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LAPAROSCOPIC VERSUS OPEN RESECTION FOR COLORECTAL CANCER: SHORT-TERM SURGICAL OUTCOMES AND ONCOLOGIC QUALITY IN A RESOURCE-CONSTRAINED TERTIARY CENTRE

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ABSTRACT

Objective: To compare short-term outcomes and oncologic quality after laparoscopic-intent versus planned-open resection.
Study Design: Prospective comparative observational study.
Settings: Department of General Surgery, Jinnah Postgraduate Medical Centre, Karachi, Pakistan.
Period: December 2025–May 2026.
Material & Methods: Eighty adults undergoing resection formed two equal groups and were analysed by intention to treat. Continuous outcomes used Welch t or Mann–Whitney U tests; categorical outcomes used Pearson chi-square or Fisher exact tests. $p \le 0.05$ was significant.
Results: Operative time was longer with laparoscopic intent (188.5±27.6 vs 153.0±27.3 minutes; difference 35.5, 95% CI 23.3–47.7; $p<0.001$), while blood loss was lower (median 150 [IQR 100–200] vs 312.5 [250–375] mL; $p<0.001$). First flatus occurred earlier (2.06±0.57 vs 3.08±0.55 days; $p<0.001$) and stay was shorter (median 6 [5–7] vs 7 [6–8] days; $p<0.001$). Thirty-day morbidity was not significantly different (20.0% vs 32.5%; OR 0.52, 95% CI 0.19–1.44; $p=0.204$). Lymph-node yield (18.2±4.8 vs 17.1±4.2; $p=0.268$), adequate harvest (92.5% vs 90.0%; $p=1.000$), and R0 resection (95.0% in both groups; $p=1.000$) were comparable.
Conclusion: In this study, laparoscopic-intent resection improved blood loss and recovery while preserving oncologic quality, despite longer operating time. Genuine prospective data are required before clinical inference or submission.

KEYWORDS: Colorectal cancer, Laparoscopy, Lymph-node yield, Minimally invasive surgery, Surgical oncology

INTRODUCTION

Colorectal cancer remains a major global health burden. Approximately 1.9 million new cases and more than 900,000 deaths occurred worldwide in 2022, and the disease is the second leading cause of cancer death. Curative-intent resection remains central to management of localized colon and rectal adenocarcinoma, with operative quality influencing perioperative recovery, nodal staging, margin status, and subsequent multidisciplinary treatment.[1,2]

Laparoscopic colorectal resection has become an accepted alternative to open surgery in appropriately selected patients and experienced units. Contemporary guidelines support minimally invasive approaches when oncologic principles can be maintained, while enhanced-recovery recommendations emphasize blood conservation, early mobilization, restoration of gut function, and shorter hospitalization. The evidence generally shows lower blood loss and faster recovery after laparoscopy, although longer operating time, conversion risk, technical training, equipment availability, and case selection remain important—particularly in resource-constrained services.[3–6]

Recent Pakistani series demonstrate increasing feasibility of minimally invasive colorectal surgery, but locally generated comparative data remain limited and may not reflect the case mix and infrastructure of a high-volume public tertiary centre. This study was therefore designed to compare laparoscopic-intent and planned-open resection for stage I–III colorectal cancer. The primary objectives were to compare operative time, estimated blood loss, return of bowel function, postoperative stay, and 30-day morbidity; secondary objectives were to compare total lymph-node yield, the proportion with at least 12 nodes, and R0 resection. We hypothesized that laparoscopic-intent surgery would improve short-term recovery without compromising oncologic quality.[7–10]

MATERIAL & METHODS

This was a prospective comparative observational study planned in the Department of General Surgery, Jinnah Postgraduate Medical Centre (JPMC), Karachi, Pakistan. The approved protocol specified four months of recruitment after institutional approval. The supplied educational dataset contains operation dates from 1 April through 31 July 2026; these dates must be checked against the genuine case records before submission. Reporting was structured according to STROBE principles.

Adults aged 18–75 years of either sex with histologically proven colorectal adenocarcinoma, clinical stage I–III disease, planned elective curative-intent resection, American Society of Anesthesiologists (ASA) class I–III, and consent under the approved protocol were eligible. Exclusion criteria were emergency presentation with perforation, peritonitis, or complete obstruction; stage IV or palliative surgery; cT4b disease requiring planned multivisceral resection; recurrent or synchronous colorectal cancer; previous major colorectal resection; and incomplete pathology or 30-day follow-up data. Non-probability purposive sampling was used.

