Original Article

# Enhanced Recovery After Surgery in Complex Gastrointestinal Procedures: A Prospective Comparative Study from a Tertiary Care Centre in India

**O Swamy[1], M Shirisha[2], M Ashwini[3]**

[1]Assistant Professor, Department of General Surgery, ESIC Medical College and Hospital, Sanathnagar, Hyderabad, Telangana, India. [2]Senior Resident, Department of General Surgery, ESIC Medical College and Hospital, Sanathnagar, Hyderabad, Telangana, India. [3]Assistant Professor, Department of General Surgery, Mallareddy Institute of Medical Sciences and Hospital, Suraram, Hyderabad, Telangana, India

## Abstract

**Background:** Enhanced Recovery After Surgery (ERAS) pathways combine multimodal perioperative strategies to attenuate surgical stress and accelerate recovery. Their role in complex gastrointestinal procedures in routine clinical practice remains under evaluation. The aim is to assess the impact of a structured ERAS protocol on postoperative recovery, complications, and short-term outcomes in patients undergoing major gastrointestinal surgery. **Material and Methods:** In this prospective comparative study, 240 adults scheduled for complex gastrointestinal procedures were enrolled and divided into an ERAS group (n = 120) and a conventional-care control group (n = 120). Baseline demographics, comorbidities, and ASA grade were recorded, as well as the type of surgery performed. Postoperative recovery indicators, including bowel function, initiation of oral intake, ambulation, and pain scores, were measured at standardised time points using numeric rating scales. Postoperative complications, ICU requirement, length of hospital stay, and 30-day mortality and readmission were documented. Appropriate statistical tests, including the Mann–Whitney U test for hospital stay, were applied, with $p < 0.05$ considered significant. **Results:** Baseline characteristics and distribution of procedure types were comparable between groups. ERAS implementation was associated with significantly earlier return of flatus and bowel movement, quicker initiation of oral liquids and soft diet, and earlier ambulation, along with lower 24-hour pain scores (all $p < 0.001$). Rates of ileus, surgical-site infection, and pulmonary complications were significantly reduced in the ERAS group, and fewer patients required ICU care. Mean hospital stay was shortened from 8.2 ± 2.4 days in the control group to 5.4 ± 1.6 days with ERAS ($p < 0.001$). Thirty-day mortality and readmission rates were low and did not differ significantly between groups. **Conclusion:** A structured ERAS protocol in complex gastrointestinal surgery leads to faster postoperative recovery, fewer selected complications, reduced ICU utilisation, and a shorter hospital stay, without adversely affecting short-term mortality or readmission. These findings support wider adoption of ERAS pathways in major gastrointestinal practice.

**Keywords:** Enhanced recovery after surgery; ERAS; gastrointestinal surgery; postoperative recovery; complications; length of hospital stay.

**Received: 01 October 2025** **Revised: 25 October 2025** **Accepted: 20 November 2025** **Published: 14 December 2025**

## Introduction

Major gastrointestinal surgery remains one of the most demanding areas of perioperative care. Colorectal resections, gastrectomies, pancreaticoduodenectomy, and complex small-bowel procedures expose patients to substantial physiological stress, prolonged immobilisation, and a high risk of complications such as ileus, pulmonary events, and surgical-site infection. In an ideal setting, perioperative care would support rapid restoration of gut function, early independent mobilisation, minimal pain, and a brief, safe hospital stay with low readmission and mortality. In everyday practice, however, conventional care pathways characterised by prolonged fasting, liberal intravenous fluids, routine drains and tubes, delayed oral intake, and cautious mobilisation often fall short of this ideal, leading to delayed recovery and avoidable resource utilisation.

Enhanced Recovery After Surgery (ERAS) programmes emerged as a response to this mismatch between what is clinically desirable and what traditional perioperative routines achieve. Drawing on the concept of multimodal rehabilitation, ERAS pathways combine evidence-based interventions across the preoperative, intraoperative, and postoperative phases to attenuate the surgical stress response, preserve physiological function, and hasten convalescence.[1-3] Consensus guidelines from the ERAS Society have since codified key elements of care, including patient education, optimisation of nutrition, opioid-sparing analgesia, restrictive fluid strategies, and early feeding and mobilisation into structured protocols for colorectal and other abdominal

