

Thirty-Day Postoperative Outcomes Following Surgery for Colorectal Malignancy: A Single-Centre Cohort Study

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Abbreviations:

CRC: Colorectal cancer;

APR: Abdominoperineal Resection;

AR: Anterior Resection;

SSI: Surgical Site Infection;

CD: Clavien-Dindo Grading of Complications.

Rezumat

Rezultate postoperatorii la treizeci de zile după intervenția chirurgicală pentru cancer colorectal: un studiu de cohortă monocentric

Introducere: Chirurgia rămâne piatra de temelie a tratamentului pentru tumorile maligne colo-rectale, complicațiile postoperatorii având un impact semnificativ asupra rezultatelor pe termen scurt și lung. Acest studiu a avut ca scop evaluarea complicațiilor postoperatorii la 30 de zile după intervenția chirurgicală pentru tumori maligne colorectale într-un singur spital universitar de îngrijire terțiară din Navi Mumbai, India.

Metode: Treizeci de pacienți care au suferit rezecție chirurgicală pentru tumori maligne colorectale au fost urmăriți timp de 30 de zile. Infecția locului operator a fost cea mai frecventă complicație, apărând la 36,66% dintre pacienți. Chirurgia de urgență a fost asociată cu o rată mai mare a complicațiilor decât chirurgia electivă.

Rezultate: Mortalitatea la treizeci de zile a fost de 10%, predominant la pacienții cu boală avansată și rezervă fiziologică scăzută. Nu s-a constatat nicio asociere semnificativă între localizarea tumorii, stadiul bolii sau contextul chirurgical și ratele complicațiilor postoperatorii. Durata mediană a spitalizării a fost de 20 de zile (IQR 16–20,75).

Concluzii: Chirurgia de urgență a avut o rată mai mare a complicațiilor, iar boala avansată cu rezervă fiziologică scăzută a fost asociată cu o mortalitate crescută. Aceste constatări evidențiază rata morbidității postoperatorii după intervenția chirurgicală pentru cancerul colorectal și rezultatele mai slabe asociate cu prezentarea de urgență.

Cuvinte cheie: cancer colorectal, hemicolectomie, rezecție anterioară, rezecție abdomino-perineală, infecție a locului chirurgical, clasificarea Clavien-Dindo, clasificarea Southampton

Abstract

Background: Surgery remains the cornerstone of treatment for colorectal malignancies, with post-operative complications significantly impacting short and long-term outcomes. This study aimed to evaluate 30-day post-operative complications following surgery for colorectal malignancies in a single tertiary care

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teaching hospital in Navi Mumbai, India.

Methods: Thirty patients who underwent surgical resection for colorectal malignancy were followed up for 30 days. Surgical site infection was the most frequent complication, occurring in 36.66% of patients. Emergency surgery was associated with a higher complication burden than elective surgery.

Results: Thirty-day mortality was 10%, predominantly in patients with advanced disease and poor physiological reserve. No significant association was found between tumour location, disease stage, or surgical setting and post-operative complication rates. The median hospital stay was 20 days (IQR 16–20.75).

Conclusion: Emergency surgery carried a higher complication burden, and advanced disease with poor physiological reserve was associated with increased mortality. These findings highlight the burden of post-operative morbidity following colorectal cancer surgery and the poorer outcomes associated with emergency presentation.

Keywords: colorectal cancer, hemicolectomy, anterior resection, abdominoperineal resection, surgical site infection, Clavien-Dindo classification, Southampton classification

Introduction

Colorectal cancer is the third most common malignancy worldwide and the second leading cause of cancer-related mortality, with approximately 1.9 million new cases and over 900,000 deaths recorded globally in 2022 (1). In India, it ranks as the fourth most common cancer, with 64,863 new cases and 38,367 deaths in 2022 (2). While Western countries have seen an overall decline in incidence attributed to widespread screening programmes and lifestyle modifications, an increasing trend is being observed across several Indian regions, particularly in urban centres, attributed to urbanisation, lifestyle factors and early detection of cancer (3). Indian patients may present at a younger age and with more advanced disease than is typically seen in Western series (4).