The sample size was calculated using the World Health Organization two-mean formula. A previous Pakistani comparison reported postoperative stay of 5.40±1.88 days after minimally invasive surgery and 6.59±1.68 days after open surgery. Using a pooled standard deviation of 1.78 days, a mean difference of 1.19 days, 95% confidence, and 80% power yielded 36 participants per group. Allowing 10% for incomplete observations produced a target of 40 per group (total n=80).[7]

The operative approach was selected by the treating surgical team according to tumour characteristics, patient factors, available expertise, and resources; it was not randomly assigned. Patients were classified as laparoscopic-intent or planned-open before incision. Laparoscopic cases converted to laparotomy remained in the laparoscopic-intent group for the primary intention-to-treat analysis. Standard oncologic resection principles were applied according to tumour location, including appropriate mesocolic or total mesorectal excision and regional lymphadenectomy. Perioperative care and discharge were determined by the treating unit. Patients were followed for 30 days after surgery.

Baseline variables included age, sex, body mass index, diabetes, hypertension, ischemic heart disease, ASA class, tumour site, clinical stage, and neoadjuvant therapy. Short-term outcomes were operative time (skin incision to closure), estimated blood loss, intraoperative transfusion, time to first flatus, postoperative hospital stay, conversion, any 30-day complication, reoperation, readmission, and mortality. Oncologic-quality outcomes were pathological T and N stage, total lymph-node yield, adequate nodal harvest (≥12 nodes), negative proximal and distal margins, negative radial/circumferential margin for rectal cancer, and final R0 resection (no microscopic residual tumour).

Analysis was specified for IBM SPSS Statistics version 26.0. Continuous variables were summarized as mean±standard deviation and median with interquartile range. Shapiro–Wilk tests were applied within each group. Welch independent-samples t tests were used when both groups met the prespecified normality criterion ($p \geq 0.05$); otherwise Mann–Whitney U tests were used. Categorical variables were reported as frequency and percentage and compared with Pearson chi-square tests when all expected cell counts were at least five; Fisher exact tests were used otherwise. Mean differences with 95% confidence intervals and Cohen d were calculated for normally distributed outcomes; rank-biserial correlations were used for non-normal outcomes. Odds ratios (ORs) with 95% confidence intervals were reported for binary outcomes where estimable. Prespecified exploratory stratification used age (<60/≥60 years), BMI (<25/≥25 kg/m²), ASA class (I–II/III), tumour site (colon/rectum), clinical stage (I–II/III), and neoadjuvant therapy. All tests were two-sided and $p \leq 0.05$ was considered statistically significant; no multiplicity adjustment was applied to exploratory analyses.

The approved synopsis specified institutional ethical approval and written informed consent. Before submission, the authors must insert and verify the JPMC institutional review board approval number and date: [INSERT VERIFIED APPROVAL NUMBER AND DATE]. The present manuscript uses only the supplied simulated educational file; it does not constitute analysis of identifiable or genuine patient data.

RESULTS

The dataset contained 80 complete records, with 40 participants in each exposure group and no missing primary or oncologic outcomes. Four laparoscopic-intent procedures were converted to open surgery (10.0%) and retained in the laparoscopic-intent group. Baseline age, sex, BMI, comorbidities, ASA class, tumour site, clinical stage, and neoadjuvant therapy did not differ significantly between groups (Table I).

Table I. Baseline demographic and clinical characteristics (n=80)

Characteristic	**Laparoscopic intent (n=40)**	**Planned open (n=40)**	**p-value**
Age, years, mean±SD	56.3±10.6	58.8±10.7	0.299

Characteristic	Laparoscopic intent (n=40)	Planned open (n=40)	p-value
Sex			**0.179**
Male	24 (60.0)	18 (45.0)	
Female	16 (40.0)	22 (55.0)	
BMI, kg/m², mean±SD	25.2±3.0	26.0±3.4	0.286
Diabetes mellitus	7 (17.5)	10 (25.0)	0.412
Hypertension	14 (35.0)	10 (25.0)	0.329
Ischemic heart disease	3 (7.5)	3 (7.5)	1.000
ASA class			**0.143**
I	8 (20.0)	12 (30.0)	
II	23 (57.5)	25 (62.5)	
III	9 (22.5)	3 (7.5)	
Tumour site			**0.465**
Right colon	9 (22.5)	14 (35.0)	
Left/sigmoid colon	17 (42.5)	14 (35.0)	
Rectum	14 (35.0)	12 (30.0)	
Clinical stage			**0.329**
I	8 (20.0)	4 (10.0)	
II	12 (30.0)	17 (42.5)	
III	20 (50.0)	19 (47.5)	
Neoadjuvant therapy	7 (17.5)	9 (22.5)	0.576

Values are n (%) unless stated otherwise. ASA, American Society of Anesthesiologists; BMI, body mass index; SD, standard deviation. Pearson chi-square was used for multi-category variables; Fisher exact was used when expected counts were <5.

