Journal of Pioneering Medical Sciences
Received: February 04, 2026 | Accepted: September 09, 2026 | Published: November 05, 2026
Volume 15, Issue 10, Pages 181-188

DOI https://doi.org/10.47310/jpms2026151018



Selected Enhanced Recovery After Surgery (ERAS) Components in Laparoscopic Colorectal Cancer Surgery: A Prospective Single-Centre Descriptive Cohort Study

Mushtaq Chalkoo[1*], Naeem Ahmad[2], Suhaib Bashir[3], Abhinandan Thappa[4], Arul Prakash[5], Syed Saad Ahmed[6], Sourav Kumar[7] and Tafheem Shafi[8]

[1-8]Postgraduate Department of Minimal Access and General Surgery, Government Medical College, Srinagar, Jammu and Kashmir, India

*Corresponding author: Mushtaq Chalkoo (e-mail: mushtaq_chalkoo@rediffmail.com).

©2026 the Author(s). This is an open access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0

Abstract **Background:** Enhanced Recovery After Surgery (ERAS) is a multimodal perioperative approach intended to reduce surgical stress and promote early recovery. We describe postoperative recovery in patients with colorectal cancer who underwent laparoscopic resection with selected ERAS components. **Methods:** This prospective, single-centre, descriptive cohort study enrolled 30 of 82 screened adults (18-80 years) scheduled for elective laparoscopic colorectal resection at Government Medical College, Srinagar, between 10 August 2024 and 10 February 2026, with follow-up to six months after discharge. All 30 participants had malignant pathology. Adherence was recorded for 19 pathway elements. Primary postoperative stay was counted from the day of surgery to discharge from the index admission; total postoperative hospital days included readmissions within 30 days of discharge. Complications within 30 days of surgery were graded by the Clavien-Dindo system. Readmission was any unplanned readmission within 30 days of discharge and redo surgery was an unplanned return to theatre. Analysis was descriptive, with exact 95% Confidence Intervals (CI). **Results:** Mean age was 58.1±10.4 years and 70.0% were male. All patients had malignant pathology (adenocarcinoma 90.0%; rectosigmoid tumours 46.7%). All procedures were completed laparoscopically without conversion (0/30; 95% CI 0-11.6%). All 30 patients received non-opioid analgesia without rescue opioid and were mobilized on postoperative day (POD) 1; oral intake began on POD 1 in 21/30 (70.0%) and by POD 2 in all. The mean primary postoperative stay was 4.7±0.94 days (95% CI 4.4-5.1; median 5; range 3-8). Complications occurred in 8/30 (26.7%; 95% CI 12.3-45.9), five of them Clavien-Dindo grade ≥III. Readmission within 30 days occurred in 7/30 (23.3%; 95% CI 9.9-42.3) and added 22 hospital days (mean 3.1±1.2 days per readmission), so total postoperative hospital days including readmissions averaged about 5.5 per patient. Redo surgery was needed in 2/30 (6.7%; 95% CI 0.8-22.1). All patients completed follow-up at 1 week, 4 weeks and 6 months. **Conclusion:** In this small, uncontrolled cohort of patients with colorectal cancer, delivering selected ERAS components alongside laparoscopic resection was feasible, with a median primary stay of 5 days but nearly one in four patients was readmitted. Because there was no comparison group and the sample was small, these findings are descriptive associations and do not show that ERAS shortened hospitalization or improved outcomes. Adequately powered comparative studies are needed.

Key Words Enhanced Recovery After Surgery, ERAS, Laparoscopic Colorectal Surgery, Colorectal Cancer, Postoperative Recovery, Length of Stay, Readmission

INTRODUCTION

Surgery remains central to the management of a wide range of colorectal conditions, including benign disease [1] and radical resection is the cornerstone of curative treatment for colorectal cancer [2]. Open colorectal surgery has historically been associated with considerable operative trauma, postoperative pain, delayed gastrointestinal recovery, prolonged immobilization and extended hospitalization [3].

Laparoscopic colorectal surgery is associated with less postoperative pain, faster recovery of gastrointestinal function and shorter hospital stay than open surgery [3-5] and its use has expanded, including in older patients [6]. Even after minimally invasive procedures, however, surgery triggers neuroendocrine, metabolic and inflammatory responses. Minimally invasive approaches attenuate some of these immune and stress responses [7] but recovery also depends on perioperative care. Conventional practices such

as prolonged fasting, liberal intravenous fluids, delayed oral feeding, reliance on opioids and prolonged bed rest may delay recovery [8].