Colorectal cancers are classified as sporadic, familial and hereditary. The majority are sporadic, arising from mutations in tumour suppressor genes, oncogenes and DNA mismatch repair genes (5). Advancing age, obesity, sedentary lifestyle and dietary factors are well-established risk factors, with heterocyclic amines from red meat and tobacco-related carcinogens playing important aetiological roles (6,7).

Colorectal cancer may present with rectal bleeding, alteration in bowel habits, abdominal pain and unintentional weight loss, and in advanced cases with intestinal obstruction. The rectum is the most frequently involved site, and the liver is the most common site of distant metastasis (8).

Treatment requires a multidisciplinary approach tailored to the tumour site and stage. Colonic cancers are managed with surgical resection followed by adjuvant chemotherapy to reduce the risk of recurrence. Rectal cancers may be preceded by neoadjuvant

chemoradiotherapy to improve resectability, aid sphincter preservation and reduce local and distant recurrence.

Post-operative complications after colorectal surgery are well recognised and include surgical site infection, anastomotic leak, wound dehiscence, stoma-related complications, pulmonary atelectasis, sepsis and death. Large Western series have reported overall morbidity rates of 15.9% to 37%, with surgical site infection among the most frequent complications (9,10). These complications adversely affect not only short-term recovery but also long-term survival, independent of disease stage. This study aimed to evaluate early post-operative complications after surgery for colorectal malignancy at a single tertiary care teaching hospital in Navi Mumbai, India, and to identify factors contributing to morbidity and mortality in this setting.

Materials and Methods

Ethics Approval

This was a non-interventional observational study undertaken as part of a postgraduate M.S. (General Surgery) dissertation. All treatment decisions and operations were delivered as routine clinical care, without any research-related alteration in management. The dissertation title and synopsis were formally approved by the Institutional Ethics Committee on 8 February 2018 (Ref. PDDYPMC / Ethics / PG Dissert / 2018). The cohort comprised an ambispective series of 30 consecutive patients undergoing surgical resection for colorectal malignancy: ten patients who underwent surgery between June 2017 and February 2018 were identified retrospectively, with outcome data extracted from hospital records after ethics approval was granted; the remaining 20

patients, operated on from February 2018 to October 2019, were followed forward prospectively using a standardised proforma. No study-related data were extracted or analysed for any patient prior to ethics approval.

Informed Consent

Verbal informed consent for inclusion and use of clinical data was obtained from all participants. For the ten patients treated before formal ethics approval, consent was obtained at a subsequent follow-up visit after ethics approval and before retrospective extraction and analysis of their clinical data. For patients treated from February 2018 onward, verbal informed consent was obtained at the time of enrolment into the observational cohort.

Inclusion Criteria

All patients over 18 years of age presenting to the Department of General Surgery, diagnosed with colorectal cancer and who underwent cancer resection.

Exclusion Criteria

Patients with unresectable colorectal cancer, or who declined to provide consent for inclusion in the study.

Data were collected using a standardised proforma and recorded on an Excel spreadsheet — prospectively, at the time of enrolment into the observational cohort, for patients managed from February 2018 onward, and retrospectively from hospital records, following ethics approval, for the ten patients treated between June 2017 and February 2018. The following parameters were recorded for each patient: age, gender, co-morbidities, family history, presenting complaint, tumour location, surgical procedure performed, emergency or elective setting, need for stoma, stoma type, post-operative complications, stoma-associated complications, duration of hospital stay, histopathological variant and pathological staging.

Complications occurring in the immediate post-operative period were categorised as surgical site complications, stoma-associated complications, and general complications. Surgical site infections were graded using the Southampton Classification (11). The Clavien-Dindo Classification was applied retrospectively to all recorded complications following completion of the study, to allow standardised comparison with contemporary literature (12). Categorical variables were compared using Fisher's exact test, given the small sample size and the presence of expected cell frequencies below 5 in several subgroup

analyses. Continuous variables were summarised using mean (SD) or median (IQR), as appropriate.