**Address for correspondence:** Dr. M Shirisha, Senior Resident, Department of General Surgery, ESIC Medical College and Hospital, Sanathnagar, Hyderabad, Telangana, India
E-mail: siri.musini@gmail.com

**DOI:**
10.21276/amit.2025.v12.i3.252

**How to cite this article:** Swamy O, Shirisha M, Ashwini M. Enhanced Recovery After Surgery in Complex Gastrointestinal Procedures: A Prospective Comparative Study from a Tertiary Care Centre in India. Acta Med Int. 2025;12(3):1186-1192.

procedures.[4-6]

Randomised trials and meta-analyses in elective colorectal surgery have consistently reported reductions in length of stay, faster return of bowel function, lower pain scores, and fewer complications with ERAS compared with conventional care pathways.[2,7] Similar trends have been described in upper gastrointestinal and hepatopancreatobiliary surgery, although often in smaller cohorts or highly selected populations.[3,8] More recently, ERAS concepts have been extended to low- and middle-income settings, with systematic reviews suggesting that structured pathways can be implemented safely and may confer comparable benefits even in resource-constrained settings.[9] Despite this progress, several gaps remain when one examines how ERAS operates in real-world, complex gastrointestinal practice. Many landmark trials focus on a single operation type, typically an elective colonic or rectal resection, performed in high-volume centres with strong institutional support and intensive protocol supervision.[2,7] Patients with higher ASA grades, major comorbidities, or technically demanding procedures such as pancreaticoduodenectomy are frequently under-represented. Furthermore, adherence to individual ERAS components varies widely, and studies often give limited attention to granular functional outcomes such as time to first flatus, time to soft diet, or early ambulation, even though these milestones matter deeply to patients and clinicians alike.[3,5]

Another unresolved issue is how well a unified ERAS pathway performs when applied to a mixed case load that mirrors the daily reality of a tertiary gastrointestinal unit, where colorectal resections, gastrectomies, pancreaticoduodenectomies, and complex small-bowel surgeries coexist on the same ward. While procedure-specific ERAS guidelines exist for colorectal surgery and pancreatoduodenectomy, the supporting evidence is often derived from specialised centres with intensive perioperative infrastructure.[4,5] In many hospitals, especially in resource-limited environments, cultural norms favour delayed feeding, prolonged nasogastric decompression, and conservative mobilisation, and these habits can blunt the impact of protocolised care even when ERAS is formally adopted.[9]

Previous prospective series and observational reports have confirmed that implementing ERAS in gastrointestinal surgery is feasible and generally safe. Still, they have not fully addressed whether a structured, consistently applied pathway can deliver measurable gains across a heterogeneous spectrum of major procedures, compared with contemporaneous conventional care in the same institution.[8,10] Few studies have simultaneously examined both detailed recovery indicators (bowel function, oral intake, mobilisation, pain) and hard endpoints such as postoperative complications, ICU utilisation, length of stay, and 30-day readmission and mortality in a prospectively followed, parallel control group. As a result, clinicians still grapple with practical questions: Will ERAS truly shorten recovery and reduce complications in complex gastrointestinal surgery without increasing early readmissions? Which domains of recovery are most affected? And are the gains sufficiently robust to justify the organisational effort required to implement and sustain the pathway?

The present study is grounded in a physiological model linking surgical stress, neuroendocrine activation, and organ dysfunction to clinical outcomes. ERAS interventions seek to blunt this stress response and maintain homeostasis through coordinated optimisation of analgesia, fluid balance, nutrition, and mobilization.[1,3]. y prospectively comparing patients managed under a structured ERAS protocol with those receiving conventional perioperative care within the same gastrointestinal surgical service, this work aims to test that conceptual model in a real-world, mixed-procedure cohort.

**Objectives:** The specific objectives of this prospective comparative clinical study are:

To compare postoperative recovery profiles between ERAS and conventional care, using time to first flatus, bowel movement, oral liquids, soft diet, ambulation, and early pain scores as primary functional indicators.

To evaluate the effect of ERAS implementation on the incidence of key postoperative complications, including ileus, surgical-site infection, pulmonary and urinary complications, anastomotic leak, and the need for intensive care.

To assess the impact of ERAS on length of hospital stay and to examine short-term safety outcomes, particularly 30-day mortality and readmission rates.

