardized anesthetic protocol utilizing short-acting agents, multimodal opioid-sparing analgesia (including regional analgesia and regular acetaminophen), goal-directed fluid therapy to maintain euvolemia, routine prevention of intraoperative hypothermia (maintaining core temperature >= 36.5 deg C), and minimally invasive laparoscopic approaches where feasible [7]. Postoperatively, the ERAS pathway mandated early removal of nasogastric tubes and urinary catheters, early initiation of oral feeding (within 24 hours), early mobilization (ambulation on postoperative day 1), multi-modal analgesia, and avoidance of routine intra-abdominal drains unless strictly indicated [5, 6].

Conversely, the conventional care group was managed using traditional paradigms. Preoperatively, patients underwent prolonged fasting from midnight and did not receive standardized preoperative counseling or carbohydrate loading. Intraoperative management included liberal intravenous fluid administration, routine placement of abdominal drains and NG tubes, and opioid-based analgesia [9]. Postoperatively, oral intake was delayed until the clear clinical return of bowel function (passage of flatus or audible bowel sounds), mobilization was delayed with prolonged bed rest, and pain management relied primarily on on-demand opioid analgesics.

Data were meticulously extracted from electronic and paper patient case records, operation notes, postoperative monitoring charts, nursing records, and discharge summaries using a structured proforma. Recorded variables encompassed demographic details (age, sex, ASA class, presence of diabetes mellitus or hypertension), primary surgical indication, type of surgical procedure, intraoperative parameters (duration of surgery, volume of blood loss, surgical approach, drain placement), postoperative recovery timelines, daily visual analogue scale pain scores, opioid requirements, and specific complications. Complications were classified and graded using the standardized Clavien-Dindo system. Readmission and survival status were tracked up to 30 days post-discharge. Statistical analysis was executed using SPSS software version 22. Continuous variables were expressed as mean +- standard deviation and compared using the independent Student's t-test. Categorical variables were presented as frequencies or percentages and analyzed using the Chi-square test or Fisher's exact test where appropriate. A p-value less than 0.05 was considered statistically significant.

RESULTS

Baseline Demographic and Clinical Characteristics

The clinical and demographic characteristics of the study cohort were well balanced between the two groups. The mean age of the patients in the ERAS pathway was 54.2 +- 11.6 years, which did not differ significantly from the mean age of 56.1 +- 10.9 years in the conventional care pathway (p = 0.42). Sex distribution was similar, with males accounting for 26 patients (65.0%) in the ERAS group and 25 patients (62.5%) in the conventional group (p = 0.82). The distribution of ASA physical status classifications and baseline metabolic comorbidities, including diabetes mellitus and hypertension, demonstrated no statistically significant differences between the cohorts, indicating excellent baseline comparability.

Table 1: Baseline Demographic and Clinical Characteristics

Variable	ERAS Group (n = 40)	Conventional Group (n = 40)	p-value
Mean age (years)	54.2 +- 11.6	56.1 +- 10.9	0.42
Male sex	26 (65.0%)	25 (62.5%)	0.82

Variable	ERAS Group (n = 40)	Conventional Group (n = 40)	p-value
Female sex	14 (35.0%)	15 (37.5%)	0.82
ASA I status	12 (30.0%)	10 (25.0%)	0.79
ASA II status	21 (52.5%)	22 (55.0%)	0.79
ASA III status	7 (17.5%)	8 (20.0%)	0.79
Diabetes mellitus	14 (35.0%)	15 (37.5%)	0.82
Hypertension	17 (42.5%)	18 (45.0%)	0.83

Surgical Indications and Procedures

The primary pathological indications for surgical intervention were uniformly distributed between the two study arms. Colorectal malignancy was the predominant indication, noted in 26 patients (65.0%) in the ERAS cohort and 27 patients (67.5%) in the conventional cohort. Other indications included diverticular disease, inflammatory bowel disease, and benign polyps or strictures.

