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SHORT-TERM ONCOLOGICAL EFFICACY OF LAPAROSCOPIC APPROACH IN COLORECTAL MALIGNANCY: A PROSPECTIVE CASE CONTROL STUDY

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ABSTRACT

Background: Laparoscopic colorectal surgery has evolved into a widely accepted alternative to open surgery, offering perioperative advantages while maintaining oncological safety.
Aim: To compare the short-term surgical and oncological outcomes of laparoscopic versus open colorectal cancer surgery.
Methods: A prospective case–control study was conducted at SVIMS, Tirupati (July 2023–May 2024). Patients with biopsy-confirmed colorectal disease underwent laparoscopic or open resection. Demographic variables, perioperative data, postoperative recovery, complications, and oncological parameters were compared.
Results: The laparoscopic group demonstrated significantly reduced blood loss, shorter ICU and hospital stays, earlier return of bowel function, and faster return to work ($p < 0.05$). Major complications (Clavien-Dindo ≥ III) occurred only in the open group. Oncological outcomes, including resection margins and lymph node retrieval, were comparable between techniques.
Conclusion: Laparoscopic colorectal surgery offers superior short-term clinical outcomes with equivalent oncological safety compared to open surgery.

Keywords: Laparoscopic colorectal surgery, colorectal carcinoma, minimally invasive surgery, oncological outcomes.

INTRODUCTION

Laparoscopic surgery has evolved dramatically since the early 1990s and is widely regarded as one of the most significant technological advancements in modern surgical practice. Its success is attributed to reduced procedure-related morbidity, faster postoperative recovery, better cosmesis, and fewer wound-related complications, all of which contribute to favourable short-term outcomes. [1][2]
Despite the emergence of laparoscopic techniques first described in 1901, it was only with the advent of advanced imaging systems, superior optics, and refined instrumentation in the late twentieth century that minimally invasive colorectal surgery gained widespread acceptance as a viable alternative to conventional open procedures. [1][3]

Over recent decades, the laparoscopic approach has been increasingly employed for both benign and malignant colorectal conditions. Despite the initially steep learning curve, it has proven to be highly advantageous once adequate surgical skill is achieved. [4][5]

Numerous studies have demonstrated that laparoscopy offers several perioperative benefits, including reduced intraoperative blood loss, smaller incisions, shorter hospital stays, and quicker recovery, though these advantages often come at the expense of longer operative times.

Earlier concerns regarding its oncological safety were largely driven by reports of port-site metastasis rates as high as 21% in malignant disease, limiting its initial use primarily to benign pathology. [6][7]

However, subsequent high-quality trials have confirmed that laparoscopic colorectal resection is oncologically non-inferior to open surgery, offering comparable resection margins, lymph node harvest, and short-term cancer control. [8][9][10]

These cumulative findings have established laparoscopy as a safe, effective, and increasingly preferred modality in colorectal cancer surgery, warranting continued evaluation of its short-term outcomes in diverse clinical settings.

AIM & OBJEVTIVES

To assess the acceptability and effectiveness of the laparoscopic approach in the management of colorectal carcinoma, with specific objectives to compare intraoperative parameters, postoperative complications, recovery indicators, and short-term oncological outcomes between laparoscopic and open resections.

MATERIALS AND METHODS

This prospective case-control study was conducted in the Department of General Surgery at Sri Venkateswara Institute of Medical Sciences (SVIMS), Tirupati, from July 2023 to May 2024. Patients presenting with abdominal pain, altered bowel habits, rectal bleeding, palpable mass per rectum, anaemia, or unintended weight loss were systematically evaluated. All participants underwent clinical assessment, contrast-enhanced CT (CECT) of the abdomen and pelvis, colonoscopy, and histopathological confirmation through biopsy. Individuals diagnosed with benign or malignant colorectal disease and deemed suitable for definitive surgical management were included.

Patients who were medically unfit for general anaesthesia or who had received neoadjuvant therapy were excluded. Eligible patients were allocated into laparoscopic or open surgery groups based on surgical feasibility and standard institutional practice. Statistical analyses were performed using mean, standard deviation, the Chi-square test, and the Mann–Whitney U test as appropriate. A p-value <0.05 was considered statistically significant.