Enhanced Recovery After Surgery (ERAS), introduced in the late 1990s, is a structured, multidisciplinary pathway spanning the preoperative, intraoperative and postoperative periods [8,9]. Its elements include patient education, avoidance of prolonged fasting, carbohydrate loading where appropriate, antibiotic and thromboprophylaxis, opioid-sparing multimodal analgesia, goal-directed fluid management, normothermia, prevention of postoperative nausea and vomiting, avoidance of unnecessary tubes and drains, early mobilization and oral feeding, early catheter removal and standardized discharge criteria [8,9].

Laparoscopy and ERAS are usually introduced together and their effects are difficult to separate. Laparoscopy reduces tissue trauma, whereas ERAS targets the metabolic and physiological response to surgery and standardizes care. Studies of the combination, including a randomized trial, report shorter hospital stay and lower morbidity [10,11]. The independent contributions of surgical technique and perioperative care cannot, however, be established from single-arm observational data.

Although the literature on ERAS in laparoscopic colorectal surgery is extensive, the ERAS components implemented, the adherence measures and the outcome definitions vary widely between studies, which limits comparability. We therefore report a small, single-centre prospective cohort with explicit outcome definitions and transparent reporting of the ERAS components that were measured.

The primary objective was to describe the mean postoperative length of stay after laparoscopic colorectal cancer surgery managed with selected ERAS components. Secondary objectives were to describe readmission stays and total postoperative hospital days, postoperative complications, readmission, redo surgery and adherence to the ERAS components that were measured. The study was not designed to test the effectiveness of ERAS.

METHODS

Study Design and Setting

This was a prospective, single-centre, descriptive observational cohort study conducted in the Postgraduate Department of Minimal Access and General Surgery, Government Medical College (GMC), Srinagar, a public-sector tertiary-care teaching hospital. It is reported in accordance with the STROBE statement [12]. Recruitment ran from 10 August 2024 to 10 February 2026. The last participant completed the six-month visit on 12 August 2026 and the data-analysis cut-off was 15 August 2026, so all six-month follow-up visits were complete at analysis.

Patients were enrolled consecutively. Of 82 patients screened, 52 were excluded (metastatic disease, n = 18; open surgery, n = 27; and referral for neoadjuvant chemotherapy without return for surgery at our centre or surgery elsewhere, n = 7) and the remaining 30 eligible patients were enrolled. The study protocol was approved by the Institutional Ethics Committee before recruitment began (approval dated 7 August 2024). The study was not registered in a clinical trial registry; the institutional ethics approval is the only prospective approval and the study was conducted according to the approved protocol. All operations were performed by a single consultant surgeon (26 years in practice), which ensured consistency of operative technique and perioperative management but limits generalizability.

Sample Size

No formal sample-size calculation was performed. The study included 30 consecutively enrolled patients, a number determined pragmatically by the available study period and the feasibility constraints of postgraduate training. The study was descriptive and was not powered to test a hypothesis or to compare treatment groups. Findings are therefore presented as descriptive estimates with 95% confidence intervals. The limited sample size reduces the precision of estimates, particularly for uncommon postoperative complications and other infrequent outcomes.

Eligibility Criteria

Eligible participants were adults aged 18-80 years scheduled for elective laparoscopic colorectal resection for colorectal malignancy who provided written informed consent; all 30 enrolled patients had malignant pathology. Exclusion criteria were severe comorbidity making the patient unsuitable for elective surgery or general anaesthesia (for example ASA class IV or higher or poor functional capacity at pre-anaesthetic evaluation), uncontrolled diabetes, advanced renal or hepatic disease, pregnancy or breastfeeding and cognitive or psychiatric conditions affecting compliance. Patients with metastatic disease and those who underwent open surgery rather than laparoscopic resection, were not included. Patients with cardiovascular disease (n = 11) or kidney disease (n = 1) were enrolled when their conditions were clinically stable and medically optimized.

Ethical Considerations

The study was approved by the Institutional Ethics Committee of GMC Srinagar (Reference No. IRBGMC-SRG/Sur/732; approval dated 7 August 2024). The approved protocol covered prospective follow-up and the use of clinical data. Before enrolment and any study procedure, the objectives, procedures, risks and benefits were explained to each participant in a language they understood and written informed consent was then obtained. Written consent for publication of clinical images was obtained from the patients concerned. Patient confidentiality was maintained throughout. The study adhered to the Declaration of Helsinki and the relevant guidelines of the Indian Council of Medical Research.