Results

Thirty patients who underwent surgical resection for colorectal malignancy were followed up for 30 days. The cohort comprised 16 males (53.3%) and 14 females (46.7%). The mean age of presentation was 56.4 years (SD 12.18, range 28–75).

77% of patients (n=23) had no comorbidities. Among those with comorbidities, two were hypertensive, one was diabetic, one had both hypertension and diabetes, one had hypothyroidism, and one was HIV positive. Only one patient had a positive family history of colorectal malignancy in a second-degree relative.

The most common presenting symptom was rectal bleeding, seen in 46.66% (n=14) of patients, followed by a change in bowel habits in 33.33% (n=10) and intestinal obstruction in 16.66% (n=5). Two patients presented with both rectal bleeding and a change in bowel habits, and one patient presented with abdominal pain alone.

The most frequent tumour site was the rectum (36.66%, n=11), followed by the sigmoid colon (23.33%, n=7) and ascending colon (16%, n=5). Three patients had tumours of the caecum, two of the descending colon, one of the transverse colon and one of the anal canal.

Twenty-three patients (76.67%) underwent elective surgery with bowel preparation, while seven (23.33%) underwent emergency surgery without bowel preparation. The surgical procedures performed are detailed in *Table 1*. Eighteen patients (60%) required a stoma.

The majority of tumours were adenocarcinomas (96.66%, n=29), including three mucinous and one signet ring cell variant. One patient had malignant melanoma of the anal canal. In terms of pathological staging, 80% (n=24) had T3 disease, 13.3% (n=4) had T2 disease and 6.66% (n=2) had T4 disease. Nodal staging showed N1 disease in 43.33% (n=13), N0 in 30% (n=9) and N2 in 26.66% (n=8). Four patients

Table 1. Surgical procedures performed

Procedure	n	%
Abdominoperineal Resection	10	33.33%
Right Hemicolectomy	9	30%
Hartmann's Procedure	5	16%
Anterior Resection	2	6.6%
Sigmoid Colectomy	2	6.6%
Left Hemicolectomy	1	3.33%
Total Colectomy	1	3.33%

(13.33%) had metastatic disease at presentation, as detailed in *Table 2*.

Surgical site infection was the most frequent complication, occurring in 36.66% (n=11) of patients, and was graded according to the Southampton Classification. Of these, five had Grade 3B, four had Grade 3D, one had Grade 4B and one had Grade 5 SSI. The patient with Grade 5 Southampton infection developed wound dehiscence requiring return to theatre and is classified separately as CD Grade IIIB in *Table 3*, distinct from the fatal wound dehiscence case described below. Complications stratified by surgical setting and graded according to the Clavien-Dindo Classification are detailed in *Table 3*. No significant association was found between tumour location and SSI rate (Fisher's exact $p=0.41$), disease stage and complications (Fisher's exact $p=0.42$), or surgical setting and major complications (Fisher's exact $p=0.60$). Given the small subgroup sizes in this cohort, Fisher's exact test was used in preference to the Chi-squared test, as several expected cell frequencies fell below 5.

Complications beyond superficial wound infections were managed as follows. The patient with a Grade 5 Southampton wound infection (following Right Hemicolectomy) developed wound dehiscence requiring return to theatre for surgical debridement and secondary closure under general anaesthesia (CD IIIB), and survived to discharge. The anastomotic leak identified on post-operative day 3, following Right Hemicolectomy, was managed by re-exploration and washout under general anaesthesia (CD IIIB). The patient who developed a paraduodenal abscess with adhesions, following emergency Right Hemicolectomy, required re-exploration and drainage (CD IIIB). Lung atelectasis in one patient, following Abdominoperineal Resection, was managed with antibiotics and chest physiotherapy (CD II). Parastomal hernia in one patient, following Abdominoperineal Resection, was managed conservatively within the 30-day follow-up period (CD II).