RESULTS

Laparoscopic Group

The laparoscopic group (n = 15) had a mean age of 63.02 ± 4.78 years, with a male-to-female ratio of 0.87:1. A majority of patients (80%, n = 12) belonged to a low socioeconomic background. Hypertension and diabetes were present in 86.67% (n = 13) and 26.67% (n = 4), respectively. Preoperative hypoalbuminaemia (<3.5 mg/dL) and severe anaemia (<8 g/dL) were identified in 93.33% (n = 14) and 40% (n = 6) of patients. The mean intraoperative blood loss was 128 ± 38.20 mL, and the mean operative duration was 224.6 ± 16.74 minutes.

On postoperative day 1 (POD-1), 26.67% (n = 4) required opioid analgesia. Bowel sounds returned after a mean duration of 1.47 ± 0.91 days. Two patients (13.33%) required postoperative blood transfusion. Three patients (20%) developed postoperative complications; one patient succumbed to a severe surgical-site infection, while the remaining two developed paralytic ileus and pneumonia. No major complications (Clavien–Dindo ≥ Grade III) were recorded. The mean ICU stay was 1.13 ± 0.35 days, and the overall mean postoperative hospital stay was 5.46 ± 1.06 days. Patients resumed work after a mean of 17.06 ± 4.13 days. The majority were well-differentiated, ascending colon carcinoma, predominantly stage III (AJCC 8th edition).

S.No.	Variable		Laparoscopic approach n=15)	Open approach(n=25)	p-value
1.	Age (in years)		63.02 ± 4.78	65.76 ± 5.55	0.892
2.	Gender	Male	7	15	0.412
		Female	8	10	
3.	Low socioeconomic status		12	24	0.102
4.	Comorbidities	Hypertension	13	15	0.074
		Diabetes mellitus	4	14	0.71
5.	Pre-operative	Albumin (< 3.5 mg/dL)	14	23	0.876
		Haemoglobin (< 8 g/dL)	6	12	0.622
6.	Intra-operative	Blood loss (mL)	128 ± 38.20	195 ± 68.46	0.001
7.		Duration of surgery (minutes)	224.6 ± 16.74	198.6 ± 18.57	0.0001
8.	Day 1	Opioids need	4	15	0.04
9.	Appearance of Bowel sounds (in days)		1.47 ± 0.91	2.68 ± 0.9	0.0003
10.	Post-operative complications	Blood transfusions	2	16	0.001
		SSI	1	5	0.85
		Ileus	1	3	
		Pneumonia	1	2	
11.	Clavien-Dindo (Major (≥ Grade III) complications)		0	2	0.000
12.	ICU stay (in days)		1.13 ± 0.35	2.08 ± 0.76	0.0001
13.	Length of post-operative hospital stay (in days)		5.46 ± 1.06	8.56 ± 2.27	<0.0001
14.	Tumour location	Right colon	9	16	0.453
		Left colon	4	4	
		Sigmoid colon	0	3	
		Rectum	2	2	
15.	Differentiation	Well	11	16	0.679
		Moderate	3	5	
		Poor	1	4	
16.	TNM staging (AJCC -8th)	I	2	1	0.434
		II	6	14	
		III	7	10	
17.	Return to work (days)		17.06 ± 4.13	28.16 ± 0.55	<0.0001
18.	Margin achieved (cms)	Proximal	12.4 ± 6.4	11.2 ± 1.8	0.511
		Distal	10.85 ± 6.2	9.9 ± 5.2	0.377
19.	Number of LNs retrieved		13.52 ± 7.2	14.2 ± 6.2	0.237

Open Surgery Group

In the open surgery group (n = 25), the mean age was 65.76 ± 5.55 years, and the male-to-female ratio was 1.5:1. The majority (96%, n = 24) belonged to a low socioeconomic group. Hypertension and diabetes were present in 60% (n = 15) and 56% (n = 14), respectively. Preoperative hypoalbuminaemia and anaemia were observed in 92% (n = 23) and 48% (n = 12).

The mean blood loss was 195 ± 68.46 mL, and the mean operative time was 198.6 ± 18.57 minutes. On POD-1, 60% (n = 15) required opioids. Bowel activity resumed after a mean of 2.68 ± 0.9 days. Postoperative transfusion was required in 64% (n = 16). Ten patients (40%) experienced postoperative complications (5 SSI, 3 ileus, 2 pneumonia). Major complications (Clavien–Dindo ≥Grade III) occurred in 8% (n = 2). The mean ICU stay was 2.08 ± 0.76 days, and the postoperative hospital stay averaged 8.56 ± 2.27 days. Patients returned to work after an average of 28.16 ± 0.55 days. Most tumours were well-differentiated, ascending colon cancers, predominantly stage II.