Table 2: Surgical Indications

Indication	ERAS Group (n = 40)	Conventional Group (n = 40)	p-value
Colorectal malignancy	26 (65.0%)	27 (67.5%)	0.94
Diverticular disease	6 (15.0%)	5 (12.5%)	
Inflammatory bowel disease	5 (12.5%)	4 (10.0%)	
Benign polyps / strictures	3 (7.5%)	4 (10.0%)	

The surgical procedures performed varied in anatomic location and complexity, reflecting standard colorectal practice. Right hemicolectomy was the most frequent operation executed across both groups, followed by anterior or low anterior resections, sigmoid colectomies, left hemicolectomies, and procedures requiring temporary or permanent stoma creation. No statistically significant difference in the procedural distribution was observed (p = 0.88), ensuring that outcomes were not biased by operative heterogeneity.

Table 3: Distribution of Surgical Procedures

Procedure	ERAS Group (n = 40)	Conventional Group (n = 40)	p-value
Right hemicolectomy	11 (27.5%)	12 (30.0%)	0.88
Left hemicolectomy	6 (15.0%)	5 (12.5%)	
Sigmoid colectomy	9 (22.5%)	8 (20.0%)	
Anterior / low anterior resection	10 (25.0%)	11 (27.5%)	
Stoma creation	4 (10.0%)	4 (10.0%)	

Intraoperative Parameters

The total mean duration of surgery was slightly lower in the ERAS pathway (145.3 +- 28.6 minutes) than in the conventional pathway (151.7 +- 31.4 minutes), though this difference did not achieve statistical significance (p = 0.34). Notably, the mean intraoperative blood loss was significantly lower in the ERAS cohort than in the conventional care cohort (210.5 +- 95.2 mL versus 298.4 +- 120.6 mL, p = 0.002) [9, 11]. The use of a minimally invasive laparoscopic approach was comparable between the arms, with 18 patients (45.0%) in the ERAS arm and 16 patients (40.0%) in the conventional arm undergoing laparoscopy (p = 0.65). In accordance with protocol specifications, prophylactic intra-abdominal drain placement was significantly less frequent in the ERAS group than in the conventional care group (35.0% versus 67.5%, p = 0.004).

Table 4: Intraoperative Parameters

Parameter	ERAS Group (n = 40)	Conventional Group (n = 40)	p-value
Duration of surgery (minutes)	145.3 +- 28.6	151.7 +- 31.4	0.34
Blood loss (mL)	210.5 +- 95.2	298.4 +- 120.6	0.002
Laparoscopic approach	18 (45.0%)	16 (40.0%)	0.65
Drain placement	14 (35.0%)	27 (67.5%)	0.004

Postoperative Recovery and Length of Stay

The implementation of ERAS protocols resulted in a substantial acceleration of all immediate postoperative recovery milestones. The mean time to initiation of clear oral intake was significantly shorter in the ERAS group than in the conventional care group (1.2 +- 0.5 days versus 3.1 +- 0.9 days, $p < 0.001$) [8]. Patients managed via the ERAS pathway achieved early out-of-bed mobilization significantly sooner than their conventional counterparts (1.1 +- 0.4 days versus 2.4 +- 0.8 days, $p < 0.001$). Additionally, the return of gastrointestinal motility, objectively determined by the mean time to the passage of first flatus, was significantly faster in the ERAS pathway (1.9 +- 0.6 days versus 3.4 +- 1.1 days, $p < 0.001$).

Table 5: Postoperative Recovery Milestones and Length of Stay

Parameter	ERAS Group (n = 40)	Conventional Group (n = 40)	p-value
Time to oral intake (days)	1.2 +- 0.5	3.1 +- 0.9	<0.001
Time to mobilization (days)	1.1 +- 0.4	2.4 +- 0.8	<0.001
Time to first flatus (days)	1.9 +- 0.6	3.4 +- 1.1	<0.001
Length of hospital stay (days)	5.3 +- 1.6	8.1 +- 2.7	<0.001

Postoperative Pain and Analgesic Consumption

Pain control was significantly enhanced by the multimodal, opioid-sparing approach utilizing regional and non-opioid blocks [4]. The mean VAS pain score recorded on postoperative day 1 was significantly lower in the ERAS group than in the conventional group (3.1 +- 0.8 versus 4.6 +- 1.0, $p < 0.001$). Consequently, non-opioid analgesia alone was entirely sufficient to manage pain in 24 ERAS patients (60.0%), whereas only 10 conventional care patients (25.0%) were managed successfully without opioids. Postoperative opioid rescue analgesics were required in only 16 patients (40.0%) in the ERAS pathway, compared to 30 patients (75.0%) in the conventional pathway, representing a highly significant reduction in opioid reliance ($p = 0.002$).