Three patients died within the study period (CD Grade V). Two deaths were due to cardiorespiratory arrest in the post-operative period (following Right Hemicolectomy and Abdominoperineal Resection, respectively), unrelated to a direct surgical complication; both patients had poor preoperative nutritional status, and two of the three patients who died had T4 disease at presentation. A further death occurred in a patient who underwent emergency Hartmann's procedure and subsequently developed wound dehiscence with evisceration requiring re-exploration and secondary closure; this patient had advanced disease at presentation. Among the 18 patients with a

Table 2. Pathological staging

Stage	N (%)
T2	4 (13.3%)
T3	24 (80%)
T4	2 (6.66%)
N0	9 (30%)
N1	13 (43.3%)
N2	8 (26.66%)
M1	4 (13.33%)

Table 3. Complications by surgical setting and Clavien-Dindo grade

Complication (CD Grade)	Elective (n=23)	Emergency (n=7)	Total
SSI (II)	9	1	10
Grade 5 SSI with wound dehiscence (IIIB)	1	0	1
Lung atelectasis (II)	1	0	1
Parastomal hernia (II)	1	0	1
Anastomotic leak (IIIB)	1	0	1
Paraduodenal abscess (IIIB)	0	1	1
Death (V)	2	1	3
Total	15	3	18

stoma, one (5.6%) developed a parastomal hernia, managed conservatively. The median duration of hospital stay was 20 days (IQR 16–20.75, range 2–45).

Discussion

This ambispective observational study evaluated 30-day post-operative outcomes in 30 patients undergoing open surgical resection for colorectal malignancy at a single tertiary care teaching hospital in Navi Mumbai, India. The mean age of presentation was 56.4 years, which is lower than that reported in Western series, consistent with observations that colorectal cancer may present at a younger age in Indian populations (3,4). Similarly, Liu et al. reported a decrease in the mean age at first colorectal cancer diagnosis in the USA from 67.0 to 61.2 years between 1992 and 2017 (13).

When complications are stratified by the Clavien-Dindo Classification, the major complication rate (CD Grade III or above) was 20.0%, which is comparable to figures reported in contemporary Western series. The overall complication burden was predominantly driven by surgical site infection, which occurred in 36.66% of patients. The majority of SSIs were Grade II on the Clavien-Dindo Classification, managed conservatively without the need for further surgical intervention, and graded as 3B or 3D on the Southampton Classification. This SSI rate, while appearing high, must be interpreted in the context of the surgical approach — all

procedures in this study were performed via open surgery. Studies comparing open and minimally invasive colorectal surgery have consistently demonstrated significantly higher wound complication rates with the open approach (14). The widely cited overall morbidity rate of 15.9% reported by Addae et al. included a substantial proportion of laparoscopic and robotic procedures, making direct comparison with an exclusively open cohort inappropriate (9). When considering open colorectal surgery specifically, our SSI rate is consistent with published figures in the literature.

Emergency surgery appeared to be associated with a higher rate of major complications, though the small sample size limits interpretation. Of the seven patients who underwent emergency surgery, two developed CD Grade III or above complications (28.6%), compared to four of twenty-three elective patients (17.4%). This finding did not reach statistical significance (Fisher's exact $p=0.60$), though this may reflect the limited sample size. In this cohort, surgical setting and bowel preparation status were perfectly collinear — all elective patients received bowel preparation and all emergency patients did not — so this comparison cannot distinguish the effect of bowel preparation itself from the effect of emergency presentation more broadly (e.g. haemodynamic instability, faecal contamination, unprepared bowel). Larger studies with independent variation in bowel preparation status would be needed to assess its effect specifically.