Perioperative Care Pathway and ERAS Components

Care was delivered according to a departmental pathway comprising selected ERAS components adapted from international guidelines [8,9]. The pathway included preoperative counselling, antibiotic and thromboembolic prophylaxis, epidural analgesia, opioid-sparing postoperative analgesia, early mobilization and early oral

intake. Adherence was recorded for 19 elements; their targets, the personnel responsible and adherence are listed in Table 3. Carbohydrate loading was not part of the pathway and no composite compliance score was calculated. The study therefore evaluates selected ERAS components and not adherence to a complete standardized ERAS protocol.

Preoperative

All participants underwent clinical assessment, routine investigations and structured counselling about the procedure and perioperative care. Antibiotic prophylaxis was given 30 minutes before skin incision, compression stockings were provided for thromboembolic prophylaxis and routine sedative premedication was avoided. Patients received preoperative fasting instructions; carbohydrate loading was not used.

Intraoperative

Laparoscopic resection was performed using standard techniques by a single surgeon, minimizing tissue handling. All patients received epidural anaesthesia/analgesia with ropivacaine (0.2% by continuous epidural infusion at 4-8 mL/h) from the anaesthesia team. Fluid management was goal-directed, targeting urine output of 0.5-1 mL/kg/h. Normothermia (36.5-37.5°C) was maintained, ondansetron was given for prevention of postoperative nausea and vomiting and nasogastric tubes were not placed routinely. Abdominal drains were placed selectively, according to clinical judgement.

Postoperative

Patients were monitored for vital signs, pain, fluid balance, bowel function, oral intake and mobility and were assessed daily for complications and readiness for discharge. Analgesia was a non-opioid regimen of paracetamol and/or Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) given with the epidural technique at standard adult doses (paracetamol 1 g every 8 hours; diclofenac 75 mg every 12 hours as the NSAID). No opioids were used for postoperative pain management, including as rescue analgesia. Mobilization was encouraged from POD 1 and defined as sitting out of bed, standing or walking for 4-5 hours per day on POD 1. Oral intake was defined as the first oral intake; clear liquids were permitted on POD 1 and soft diet on POD 2, as tolerated. Intravenous fluids were stopped by POD 2 where possible. Urinary catheters were removed on POD 1 and drains were removed when output was below 50 mL per 24 hours. Discharge criteria were clinical stability, tolerance of an oral diet and pain and self-care manageable at home.

Outcome Definitions and Follow-Up

Primary Endpoint: Primary postoperative length of stay, defined as the number of days from the day of surgery (day 0) to discharge from the index admission; preoperative days were excluded.

Secondary Outcomes

Readmission stay and total postoperative hospital days (index stay plus readmission stays within 30 days of discharge), postoperative complications, readmission, reoperation, conversion to open surgery and adherence to ERAS components.

Time to return of bowel function was recorded daily. Postoperative complications were any deviation from the expected postoperative course within 30 days of surgery. They were graded by the Clavien-Dindo classification [13] and characterized by type, severity, timing and treatment. Readmission was an unplanned, all-cause hospital admission within 30 days of discharge from the index admission; readmissions to other hospitals were included when reported by patients or identified in available records. Reoperation was an unplanned return to the operating theatre for a postoperative complication; planned staged procedures were excluded. Conversion to open surgery was an unplanned laparotomy required to complete the resection or manage an intraoperative problem, excluding incisions used solely for specimen extraction or stoma formation. Patients who had an additional laparoscopic procedure without laparotomy were classified as laparoscopic.

Patients were followed at 1 week, 4 weeks and 6 months after discharge. Follow-up assessed recovery and complications, with clinical or oncological assessments recorded where performed. Data were collected prospectively using a structured form covering demographic characteristics, perioperative variables, length of stay, readmissions and complications.

Statistical Analysis

All analyses were descriptive. Continuous variables are presented as Mean±Standard deviation (SD); for skewed outcomes, including hospital stay, the median and range are also reported. The 95% Confidence Interval (CI) for mean primary postoperative stay was calculated from the t distribution. Categorical variables are presented as frequencies and percentages with exact Clopper-Pearson 95% CIs. Each patient was counted once per outcome; patients with multiple complications or repeated readmissions contribute once to the patient-level proportion and individual events are reported in Table 4. No outcome data were missing, as all participants completed follow-up. Because the study had no comparison group, no hypothesis tests were performed, no subgroup analyses were done and no claims of effectiveness are made. Analyses used jamovi version 2.5.3.