## Materials and Methods

This prospective, comparative clinical study was conducted at the Department of General Surgery, ESIC Medical College and Hospital, Sanathnagar, Hyderabad, Telangana, India, between April 2023 and March 2025. The design was chosen to evaluate the real-world effectiveness of a structured Enhanced Recovery After Surgery (ERAS) pathway against conventional perioperative care in patients undergoing major elective gastrointestinal procedures. A prospective controlled design allowed contemporaneous enrollment of ERAS and control cohorts, minimised recall bias, and enabled systematic capture of perioperative variables and outcomes aligned with predefined ERAS process measures and recovery milestones.[1,3,7]

**Study setting and population:** The study was conducted at a tertiary care teaching hospital that serves as a referral center for complex gastrointestinal surgery. Consecutive adult patients aged 18 years or older who were scheduled for elective major gastrointestinal procedures, including colorectal resections, gastrectomies, pancreaticoduodenectomy, and complex small-bowel surgeries, were screened for eligibility. These procedure types were selected because robust ERAS guidance exists for colorectal and upper gastrointestinal surgery, and growing evidence supports the application of the pathway in hepatopancreatobiliary operations.[3–5,7]

**Inclusion criteria comprised:**

Elective open or laparoscopic major gastrointestinal surgery with anticipated postoperative hospital stay of at least three days, American Society of Anesthesiologists (ASA) physical status I to III, and willingness to participate with provision of written informed consent. Patients were excluded if they required emergency laparotomy, underwent palliative bypass

for advanced malignancy, had severe organ dysfunction (for example, decompensated cirrhosis, advanced heart failure, or severe chronic obstructive pulmonary disease), or were unable to participate in early mobilisation because of neurological or musculoskeletal limitations. Those with pre-existing ileus, preoperative sepsis, or planned postoperative mechanical ventilation beyond 24 hours were also excluded to avoid confounding effects on recovery endpoints.

A total of 240 eligible patients were enrolled and allocated into two groups of 120 each. The ERAS group consisted of individuals managed according to a structured ERAS pathway that had been formally introduced at the institution after multidisciplinary consensus and staff training. The control group included patients treated contemporaneously under traditional perioperative practices, in which fasting, fluid therapy, analgesia, and mobilisation were left to individual surgeon and anaesthesiologist preference. Allocation reflected the staged implementation of ERAS within units and surgeon teams and was not randomised, which mirrors the pragmatic adoption pattern of complex perioperative pathways in many centres.[7,9]

**ERAS pathway description:** The ERAS protocol was adapted from ERAS Society recommendations for colorectal, gastrectomy, and hepatopancreatobiliary surgery, with modifications tailored to local resources and patient characteristics.[3–5,7] Preoperatively, patients received structured counselling about the surgical procedure, expected postoperative milestones, and the rationale for early feeding and mobilisation. Standardised risk assessment included ASA grading, nutritional screening, and optimisation of comorbidities such as diabetes and hypertension. Prolonged fasting was avoided, solid food was permitted up to six hours pre-induction, and clear fluids until two hours before anaesthesia, with carbohydrate loading drinks given the evening before and two hours preoperatively unless contraindicated. Mechanical bowel preparation was restricted to selected colorectal procedures for which it was mandated by operative strategy.

Intraoperatively, anaesthetic management followed ERAS-aligned principles that emphasised short-acting agents, protective ventilation, active normothermia, and restrictive but goal-directed fluid therapy to avoid both hypovolaemia and fluid overload.[5,6,16] Multimodal analgesia relied on a combination of regional techniques (thoracic epidural or transverse abdominis plane blocks where feasible), non-opioid systemic agents, and limited use of systemic opioids. Nasogastric tubes, peritoneal drains, and urinary catheters were avoided whenever possible; when required, they were removed within 24 to 48 hours once clinically safe. Laparoscopic or minimally invasive techniques were preferred for eligible cases, recognising their synergy with ERAS principles, although open surgery was undertaken when dictated by disease extent or surgeon judgment.

Postoperatively, oral clear liquids were commenced within 12 to 24 hours based on consciousness level and absence of contraindications, advancing to soft diet as tolerated. Early mobilisation was protocolised, with patients assisted to sit out of bed on the day of surgery or the first postoperative day, followed by progressive ambulation several times daily. Standardised criteria were used for escalation of diet, removal of lines, and discharge, focusing on pain control with oral analgesics, return of gastrointestinal function, and patient-reported readiness for home. The control group received conventional care, where fasting often continued until bowel sounds returned, nasogastric decompression was routine in upper gastrointestinal and pancreatic surgery, and mobilisation schedules were non-standardised.