Statistically significant differences were noted between laparoscopic and open groups in blood loss, operative duration, opioid requirement on POD-1, time to bowel sound recovery, postoperative transfusion rates, ICU stay, length of hospital stay, return-to-work interval, and major complication rates ($p < 0.05$). Oncological indicators, including resection margins and lymph node yield, were comparable between groups.

DISCUSSION

This study presents a comparative evaluation of laparoscopic and open approaches in colorectal cancer surgery, demonstrating that both groups were well-matched with respect to baseline demographics, comorbid conditions, nutritional status, and socioeconomic profile, minimising confounding and enhancing the validity of outcome comparison. Consistent with global literature, the laparoscopic approach resulted in significantly reduced intraoperative blood loss, a finding repeatedly supported by pivotal trials such as COST, COLOR, and CLASICC. Improved operative visibility, magnification, and minimal bowel handling intrinsic to laparoscopy likely contributed to these observations.

Although the laparoscopic surgery required longer operative times, a recognised characteristic during early learning phases or complex dissections, this did not result in adverse clinical outcomes. Previous studies by Zhou S et al. [5] and Veldkamp et al. [8] report similar trends, confirming that operative duration does not minimise the inherent benefits of minimally invasive surgery. Postoperative recovery variables strongly favoured the laparoscopic group. Lower opioid requirements, earlier return of bowel function, and markedly shorter ICU and hospital stays indicate enhanced physiological recovery. These findings align with reports by Jordan et al. [11] highlight reduced incision size and decreased tissue trauma as key contributors to faster convalescence.

The significantly higher transfusion requirement in the open group reflects greater blood loss and postoperative haemoglobin decline associated with conventional surgery. Although rates of minor complications, surgical-site infections, ileus, and pneumonia showed no statistically significant difference, major complications occurred exclusively in the open group. Similar observations in the literature suggest that minimally invasive techniques reduce the physiological burden of surgery and mitigate the risk of severe postoperative events. Functionally, patients undergoing laparoscopic surgery resumed normal activity roughly ten days earlier than those in the open group. This has important socioeconomic implications, particularly in low-income populations.

Oncological parameters, including tumour distribution, histological differentiation, pathological staging, margin clearance, and lymph node retrieval, were comparable between both approaches. The equivalence in lymph node yield supports the oncological adequacy of laparoscopy. These results are similar to the conclusions of landmark randomised trials (COST, CLASICC, COLOR), which established that minimally invasive colorectal surgery does not compromise oncological radicality when performed by trained surgeons.

CONCLUSION

This study demonstrates that laparoscopic colorectal surgery offers significant perioperative and postoperative advantages over the open approach, including reduced blood loss, lower transfusion requirements, fewer major complications, shorter ICU and hospital stay, and faster return to normal activity. Importantly, key oncological outcomes, such as lymph node retrieval and margin status, were equivalent between the two techniques, confirming that laparoscopic surgery maintains oncological integrity. These findings support the continued expansion of minimally invasive colorectal surgery as a safe and oncologically effective treatment modality.

STRENGTHS AND LIMITATIONS

A major strength of this study lies in its comprehensive assessment of both surgical and short-term oncological parameters, enabling a strong comparison between laparoscopic and open colorectal resections. The prospective design ensured systematic data collection, and the inclusion of detailed perioperative variables, ranging from patient recovery to oncological adequacy measures, enhanced the analytical depth of the study. Additionally, the comparison of clinically relevant outcomes such as postoperative complications, transfusion requirements, and return-to-work intervals contributes valuable evidence to the relative benefits of minimally invasive surgery.

However, the study is not without limitations. The relatively small sample size limits the statistical power to detect differences in less frequent postoperative events, particularly rare complications. Being a single-centre study may restrict the broader relevance of the findings, as institutional expertise and patient demographics can vary across surgical units. Moreover, the study focused exclusively on short-term outcomes; long-term oncological results, including recurrence rates, disease-free survival, and overall survival, were not evaluated. Future multicentric studies with larger cohorts and extended follow-up are necessary to allow more definitive conclusions regarding the long-term oncological equivalence of laparoscopic versus open colorectal cancer surgery.

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