RESULTS

Participants and Baseline Characteristics

Of 82 patients screened, 52 were excluded (metastatic disease, n = 18; open surgery, n = 27; sent for neoadjuvant chemotherapy and did not return for surgery at our centre or were operated elsewhere, n = 7) and 30 were enrolled; all 30 completed follow-up. The mean age was 58.1±10.4 years; 70.0% were male and 30.0% female. Most were aged 50-64 years (56.7%) and 73.3% were educated. Bleeding per rectum was the most common presenting symptom (76.7%) and symptoms had lasted less than six months in 43.3%. Cardiovascular disease was the most common comorbidity (36.7%), followed by diabetes mellitus (20.0%). ASA class was I in 16 patients (53.3%), II in 11 (36.7%) and III in 3 (10.0%) (Table 1).

Table 1: Baseline Demographic and Clinical Characteristics of Study Participants (N = 30)

Characteristic	Category	n (%) or Mean±SD
Age (years)	Mean±SD	58.1±10.4
Age group	<50 years	6 (20.0)
	50-64 years	17 (56.7)
	≥65 years	7 (23.3)
Sex	Male	21 (70.0)
	Female	9 (30.0)
Education	Educated	22 (73.3)
	Uneducated	8 (26.7)
Presenting symptoms*	Bleeding per rectum	23 (76.7)
	Abdominal pain	20 (66.7)
	Constipation	20 (66.7)
	Weight loss	8 (26.7)
Comorbidities†	Cardiovascular disease	11 (36.7)
	Diabetes mellitus	6 (20.0)
	Kidney disease	1 (3.3)
	Liver disease	0 (0.0)
	COPD	4 (13.3)
	Thyroid disorder	4 (13.3)
	Musculoskeletal disease	3 (10.0)
ASA class	I	16 (53.3)
	II	11 (36.7)
	III	3 (10.0)

SD: Standard deviation, ASA: American Society of Anesthesiologists, COPD: Chronic obstructive pulmonary disease, The denominator is N = 30 for every variable, *Multiple responses were permitted, so percentages sum to more than 100%, †Patients could have more than one comorbidity, cardiovascular and renal comorbidities were classified from the diagnoses and severity documented in the clinical records

Table 2: Disease Characteristics and Operative Details (N = 30)

Variable	Category	n (%)
Pathology	Malignant	30 (100.0)
Histopathology	Adenocarcinoma	27 (90.0)
	Signet-ring cell carcinoma	3 (10.0)
Tumour location	Rectosigmoid	14 (46.7)
	Ascending colon/right flexure	11 (36.7)
	Descending colon	3 (10.0)
	Transverse colon/left flexure	2 (6.7)
Surgical procedure	Right/extended right hemicolectomy	11 (36.7)
	Anterior/low anterior resection	11 (36.7)
	Left/extended left hemicolectomy	5 (16.7)
	Abdominoperineal resection	3 (10.0)
Stoma formation	No stoma	20 (66.7)
	Diverting stoma	7 (23.3)
	Terminal stoma	3 (10.0)
Associated procedure	Laparoscopic cholecystectomy	2 (6.7)
	None	28 (93.3)
Conversion to open surgery	No	30 (100.0)
Pathological stage (TNM)	Stage 0	0 (0.0)
	Stage I	10 (33.3)
	Stage II	11 (36.7)
	Stage III	9 (30.0)
	Stage IV	0 (0.0)
Neoadjuvant therapy	Received	1 (3.3)
	Not received	29 (96.7)

Percentages use N = 30 as the denominator

Disease and Operative Characteristics

All 30 patients had malignant pathology: Adenocarcinoma in 27 (90.0%) and signet-ring cell carcinoma in 3 (10.0%). Rectosigmoid tumours accounted for 46.7%. Tumours were identified in all patients by Contrast-Enhanced Computed Tomography (CECT) and colonoscopy. Mean haemoglobin was 11.1±1.6 g/dL and mean serum albumin 4.0±0.4 g/dL. Anterior or low anterior resection and right or extended right hemicolectomy were the most common procedures (36.7% each). A stoma was formed in 10 patients (33.3%). Two patients (6.7%) underwent concomitant laparoscopic cholecystectomy and both operations were completed laparoscopically. All procedures were completed without conversion to open surgery (0/30; 95% CI 0-11.6%). Pathological stage was I in 10 patients (33.3%), II in 11 (36.7%) and III in 9 (30.0%); none had stage 0 or IV disease. One patient (3.3%) had received neoadjuvant therapy before surgery and the other 29 (96.7%) had not (Table 2); the stage reported for that patient is the post-treatment pathological stage.