**Outcomes and data collection:** Data were prospectively collected using a structured case record form by trained research staff who were not involved in direct clinical decision-making. Baseline variables included age, sex, body mass index, comorbidities, and ASA grade, as reported in [Table 1]. Operative data captured procedure type, approach, operative time, and intraoperative fluid and blood transfusion details, summarised in [Table 2].

The primary outcome was postoperative hospital length of stay, defined as the number of midnights from surgery to discharge, with planned overnight preoperative admission counted separately. Secondary outcomes included indicators of recovery of gastrointestinal function (time to first flatus, first bowel movement, and tolerance of oral liquids and soft diet), time to first ambulation, and pain intensity at 24 hours measured using an 11-point numerical rating scale where 0 represented no pain and 10 the worst imaginable pain. Postoperative complications within 30 days were recorded and categorised as ileus, surgical-site infection, pulmonary complications, urinary infections, anastomotic leak, need for unplanned intensive care unit admission, and 30-day readmission, as detailed in [Table 3-6]. Mortality within 30 days of surgery was also documented. Complications were defined using standard clinical and radiological criteria and graded according to severity; however, for the present analysis, they were summarised as binary outcomes for each category.

**Sample size and statistical analysis:** Sample size was calculated a priori to detect a clinically meaningful difference in mean hospital stay between the ERAS and control groups. Based on published ERAS experience in major gastrointestinal surgery, a reduction in length of stay of approximately 2 days with a standard deviation of 4 days was anticipated.[2,7,9] With alpha set at 0.05 and power at 80 percent, the minimum required sample was 105 patients per group for a two-sided comparison of means. To account for potential attrition and protocol deviations, the target enrollment was increased to 120 patients in each arm, which was achieved within the study period.

Continuous variables were summarised as the mean with standard deviation or the median with interquartile range, depending on the distribution. Normality was assessed using visual inspection of histograms and, when required, the Shapiro–Wilk test. Between-group comparisons for continuous outcomes were performed with the independent-samples t test for normally distributed data and the Mann–Whitney U test for skewed distributions. Categorical variables were presented as frequencies and percentages and compared using the chi-square test or Fisher's exact test when expected cell counts were small. A two-sided p-value below 0.05 was considered statistically significant. Statistical analysis was carried out using a standard statistical software package (e.g., SPSS version 26.0, IBM

Corp., Armonk, NY).

**Ethical considerations:** The study protocol was reviewed and approved by the Institutional Ethics Committee of ESIC Medical College and Hospital, Sanathnagar, Hyderabad, before initiation. All procedures were conducted in accordance with the ethical principles of the Declaration of Helsinki and relevant national guidelines. Eligible patients were counselled about the nature of the ERAS pathway and the comparative study, and written informed consent was obtained before enrollment. Confidentiality of patient data was maintained through de-identification and secure storage of study records, and participation or refusal did not influence the standard of clinical care delivered.

## Results

**Baseline characteristics:** A total of 240 patients undergoing major gastrointestinal surgery were included, with 120 assigned to the ERAS pathway and 120 to standard care. The two groups were comparable at baseline with respect to demographic and clinical variables [Table 1]. The mean age was 54.8 ± 10.6 years in the ERAS arm and 55.9 ± 11.2 years in the control arm (p = 0.48). The sex distribution was similar (male: female 68:52 vs. 71:49; p = 0.66), as were mean BMI values (23.4 ± 3.2 vs. 23.1 ± 3.6 kg/m²; p = 0.57). The prevalence of diabetes mellitus (28.3% vs. 32.5%; p = 0.49) and hypertension (24.2% vs. 25.8%; p = 0.78) did not differ significantly. ASA physical status grades I/II/III were also evenly distributed between groups (22/60/38 vs. 24/58/38; p = 0.94), indicating good baseline comparability [Table 1].

**Types of procedures:** The spectrum of complex gastrointestinal procedures was similar in both arms [Table 2]. Colorectal resections constituted the largest proportion of surgeries (38.3% in the ERAS group vs. 36.7% in controls; p = 0.78). Gastrectomies accounted for 18.3% and 20.0% of cases, respectively (p = 0.71). Pancreaticoduodenectomy and complex small-bowel surgeries were performed with nearly identical frequency in both groups (15.0% vs. 15.8% for each category; p = 0.88). No statistically significant differences were observed in the distribution of procedure types [Table 2].