Postoperative Morbidity, Complications, and Safety

The incidence of specific postoperative complications was systematically lower across all evaluated categories in the ERAS group than in the conventional care group. Surgical site infections occurred in 3 patients (7.5%) in the ERAS cohort compared to 8 patients (20.0%) in the conventional cohort. Clinically significant postoperative ileus was observed in only 2 ERAS patients (5.0%) versus 7 conventional patients (17.5%). Rates of pulmonary complications, urinary tract infections, and anastomotic leaks were also lower in the ERAS group. Overall, the total complication rate was significantly lower in the ERAS group than in the conventional care group ($p = 0.04$) [11].

Table 6: Postoperative Complications Profile

Complication	ERAS Group (n = 40)	Conventional Group (n = 40)	p-value
Surgical site infection	3 (7.5%)	8 (20.0%)	0.04
Postoperative ileus	2 (5.0%)	7 (17.5%)	
Pulmonary complications	1 (2.5%)	5 (12.5%)	
Urinary tract infection	1 (2.5%)	4 (10.0%)	
Anastomotic leak	1 (2.5%)	3 (7.5%)	

When evaluated via the Clavien-Dindo classification system, the severity of postoperative complications was significantly lower in the ERAS group than in the conventional care group (p = 0.03). Minor complications (Grades I and II) predominated in both groups but occurred less frequently in the ERAS cohort. Grade III complications requiring secondary radiological or surgical intervention occurred in 1 ERAS patient (2.5%) compared to 4 conventional care patients (10.0%). Life-threatening Grade IV complications occurred in 1 patient (2.5%) in the conventional care group, while none occurred in the ERAS pathway.

Table 7: Severity of Complications via Clavien-Dindo Grading

Clavien-Dindo Grade	ERAS Group (n = 40)	Conventional Group (n = 40)	p-value
Grade I	3 (7.5%)	9 (22.5%)	0.03
Grade II	3 (7.5%)	7 (17.5%)	
Grade III	1 (2.5%)	4 (10.0%)	
Grade IV	0 (0.0%)	1 (2.5%)	
Grade V (Mortality)	0 (0.0%)	0 (0.0%)	

Unplanned readmissions within 30 days of discharge occurred in 3 patients (7.5%) in the ERAS cohort, which was significantly lower than the 8 readmissions (20.0%) recorded in the conventional care cohort (p = 0.04) [12]. No deaths occurred in the ERAS group during the 30-day postoperative monitoring window, while 1 patient (2.5%) in the conventional care cohort expired due to severe complications; this difference in mortality was not statistically significant (p = 0.31).

DISCUSSION

The present study confirms that the systematic application of ERAS protocols in elective colorectal surgery offers substantial clinical benefits within a South Indian tertiary care setting. The primary finding was a statistically significant and clinically meaningful reduction in the mean length of hospital stay by nearly 3 days in the ERAS group compared to the conventional care group, without any concomitant increase in complication or readmission rates [14, 15]. These findings strongly support the concept that ERAS pathways optimize the recovery environment, leading to early discharge readiness rather than premature discharge [11, 12, 13].

The baseline demographic data, surgical indications, and types of operative procedures were highly comparable between the two cohorts, ensuring that the differences in outcomes were directly attributable to perioperative care paradigms. The clear predominance of colorectal malignancy as the main surgical indication aligns with previous landmark studies [11, 14]. Maintaining a balanced distribution of underlying pathology and procedural complexity between groups is critical, as rectal resections and oncological procedures inherently introduce a higher baseline risk for prolonged recovery and morbidity [11].