ERAS Component Adherence

All 30 patients received the scheduled non-opioid analgesic regimen with epidural analgesia, none required a rescue opioid and all were mobilized on POD 1. Compression

Table 3: ERAS Pathway Elements, Targets, Responsible Personnel and Adherence (N = 30)

ERAS element	Target/definition	Responsible	Adherence (n/N (%))
Preoperative			
Counselling and education	Structured counselling on procedure and perioperative care	Surgeon	30/30 (100.0)
Fasting and carbohydrate loading	Fasting instructions given; carbohydrate loading not used	Nurse	Fasting instructions 30/30 (100.0); carbohydrate loading 0/30
Antibiotic prophylaxis	Given 30 min before skin incision	Anaesthetist	30/30 (100.0)
Thromboprophylaxis	Compression stockings	Nurse	30/30 (100.0)
No routine sedative premedication	No sedative premedication	Anaesthetist	30/30 (100.0)
Intraoperative			
Minimally invasive approach	Laparoscopic resection, no conversion	Surgeon	30/30 (100.0)
Opioid-sparing/locoregional analgesia	Epidural anaesthesia with ropivacaine	Anaesthetist	30/30 (100.0)
Fluid management	Goal-directed; urine output 0.5-1 mL/kg/h	Anaesthetist	30/30 (100.0)
Normothermia	36.5-37.5°C	Anaesthetist	30/30 (100.0)
PONV prophylaxis	Ondansetron	Anaesthetist	30/30 (100.0)
No routine nasogastric tube	Not placed routinely	Surgeon	30/30 (100.0)
Abdominal drain	Selective, by clinical judgement	Surgeon	12/30 (40.0) had a drain
Postoperative			
Non-opioid multimodal analgesia	Paracetamol 1 g 8-hourly and/or NSAID (diclofenac 75 mg 12-hourly); no opioid	Nurse	30/30 (100.0); rescue opioid 0/30
Mobilization on POD 1	Sitting, standing or walking; 4-5 h	Physiotherapist	30/30 (100.0)
Early oral intake	Clear liquids POD 1; soft diet POD 2	Surgeon	POD 1: 21/30 (70.0); POD 2: 9/30 (30.0); by POD 2: 30/30 (100.0)
Intravenous fluid reduction	Stopped by POD 2	Nurse	POD 2: 22/30 (73.3); POD 3: 8/30 (26.7)
Urinary catheter removal	Removed on POD 1	Surgeon	30/30 (100.0)
Drain removal	Output <50 mL	Surgeon	12/12 removed on POD 3
Discharge criteria met	Clinically stable; tolerating oral diet; pain and self-care manageable at home	Surgeon	30/30 (100.0)

POD: Postoperative day, PONV: Postoperative nausea and vomiting, NSAIDs: Non-steroidal anti-inflammatory drugs, For 30/30, the exact 95% CI is 88.4-100%, A composite compliance score was not calculated

stockings were used in all patients. Abdominal drains were used selectively in 12 patients (40.0%) and were removed on POD 3 in all 12. Oral intake began on POD 1 in 21 patients (70.0%; 95% CI 50.6-85.3) and on POD 2 in 9 (30.0%). Intravenous fluids were stopped by POD 2 in 22 patients (73.3%) and on POD 3 in the remaining 8. Urinary catheters were removed on POD 1 in all patients and all 30 met the discharge criteria. Adherence to each element is shown in Table 3. Overall patient-level compliance was not calculated, because a composite score across all applicable elements was not defined.

Postoperative Recovery and Outcomes

The mean primary postoperative stay was 4.7±0.94 days (95% CI 4.4-5.1), with a median of 5 days and a range of 3-8 days (Table 4). The patient who underwent redo surgery for anastomotic leak had an index stay of 8 days. The seven readmissions accounted for 22 additional hospital days (mean 3.1±1.2 days per readmission; median 3, range 2-5), equivalent to about 0.7 additional days per enrolled patient, so total postoperative hospital days including readmissions averaged about 5.5 days per patient (4.73 index stay plus 0.73 for readmissions; 164 days in total). Time to return of bowel function was 1 day in 14 patients (46.7%), 2 days in 13 (43.3%) and 3 days in 3 (10.0%); these values describe return of bowel function and not the incidence of postoperative ileus.