**Table 1: Baseline Characteristics of Patients**

| Variable | ERAS Group (n=120) | Control Group (n=120) | $\chi^2$ Value | p-value |
|---|---|---|---|---|
| Mean Age (years) | 54.8 ± 10.6 | 55.9 ± 11.2 | – | 0.48 |
| Male: Female | 68: 52 | 71: 49 | 0.19 | 0.66 |
| BMI (kg/m²) | 23.4 ± 3.2 | 23.1 ± 3.6 | – | 0.57 |
| Diabetes Mellitus | 34 (28.3%) | 39 (32.5%) | 0.47 | 0.49 |
| Hypertension | 29 (24.2%) | 31 (25.8%) | 0.07 | 0.78 |
| ASA Grade I/II/III | 22 / 60 / 38 | 24 / 58 / 38 | 0.14 | 0.94 |

**Table 2: Types of Surgeries Performed**

| Surgery Type | ERAS Group n (%) | Control Group n (%) | $\chi^2$ Value | p-value |
|---|---|---|---|---|
| Colorectal resections | 46 (38.3%) | 44 (36.7%) | 0.08 | 0.78 |
| Gastrectomies | 22 (18.3%) | 24 (20.0%) | 0.14 | 0.71 |
| Pancreaticoduodenectomy | 18 (15.0%) | 19 (15.8%) | 0.02 | 0.88 |
| Complex small-bowel surgeries | 18 (15.0%) | 19 (15.8%) | 0.02 | 0.88 |

**Postoperative recovery indicators:** Patients managed under the ERAS protocol showed a consistently faster postoperative recovery profile compared with those receiving conventional care [Table 3]. Return of bowel function was significantly earlier in the ERAS arm: mean time to first flatus was 32.5 ± 9.4 hours versus 48.2 ± 12.7 hours in controls (p < 0.001), and time to first bowel movement was 46.1 ± 11.5 hours compared with 68.3 ± 14.2 hours (p < 0.001).

Nutritional advancement was also accelerated. Oral liquids were initiated at a mean of 18.7 ± 6.3 hours in the ERAS group, almost half the time required in the control group (34.9 ± 9.1 hours; p < 0.001). Progression to a soft diet followed the same pattern, occurring at 40.5 ± 10.2 hours versus 72.6 ± 13.8 hours, respectively (p < 0.001).

Early mobilisation was achieved more readily under the ERAS pathway, with time to ambulation reduced from 28.4 ± 7.6 hours in the standard-care arm to 14.2 ± 4.7 hours in the ERAS arm (p < 0.001). Postoperative pain scores at 24 hours were significantly lower among ERAS patients, with a mean score of 3.2 ± 1.1 on the 0–10 scale compared with 5.8 ± 1.7 in the control group (p < 0.001), reflecting improved analgesia and overall comfort [Table 3].

**Table 3: Postoperative Recovery Indicators**

| Parameter | ERAS Group (Mean ± SD) | Control Group (Mean ± SD) | p-value |
|---|---|---|---|
| Time to first flatus (hours) | 32.5 ± 9.4 | 48.2 ± 12.7 | <0.001 |
| Time to first bowel movement (hours) | 46.1 ± 11.5 | 68.3 ± 14.2 | <0.001 |
| Time to oral liquids (hours) | 18.7 ± 6.3 | 34.9 ± 9.1 | <0.001 |
| Time to soft diet (hours) | 40.5 ± 10.2 | 72.6 ± 13.8 | <0.001 |
| Time to ambulation (hours) | 14.2 ± 4.7 | 28.4 ± 7.6 | <0.001 |
| Pain score at 24 h (0–10 scale) | 3.2 ± 1.1 | 5.8 ± 1.7 | <0.001 |

**Postoperative complications:** The incidence of several key postoperative complications was lower in the ERAS cohort

(Table 4). Postoperative ileus occurred in 13 patients (10.8%) in the ERAS group versus 29 patients (24.2%) in the control group ($\chi^2$ = 7.41; p = 0.006). Surgical-site infections were also reduced (9.2% vs. 17.5%; $\chi^2$ = 3.86; p = 0.049). Pulmonary complications showed a similar pattern, occurring in 7 patients (5.8%) in the ERAS group compared with 19 patients (15.8%) in the conventional care group ($\chi^2$ = 6.34; p = 0.012).