Laparoscopic-intent surgery required 35.5 additional minutes on average (95% CI 23.3–47.7; p<0.001) but was associated with substantially lower estimated blood loss (rank-biserial correlation −0.76; p<0.001). Intraoperative transfusion occurred in 5.0% versus 20.0% (p=0.043). First flatus occurred 1.02 days earlier (95% CI −1.27 to −0.77; p<0.001), and median postoperative stay was one day shorter (p<0.001). Overall 30-day morbidity was numerically lower after laparoscopic-intent surgery, but the difference was not statistically significant (20.0% vs 32.5%; OR 0.52, 95% CI 0.19–1.44; p=0.204). Reoperation, readmission, and mortality were uncommon and comparable (Table II).

Table II. Short-term surgical outcomes by intended operative approach

Outcome	Laparoscopic intent (n=40)	Planned open (n=40)	p-value
Operative time, min, mean±SD	188.5±27.6	153.0±27.3	<0.001
Estimated blood loss, mL, median (IQR)	150 (100–200)	312.5 (250–375)	<0.001
Intraoperative transfusion	2 (5.0)	8 (20.0)	0.043
Time to first flatus, days, mean±SD	2.06±0.57	3.08±0.55	<0.001
Postoperative stay, days, median (IQR)	6 (5–7)	7 (6–8)	<0.001
Conversion to open surgery	4 (10.0)	Not applicable	—
Any 30-day complication	8 (20.0)	13 (32.5)	0.204

Outcome	Laparoscopic intent (n=40)	Planned open (n=40)	p-value
Anastomotic leak	1 (2.5)	3 (7.5)	—
Surgical-site infection	3 (7.5)	8 (20.0)	—
Ileus	3 (7.5)	0	—
Pulmonary complication	1 (2.5)	2 (5.0)	—
Reoperation within 30 days	1 (2.5)	1 (2.5)	1.000
Readmission within 30 days	1 (2.5)	2 (5.0)	1.000
Mortality within 30 days	0	1 (2.5)	1.000

Values are n (%) unless stated otherwise. IQR, interquartile range; SD, standard deviation. Welch t tests compared operative time and time to flatus; Mann–Whitney U tests compared blood loss and length of stay. Pearson chi-square compared transfusion and any morbidity; Fisher exact compared sparse binary outcomes. Complication subtypes are descriptive and were not individually tested.

Pathological stage distributions were similar between groups. Mean lymph-node yield was 18.2±4.8 after laparoscopic-intent and 17.1±4.2 after planned-open resection (p=0.268). Adequate harvest of at least 12 nodes occurred in 92.5% and 90.0%, respectively (OR 1.37, 95% CI 0.29–6.56; p=1.000). Proximal and distal margins were negative in 97.5% of each group; among rectal resections, the radial margin was negative in 13/14 (92.9%) and 11/12 (91.7%). R0 resection was achieved in 95.0% of each group (Table III).

Table III. Pathological findings and oncologic-quality outcomes

Outcome	Laparoscopic intent (n=40)	Planned open (n=40)	p-value
Pathological T stage			**0.558**
T1	4 (10.0)	1 (2.5)	
T2	7 (17.5)	7 (17.5)	
T3	27 (67.5)	29 (72.5)	
T4	2 (5.0)	3 (7.5)	
Pathological N stage			**0.328**
N0	25 (62.5)	22 (55.0)	
N1	13 (32.5)	12 (30.0)	
N2	2 (5.0)	6 (15.0)	
Total lymph nodes, mean±SD	18.2±4.8	17.1±4.2	0.268
Adequate lymph-node harvest (≥12)	37 (92.5)	36 (90.0)	1.000
Negative proximal/distal margins	39 (97.5)	39 (97.5)	1.000
Negative radial margin, rectal cases only	13/14 (92.9)	11/12 (91.7)	1.000
Final R0 resection	38 (95.0)	38 (95.0)	1.000

Values are n (%) unless stated otherwise. SD, standard deviation. Welch t test compared total lymph-node yield; Pearson chi-square compared stage distributions; Fisher exact compared binary oncologic-quality outcomes.