Intraoperatively, the implementation of ERAS did not result in an increase in the duration of surgery, confirming its safety and feasibility from a surgical workflow perspective. Interestingly, mean intraoperative blood loss was significantly lower in the ERAS group. This finding is echoed in previous literature and can be attributed to several synergistic factors, including meticulous surgical dissection, restricted and goal-directed fluid strategies that prevent microvascular engorgement, and the optimized utilization of minimally invasive approaches [9, 11]. Restricting prophylactic abdominal drain placement, which was significantly achieved in our ERAS cohort, represents a pivotal paradigm shift that minimizes postoperative pain, facilitates early mobilization, and avoids unnecessary tube-related complications without increasing anastomotic leak detection times [1, 11].

The recovery milestones evaluated—time to first oral intake, early ambulation, and return of bowel function—were achieved significantly faster in the ERAS pathway. Traditional care has historically mandated prolonged fasting out of concern for anastomotic vulnerability or postoperative ileus. However, our data corroborate international consensus guidelines indicating that early enteral nutrition preserves gut mucosal integrity, dampens the catabolic response, and directly stimulates gastrointestinal motility [8]. The earlier passage of flatus observed in our ERAS group clearly demonstrates that early feeding, when combined with opioid-sparing analgesia and early mobilization, reduces the incidence and duration of postoperative ileus [5].

Pain management constitutes a cornerstone of the ERAS philosophy. The utilization of a multimodal, opioid-sparing regimen resulted in significantly lower VAS pain scores on the first postoperative day and a major reduction in overall opioid requirements [4]. Minimizing postoperative opioid administration is directly tied to faster recovery profiles, as opioids are potent inhibitors of gastrointestinal tract motility, cause central sedation, increase the risk of respiratory complications, and delay physical mobilization [4]. Consequently, 60% of our ERAS patients required only non-opioid medications, which actively contributed to their ability to ambulate within 24 hours of surgery.

A common concern among traditional clinicians is whether accelerated recovery pathways compromise patient safety or drive up complication rates. Our results directly refute this assumption, showing a significantly lower overall complication

rate in the ERAS group [11, 13]. Minor and major complications, classified via the Clavien-Dindo system, were consistently reduced in the protocol-driven arm. Specifically, the reduction in surgical site infections and pulmonary complications can be directly traced to shortened bed rest, optimal intraoperative fluid balance preventing tissue edema, and improved nutritional preservation [9, 11]. Crucially, the rate of anastomotic leakage did not increase, confirming that early oral intake and restrictive fluid administration do not compromise bowel healing [11, 14].

Furthermore, the shorter hospital stay did not shift the burden of care to the post-discharge period. The 30-day readmission rate was significantly lower in the ERAS group (7.5% versus 20.0%), which aligns with large-scale meta-analyses indicating that ERAS patients are discharged in a superior state of functional recovery and are less prone to post-discharge dehydration, unmanaged pain, or delayed complications [12].

Several limitations of this study must be acknowledged. First, its retrospective observational design carries inherent risks of unmeasured confounding factors, such as shifts in surgeon experience over time, or baseline variations in patient nutritional status that were not fully quantified [11, 12, 13]. Second, individual compliance with each discrete element of the multifaceted ERAS protocol was not formally audited, meaning that the specific impact of partial adherence could not be determined [15]. Future research should utilize prospective, randomized controlled designs with strict compliance auditing to isolate the most high-yielding components of the protocol [15]. Additionally, cost-effectiveness analyses and long-term functional or oncological outcome measures should be integrated to guide large-scale institutional policy.

In conclusion, the routine clinical adoption of ERAS protocols for patients undergoing elective colorectal surgery is highly safe, feasible, and effective [1, 11, 13]. Compared to conventional traditional care, ERAS substantially shortens the length of hospital stay, enhances postoperative pain control while lowering opioid dependency, accelerates functional bowel recovery, and reduces both the incidence and severity of postoperative complications [11, 12, 13, 14].

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CONFLICT OF INTEREST

The authors declare that they have no competing interests or financial conflicts of interest related to the research, authorship, or publication of this manuscript.

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