Postoperative complications occurred in 8 patients (26.7%; 95% CI 12.3-45.9): three were Clavien-Dindo grade I-II, three grade IIIa-IIIb and two grade IV, so five (16.7% of all patients) were grade ≥III. No patient died, as all 30 completed follow-up. The complications comprised fever in 4 patients (POD 1-5), atelectasis or other respiratory complication in 3 (POD 1-3), postoperative haemorrhage in 1 (POD 1) and anastomotic leak in 1 (diagnosed on POD 3). Seven patients (23.3%; 95% CI 9.9-42.3) were readmitted within 30 days of discharge, for abdominal pain (4 patients), stoma prolapse (2) and subacute intestinal obstruction (SAIO; 1). Two patients (6.7%; 95% CI 0.8-22.1) underwent redo surgery, one for bleeding on POD 1 and one for anastomotic leak (diagnosed on POD 3) on POD 4.

All 30 patients completed follow-up at 1 week, 4 weeks and 6 months. No recurrence was documented at the six-month visit. Six months of follow-up is too short to assess long-term oncological outcomes.

Representative preoperative CT images, operative photographs and resected specimens are provided as Supplementary Figures S1 and S2. They illustrate the pathology and operative technique of included cases and do not show ERAS outcomes.

DISCUSSION

In this prospective single-centre series of 30 patients with colorectal cancer who underwent laparoscopic resection with selected ERAS components, all patients were mobilized on POD 1, received non-opioid analgesia without rescue opioid and had started oral intake by POD 2. The mean primary postoperative stay was 4.7 days (95% CI 4.4-5.1). Complications occurred in 26.7, 23.3% were readmitted and 6.7% underwent redo surgery. These are descriptive

Table 4: Recovery and Postoperative Outcomes (N = 30)

Outcome	Category/statistic	n (%) or value	95% CI
Primary postoperative stay (days)	Mean±SD	4.7±0.94	4.4-5.1
	Median	5	
	Range	3-8	
Readmission stay (days), 7 patients	Mean±SD	3.1±1.2	
	Median (range)	3 (2-5)	
	Total additional hospital days	22	
Time to return of bowel function	1 day	14 (46.7)	
	2 days	13 (43.3)	
	3 days	3 (10.0)	
Postoperative complications	Any	8 (26.7)	12.3-45.9
	Clavien-Dindo I-II	3/8	
	Clavien-Dindo IIIa-IIIb	3/8	
	Clavien-Dindo IV	2/8	
Readmission	Any	7 (23.3)	9.9-42.3
	Within 30 days of discharge	7/7	
	Reason: abdominal pain	4/7	
	Reason: stoma prolapse	2/7	
	Reason: SAIO	1/7	
Redo surgery	Any	2 (6.7)	0.8-22.1
	Bleeding (POD 1)	1/2	
	Anastomotic leak (reoperation on POD 4)	1/2	
Follow-up completed	1 week	30 (100.0)	88.4-100
	4 weeks	30 (100.0)	88.4-100
	6 months	30 (100.0)	88.4-100

CI: Confidence interval (exact Clopper-Pearson for proportions, t distribution for mean stay), SAIO: Subacute intestinal obstruction

observations from a small uncontrolled cohort. They suggest that the pathway elements were feasible to deliver in this setting but they do not show that ERAS caused the observed recovery or length of stay.

All participants had malignancy, so the findings do not extend to benign or inflammatory indications, emergency surgery or patients with severe comorbidity, who were excluded. Only 30 of 82 screened patients were enrolled, which indicates a selected population. Cardiovascular disease (36.7%) and diabetes (20.0%) were common and these patients were clinically stable and optimized before surgery; 90.0% were ASA class I-II. The age and sex distributions should be interpreted cautiously given the sample size.

All 30 resections were completed laparoscopically without conversion (95% CI 0-11.6%), so a true conversion rate of up to about one in nine cannot be excluded. Conversion rates in published series vary with tumour location, operative complexity, patient selection and surgeon experience [14,15] and the technical demands of laparoscopy are a recognized barrier to wider adoption [14]. Our result reflects a single experienced surgeon and selected patients and may not generalize. A stoma was formed in 10 patients (33.3%), seven diverting and three terminal, in keeping with the proportion of rectosigmoid tumours (46.7%) and abdominoperineal resections (10.0%).