In prespecified exploratory strata, the direction of the length-of-stay difference generally favoured laparoscopic intent across age, BMI, tumour-site, and stage categories. The comparison was imprecise among the small ASA III and neoadjuvant-therapy subgroups. No consistent subgroup difference was observed for morbidity, adequate nodal harvest, or R0 resection. Because these analyses were sparse, unadjusted, and not corrected for multiple testing, they should be considered descriptive rather than evidence of effect modification.

DISCUSSION

This study produced a coherent short-term profile: laparoscopic-intent resection took longer but was associated with lower blood loss, fewer transfusions, earlier return of bowel function, and shorter hospitalization. The 10%

conversion rate remained within the intention-to-treat group, preserving the clinically relevant consequence of selecting a laparoscopic strategy. The 35.5-minute increase in operating time closely resembles the 30.4-minute pooled increase reported in a 2022 meta-analysis, while the approximately one-day earlier bowel recovery also aligns with its pooled estimate.[15]

The observed reduction in blood loss and one-day shortening of postoperative stay are consistent with contemporary comparative studies. A population-based Swedish analysis of 13,683 colon-cancer resections found shorter stay and fewer adverse short-term outcomes after laparoscopy. A Pakistani comparison likewise reported less blood loss and shorter hospitalization with minimally invasive resection. More recent experience from high-volume centres in Pakistan has shown that laparoscopic colorectal programmes can achieve acceptable conversion, morbidity, and short-term recovery despite constraints in training and infrastructure.[7,9–12]

Overall 30-day morbidity was 12.5 percentage points lower with laparoscopic intent, but the confidence interval was wide and crossed the null. This should not be interpreted as equivalence or absence of a clinically meaningful effect. The sample was powered for length of stay, not morbidity. The direction is compatible with evidence in elderly patients: both a 2022 meta-analysis and a multicentre cohort reported lower complications after laparoscopic surgery, although patient selection and centre expertise can influence observational comparisons. The randomized LapCoRe trial, conversely, found no significant difference in overall complications between laparoscopic and open right colectomy with central lymphadenectomy, illustrating that morbidity benefits are not uniform across settings and procedures.[14–16]

Oncologic quality was preserved in this study data. Both groups exceeded the accepted benchmark of 12 lymph nodes in approximately nine of ten resections, mean yields were similar, and R0 resection was 95% in each group. These findings accord with the LASRE randomized trial, which reported comparable mesorectal completeness, margins, and node retrieval between approaches, and with nationwide rectal-cancer data showing non-inferior long-term oncologic outcomes after laparoscopy. A propensity-matched analysis of locally advanced rectal cancer also found laparoscopic surgery oncologically safe with lower morbidity and shorter stay.[13,17,18]

Resource constraints remain central to interpretation and implementation. Laparoscopy requires stable access to equipment, energy devices, trained camera assistants, anaesthetic support, and surgeons able to manage advanced pelvic and multiquadrant dissection. Longer theatre occupancy may offset some ward-level savings, whereas lower blood loss, faster recovery, and shorter admission may be particularly valuable where beds and blood products are scarce. Recent propensity-weighted evidence from another middle-income setting favoured laparoscopic outcomes after adjustment for measured confounders, but residual confounding remains possible. Enhanced-recovery pathways should accompany either approach because standardized perioperative care can independently improve return of function and length of stay.[5,6,19]

The analysis also has important limitations. Most importantly, the single-centre, non-randomized design would be vulnerable to selection bias and confounding by tumour complexity, surgeon preference, learning curve, and resource availability. The sample was small, subgroup analyses were underpowered, complication severity was not graded, and 30-day follow-up cannot evaluate recurrence, disease-free survival, quality of life, or cost-effectiveness. Contemporary reviews report favourable recovery and quality-of-life outcomes with laparoscopy, but heterogeneity and risk of bias remain substantial. The primary analysis rerun without outcome-driven changes, and adjusted or propensity-based sensitivity analyses considered if covariate balance permits.[19–21]

CONCLUSION

In this study, laparoscopic-intent colorectal cancer resection was associated with lower blood loss and faster postoperative recovery, with similar 30-day morbidity and oncologic-quality measures, despite longer operating time. These findings require confirmation using genuine prospectively collected records before clinical interpretation or publication.

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