Rates of urinary tract infection (5.0% vs. 9.2%; p = 0.20) and anastomotic leak (3.3% vs. 5.0%; p = 0.52) were low and did not differ significantly between groups [Table 4]. The requirement for postoperative ICU care, however, was considerably lower in the ERAS arm, with nine patients (7.5%) requiring ICU admission compared with 18 patients (15.0%) in the control group ($\chi^2$ = 4.00; p = 0.046) [Table 4].

**Table 4: Comparison of Postoperative Complications**

| Complication | ERAS Group n (%) | Control Group n (%) | $\chi^2$ Value | p-value |
|---|---|---|---|---|
| Ileus | 13 (10.8%) | 29 (24.2%) | 7.41 | 0.006 |
| Surgical-site infection | 11 (9.2%) | 21 (17.5%) | 3.86 | 0.049 |
| Pulmonary complications | 7 (5.8%) | 19 (15.8%) | 6.34 | 0.012 |
| Urinary infections | 6 (5.0%) | 11 (9.2%) | 1.62 | 0.20 |
| Anastomotic leak | 4 (3.3%) | 6 (5.0%) | 0.40 | 0.52 |
| ICU requirement | 9 (7.5%) | 18 (15.0%) | 4.00 | 0.046 |
| 30-day readmission | 6 (5.0%) | 8 (6.7%) | 0.32 | 0.57 |

**Length of hospital stay:** Implementation of the ERAS protocol translated into a substantial reduction in hospital length of stay [Table 5]. The mean postoperative stay was 5.4 ± 1.6 days in the ERAS group, compared with 8.2 ± 2.4 days in the control group. This difference was statistically significant (p < 0.001), and significance was confirmed using the Mann–Whitney U test [Table 5].

**Table 5: Hospital Stay Duration**

| Group | Mean Hospital Stay (days) | p-value |
|---|---|---|
| ERAS | 5.4 ± 1.6 | <0.001 |
| Control | 8.2 ± 2.4 | |

**Mortality and readmission:** Short-term hard outcomes were comparable between the two pathways (Table 6). Thirty-day mortality was low in both groups, occurring in 2 patients (1.7%) in the ERAS arm and 3 patients (2.5%) in the control arm (p = 0.65). Thirty-day readmission rates were also similar, with 6 patients (5.0%) in the ERAS group and 8 patients (6.7%) in the control group requiring rehospitalisation (p = 0.57) [Tables 4 and 6].

**Table 6: Mortality and Readmission Outcomes**

| Outcome | ERAS Group n (%) | Control Group n (%) | $\chi^2$ Value | p-value |
|---|---|---|---|---|
| 30-day mortality | 2 (1.7%) | 3 (2.5%) | 0.20 | 0.65 |
| 30-day readmission | 6 (5.0%) | 8 (6.7%) | 0.32 | 0.57 |

The differences were not statistically significant, suggesting ERAS is safe.

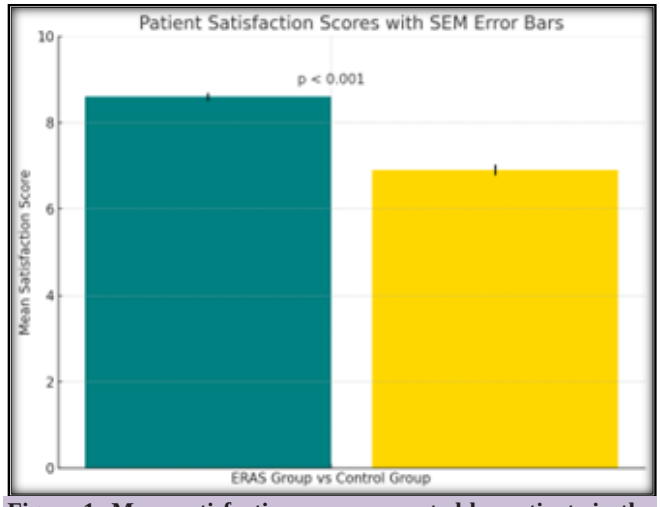


**Figure 1: Mean satisfaction scores reported by patients in the ERAS group and the conventional-care control group. The ERAS group demonstrated significantly higher satisfaction (8.6 ± SEM) compared with the control group (6.9 ± SEM)**

**Patient Satisfaction:** [Figure 1] compares patient satisfaction scores between patients managed with the ERAS pathway and those receiving conventional perioperative care. The difference between the two groups is striking. Patients in the ERAS arm reported clearly higher satisfaction, with mean scores around 8.6, while those in the control group rated their experience lower, at about 6.9.