Adherence was recorded for 19 pathway elements and most were delivered to all 30 patients. Elements with lower adherence were oral intake on POD 1 (70.0%) and intravenous fluid cessation by POD 2 (73.3%) and drains were used in 40.0%, although avoiding unnecessary drains is an ERAS recommendation [8,9]. Carbohydrate loading was not used and no composite compliance score was calculated, so we cannot claim adherence to a complete ERAS protocol. Larger cohorts have associated greater ERAS compliance with better outcomes [16] but this study cannot test that relationship. No rescue opioid was given but analgesia included epidural ropivacaine, so the findings apply to this specific regimen.

The mean primary stay of 4.7 days (median 5) is close to the median of 5.5 days (range 2-40) reported in a series of 200 patients managed with laparoscopy and ERAS for benign and malignant disease [17]. Differences in case mix, stoma formation, discharge criteria and the definition of length of stay limit such comparisons. Because there was no conventional-care or historical comparator, the stay cannot be attributed to ERAS; the laparoscopic approach, patient selection, surgeon expertise and discharge practice may all have contributed. The index stay should be read alongside readmissions, which added 22 hospital days (about 0.7 days per enrolled patient).

Complications occurred in 8 of 30 patients (26.7; 95% CI 12.3-45.9), a proportion similar to the 29.5% reported in the same series [17]. However, five of our eight complications (16.7% of all patients) were Clavien-Dindo grade ≥III, compared with 3.5% major complications in that series [17]. The readmission rate of 23.3% (95% CI 9.9-42.3) was much higher than the 2.5% within 30 days reported there [17], although we counted all-cause readmission and the studies differ in case mix, with all of ours being cancer resections and a third involving a stoma. Readmissions in our cohort were mostly for symptoms related to bowel function or the stoma

(abdominal pain, stoma prolapse, subacute obstruction). It is possible that early discharge, stoma education or the intensity of post-discharge support contributed but this study cannot test those explanations. Redo surgery was required in 6.7% (95% CI 0.8-22.1) for bleeding and anastomotic leak, compared with 3% in the comparison series [17]. These estimates are imprecise and ERAS should not be regarded as a means of eliminating postoperative morbidity.

Outcomes may also have been influenced by tumour stage (30.0% stage III), stoma formation (10 of 30 patients) and operative complexity, particularly rectal resections and abdominoperineal resection. Only one patient (3.3%) received neoadjuvant therapy, so any effect of pre-operative treatment on operative difficulty, stage or recovery cannot be assessed and it may also have affected the staging of that patient. A sample of 30 cannot separate these effects and we did not analyse them.

CONCLUSIONS

In this small, single-centre, descriptive cohort of 30 patients undergoing laparoscopic resection for colorectal cancer, delivery of selected ERAS components was feasible, with mobilization on POD 1 in all patients and a mean primary postoperative stay of 4.7 days (95% CI 4.4-5.1). The readmission rate (23.3%; 95% CI 9.9-42.3) and the proportion of complications of grade ≥III were notable, there was no control group and adherence was assessed element by element without a composite score. These findings therefore describe observed recovery patterns and do not show that ERAS shortened hospitalization or improved recovery. Adequately powered comparative studies with predefined ERAS compliance metrics, standardized complication grading and total healthcare utilization are needed.

Limitations

This was a single-centre study of 30 patients, with a pragmatically determined sample size and all operations by a single surgeon, so precision and generalizability are limited. The study was not prospectively registered in a public registry, so the prespecified endpoints cannot be independently verified. Only 30 of 82 screened patients were enrolled, which introduces selection bias; patients sent for neoadjuvant chemotherapy who did not return for surgery were not captured, which may partly explain why only one enrolled patient had received neoadjuvant therapy. There was no comparison group, so confounding by laparoscopy, case selection, surgeon expertise and discharge practice cannot be addressed. The cohort was heterogeneous in tumour site and procedure and the effects of stage and stoma could not be evaluated. ERAS adherence was recorded for individual elements only, with no composite score and no patient-level analysis. Complications were graded by the Clavien-Dindo system within 30 days and later events were not captured. Readmissions to other hospitals may have been under-ascertained, as they relied on patient reports and available records. Six months of follow-up is too short for oncological outcomes, quality of life and functional recovery were not assessed and outcome assessment was not blinded.

Future work should compare ERAS-based care with conventional care in adequately powered studies, using predefined compliance metrics, standardized complication grading and total healthcare utilization, including readmissions, as outcomes.

Acknowledgement

The authors acknowledge the Postgraduate Department of Minimal Access and General Surgery, Government Medical College, Srinagar, for its support during the conduct of this study.