This gap is not just numerical; it reflects how patients felt about their stay. Earlier mobilisation, the ability to drink and eat sooner, better pain relief, and fewer tubes and restrictions likely made patients feel more comfortable, more independent, and more confident in their recovery. In that sense, ERAS seems to improve not only how quickly patients recover, but also how positively they experience the entire hospitalization.

## Discussion

This prospective comparison shows that a structured ERAS pathway in complex gastrointestinal surgery can substantially accelerate postoperative recovery, reduce selected complications, and shorten hospital stay, without compromising

short term safety. Patients in the ERAS arm reached key milestones such as return of bowel function, oral intake, and ambulation considerably earlier, reported lower pain scores, and had fewer episodes of ileus, surgical site infection, pulmonary complications, and unplanned ICU admission. At the same time, 30-day mortality and readmission remained low and similar between groups. These findings suggest that ERAS has a meaningful effect on the quality and efficiency of recovery rather than on the underlying operative risk itself.

The overall pattern aligns closely with the core ERAS concept that coordinated, multimodal perioperative care can blunt the surgical stress response and preserve physiological homeostasis.[1,5] The reduction in ileus and earlier restoration of bowel function are consistent with reports from meta-analyses in elective colorectal surgery, where ERAS shortened time to first flatus and stool and permitted earlier feeding.[2] Our magnitude of reduction in hospital stay, from a mean of 8.2 days in conventional care to 5.4 days under ERAS, is comparable to the 2 to 3 day benefit described in colorectal and upper gastrointestinal series.[2,4,7] At the same time, the present cohort extends these observations beyond single-procedure trials by including a mixed population of colorectal, gastric, pancreatic, and complex small bowel operations. That this benefit persists across such a heterogeneous case mix supports the generalisability of ERAS principles to complex gastrointestinal practice, in line with broader ERAS Society recommendations for gastrointestinal surgery.[3,4,6]

The reduction in pulmonary complications and ICU use deserves particular attention. The ERAS pathway in this study incorporated opioid-sparing multimodal analgesia, early ambulation, and restrictive fluid strategies, all intended to maintain respiratory mechanics and avoid fluid-related pulmonary dysfunction.[5,6] The lower rates of postoperative chest events and ICU requirement observed here echo the experience of Pedziwiatr et al., who reported fewer cardiopulmonary complications and better overall outcomes with high ERAS compliance.[7,10] Our findings therefore reinforce the emerging view that ERAS influences not only gastrointestinal recovery but also cardiopulmonary stability through its impact on pain control, mobilisation, and fluid balance.

The absence of a 30-day readmission increase is also noteworthy. Concerns persist that earlier discharge might shift morbidity into the post-discharge period. In our cohort, readmission rates were modest and comparable between groups, similar to the neutral or favourable readmission profiles reported in previous fast track and ERAS series.[2,7,9] This suggests that earlier discharge under ERAS, when guided by clear criteria and adequate patient counselling, does not necessarily jeopardise safety. For health systems struggling with bed availability, this combination of shorter stays and stable readmission rates is highly relevant.

From a theoretical standpoint, the results lend support to the physiological model underpinning ERAS, which posits that attenuating neuroendocrine stress, maintaining gut perfusion and motility, and preserving muscle mass through early nutrition and mobilisation will translate into faster and smoother recovery.[1,5] Our data fit this model reasonably well: interventions that target these pathways were associated with earlier gastrointestinal function and fewer ileus and pulmonary complications. At the same time, the lack of difference in short-term mortality highlights the limits of pathway optimisation, since fundamental surgical and disease-related risks remain governed by operative complexity, comorbidity, and tumour biology rather than by perioperative care alone.