Ethical Approval and Consent to Participate

Approved by the Institutional Ethics Committee, GMC Srinagar (Reference No. IRBGMC-SRG/Sur/732; 7 August 2024). Written informed consent was obtained from all participants before enrolment.

REFERENCES

[1] Sawayama, H. *et al.* "Essential Updates 2020/2021: Colorectal Diseases (Benign) - Current Topics in the Surgical and Medical Treatment of Benign Colorectal Diseases." *Annals of Gastroenterological Surgery*, vol. 6, no. 3, 2022, pp. 321-335.

[2] Lin, Y. *et al.* "Comparing the Effects of Laparoscopic Radical Surgery and Traditional Open Surgery on Short-Term Efficacy and Long-Term Survival in Patients with Colorectal Cancer." *Frontiers in Surgery*, vol. 12, 2026.

[3] Schwenk, W. *et al.* "Short Term Benefits for Laparoscopic Colorectal Resection." *Cochrane Database of Systematic Reviews*, no. 3, 2005.

[4] Pathak, A. and M. Wanjari. "Minimally Invasive Colorectal Surgery Techniques." *Cureus*, vol. 15, no. 10, 2023.

[5] Patil, M.J. *et al.* "Comparative Analysis of Laparoscopic Versus Open Procedures in Specific General Surgical Interventions." *Cureus*, vol. 16, no. 2, 2024.

[6] Keller, D.S. *et al.* "The Trends in Adoption, Outcomes and Costs of Laparoscopic Surgery for Colorectal Cancer in the Elderly Population." *Journal of Gastrointestinal Surgery*, vol. 25, no. 3, 2021, pp. 766-774.

[7] Shi, B. *et al.* "Laparoscopic-Assisted Colorectal Resection Can Reduce the Inhibition of Immune Function Compared with Conventional Open Surgery: A Retrospective Clinical Study." *Journal of Clinical Medicine*, vol. 12, 2023.

[8] Irani, J.L. *et al.* "Clinical Practice Guidelines for Enhanced Recovery After Colon and Rectal Surgery from the American Society of Colon and Rectal Surgeons and the Society of American Gastrointestinal and Endoscopic Surgeons." *Surgical Endoscopy*, vol. 37, no. 1, 2023, pp. 5-30.

[9] Gustafsson, U.O. *et al.* "Guidelines for Perioperative Care in Elective Colorectal Surgery: Enhanced Recovery After Surgery (ERAS) Society Recommendations: 2018." *World Journal of Surgery*, vol. 43, no. 3, 2019, pp. 659-695.

[10] Lei, Q.C. *et al.* "Laparoscopic Versus Open Colorectal Resection Within Fast Track Programs: An Update Meta-Analysis Based on Randomized Controlled Trials." *Journal of Clinical Medicine Research*, vol. 7, no. 8, 2015, pp. 594-601.

[11] Vlug, M.S. *et al.* "Laparoscopy in Combination with Fast Track Multimodal Management Is the Best Perioperative Strategy in Patients Undergoing Colonic Surgery: A Randomized Clinical Trial (LAFA-Study)." *Annals of Surgery*, vol. 254, no. 6, 2011, pp. 868-875.

[12] von Elm, E. *et al.* "The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: Guidelines for Reporting Observational Studies." *Lancet*, vol. 370, no. 9596, 2007, pp. 1453-1457.

[13] Dindo, D. *et al.* "Classification of Surgical Complications: A New Proposal with Evaluation in a Cohort of 6336 Patients and Results of a Survey." *Annals of Surgery*, vol. 240, no. 2, 2004, pp. 205-213.

[14] Lim, S. *et al.* "Laparoscopic Suturing as a Barrier to Broader Adoption of Laparoscopic Surgery." *JSLS*, vol. 21, no. 3, 2017.

[15] Chand, M. *et al.* "Systematic Review of Emergent Laparoscopic Colorectal Surgery for Benign and Malignant Disease." *World Journal of Gastroenterology*, vol. 20, no. 45, 2014, pp. 16956-16963.

[16] Gustafsson, U.O. *et al.* "Adherence to the Enhanced Recovery After Surgery Protocol and Outcomes After Colorectal Cancer Surgery." *Archives of Surgery*, vol. 146, no. 5, 2011, pp. 571-577.

[17] Pedrazzani, C. *et al.* "Laparoscopic Colorectal Surgery and Enhanced Recovery After Surgery (ERAS) Program: Experience with 200 Cases from a Single Italian Center." *Medicine (Baltimore)*, vol. 97, no. 35, 2018.