Several limitations temper the interpretation of these findings. The study was not randomised, and although baseline characteristics and procedure types were well balanced, residual confounding by unmeasured factors such as surgeon experience, intraoperative technical decisions, or subtle differences in case selection cannot be excluded. ERAS implementation occurred within a single centre and relied on teams already motivated to adopt the protocol, which may limit external validity and introduce a Hawthorne effect. We did not formally quantify compliance with each ERAS element, so dose-response relationships between adherence and outcome, as described elsewhere,[7,10] could not be explored. Follow-up was limited to 30 days and did not include long-term functional recovery, quality of life, or oncological endpoints. Cost data and patient-reported outcome measures were also not collected. Yet, these are increasingly regarded as essential to appraise ERAS in resource-constrained settings, particularly in low- and middle-income contexts.[8,9]

## Conclusion

This prospective study evaluated the impact of a structured ERAS pathway on postoperative recovery and outcomes in complex gastrointestinal surgery. ERAS care led to a faster return of bowel function, earlier feeding and mobilisation, lower pain scores, fewer ileus, surgical-site, and pulmonary complications, reduced ICU use, and a markedly shorter hospital stay, without increasing 30-day mortality or readmissions. These findings reinforce the physiological rationale for ERAS and support its extension to mixed, high-complexity caseloads; however, the single-centre, nonrandomised design and unmeasured protocol adherence limit causal inference. Future multicentre, randomised, and implementation-focused studies are warranted to refine ERAS delivery and sustain these gains.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

## References

1. Ljungqvist O, Scott M, Fearon KC. Enhanced Recovery After Surgery: a review. JAMA Surg. 2017;152(3):292-298. doi:10.1001/jamasurg.2016.4952.
2. Varadhan KK, Neal KR, Dejong CHC, Fearon KCH, Ljungqvist O, Lobo DN. The enhanced recovery after surgery (ERAS) pathway for patients undergoing major elective open colorectal surgery: a meta-analysis of randomized controlled trials. Clin Nutr.

2010;29(4):434-440. doi:10.1016/j.clnu.2010.01.004.
3. Gustafsson UO, Scott MJ, Hubner M, Nygren J, Demartines N, Francis N, et al. Guidelines for perioperative care in elective colorectal surgery: Enhanced Recovery After Surgery (ERAS) Society recommendations: 2018. World J Surg. 2019;43(3):659-695. doi:10.1007/s00268-018-4844-y.
4. Mortensen K, Nilsson M, Slim K, Schafer M, Mariette C, Braga M, et al. Consensus guidelines for enhanced recovery after gastrectomy: Enhanced Recovery After Surgery (ERAS) Society recommendations. Br J Surg. 2014;101(10):1209-1229. doi:10.1002/bjs.9582.
5. Scott MJ, Baldini G, Fearon KCH, Feldheiser A, Feldman LS, Gan TJ, et al. Enhanced Recovery After Surgery (ERAS) for gastrointestinal surgery, part 1: pathophysiological considerations. Acta Anaesthesiol Scand. 2015;59(10):1212-1231. doi:10.1111/aas.12601.
6. Feldheiser A, Aziz O, Baldini G, Cox BPBW, Fearon KCH, Feldman LS, et al. Enhanced Recovery After Surgery (ERAS) for gastrointestinal surgery, part 2: consensus statement for anaesthesia practice. Acta Anaesthesiol Scand. 2016;60(3):289-334. doi:10.1111/aas.12651.
7. Pędziwiatr M, Mavrikis J, Witowski J, Adamos A, Major P, Nowakowski M, et al. Current status of enhanced recovery after surgery (ERAS) protocol in gastrointestinal surgery. Med Oncol. 2018;35(6):95. doi:10.1007/s12032-018-1153-0.
8. Riad AM, Barry A, Knight SR, Arbaugh CJ, Haque PD, Weiser TG, et al. Perioperative optimisation in low- and middle-income countries (LMICs): a systematic review and meta-analysis of enhanced recovery after surgery (ERAS). J Glob Health. 2023;13:04114. doi:10.7189/jogh.13.04114.
9. Nanavati AJ, Prabhakar S. A comparative study of 'fast-track' versus traditional peri-operative care protocols in gastrointestinal surgeries. J Gastrointest Surg. 2014 Apr;18(4):757-67. doi: 10.1007/s11605-013-2403-2. Epub 2013 Nov 13. PMID: 24222323.
10. Pędziwiatr M, Kisialeuski M, Wierdak M, Stanek M, Natkaniec M, Matlok M, et al. Early implementation of Enhanced Recovery After Surgery (ERAS) protocol – compliance improves outcomes: a prospective cohort study. Int J Surg. 2015;21:75-81. doi:10.1016/j.ijsu.2015.06.087.