The relatively prolonged median hospital stay observed in this cohort (20 days, IQR 16–20.75) is considerably longer than contemporary benchmarks from centres where Enhanced Recovery After Surgery (ERAS) protocols have been implemented. A 2024 real-world study from Northern Italy reported a reduction in mean length of stay from 8.1 to 5 days following ERAS adoption, alongside a reduction in postoperative complications from 22.1% to 17.3% (15). Similarly, a 2025 prospective study from a tertiary Indian centre reported a mean length of stay of 6.3 days with 78.6% ERAS protocol compliance, with greater compliance independently associated with fewer overall complications (16). As this study predates the structured adoption of ERAS pathways at our centre, the absence of standardised perioperative optimisation — including early mobilisation, restrictive intravenous fluid therapy and early enteral feeding — may partly account for both the prolonged hospital stay and the comparatively high surgical site infection rate observed in this cohort. Prospective implementation and evaluation of ERAS protocols in similar resource-limited settings represents an

important direction for future work.

Five patients underwent Hartmann's procedure. In the emergency setting, three patients were not suitable candidates for primary anastomosis due to haemodynamic instability, faecal contamination and unprepared bowel — factors well established as contraindications to primary anastomosis in the emergency setting (17). The two elective Hartmann's procedures were performed in patients with metastatic disease, where palliative resection of the primary tumour was undertaken without curative intent. In this context, Hartmann's procedure was favoured over primary anastomosis given the advanced disease burden and poor physiological reserve, avoiding the additional risk of anastomotic failure in patients with limited life expectancy (18).

No significant association was found between tumour location and SSI rate (Fisher's exact $p=0.41$), or between disease stage and post-operative complications (Fisher's exact $p=0.42$). Eighty per cent of patients presented with T3 disease, reflecting the advanced stage at presentation that is characteristic of colorectal cancer in populations where presentation may be delayed due to limited health awareness and competing socioeconomic priorities. This pattern of late presentation is well recognised in the Indian literature (2,4).

Three patients died within the 30-day study period, representing a mortality rate of 10%. Two deaths were due to cardiorespiratory arrest in the post-operative period and were not directly attributable to a surgical complication; both of these patients had poor preoperative nutritional status. Overall, two of the three patients who died had T4 disease at presentation. A further death occurred in a patient who underwent emergency Hartmann's procedure and subsequently developed wound dehiscence with evisceration requiring re-exploration, and had advanced disease at presentation. This mortality rate is higher than the less than 2% reported in large Western registry-based studies (19) a difference likely attributable to the advanced stage of disease and poor nutritional status at presentation in this cohort, in addition to the exclusively open surgical approach.

Among the 18 patients with a stoma, one (5.6%) developed a parastomal hernia, managed conservatively, reflecting a low rate of stoma-associated morbidity in this cohort.

Limitations

This study has several limitations. The sample size of 30 patients limits the statistical power of subgroup analyses, and findings should be interpreted

accordingly. The disparity in patient numbers between the emergency (n=7) and elective (n=23) arms further limits the validity of comparisons between these groups. Although contemporary studies have used multivariable logistic regression to identify independent risk factors for postoperative complications in colorectal cancer surgery (20), with only 30 patients and six patients with Clavien-Dindo Grade III or higher complications, there were insufficient outcome events to support a statistically reliable multivariable model without a high risk of overfitting; the univariable comparisons reported here should therefore be interpreted with corresponding caution. As a single-centre study with an exclusively open surgical cohort, the results may not be generalisable to centres with minimally invasive surgical programmes. The Clavien-Dindo Classification was applied retrospectively following completion of the study, which, while an accepted practice, introduces the possibility of grading variability. Post-mortem records were not available to the authors for the two patients who died of cardio-respiratory arrest of unclear aetiology; the cause of the third death (wound dehiscence with evisceration and septic complications) was clinically evident and did not require post-mortem confirmation. A larger multicentre study, inclusive of minimally invasive approaches, would be needed to draw more definitive conclusions.

Conclusion

In this ambispective observational study of 30 patients undergoing surgery for colorectal malignancies, surgical site infection was the most common complication, the majority of which were managed conservatively. When stratified by the Clavien-Dindo Classification, the major complication rate (CD Grade III or above) was 20.0%, comparable to contemporary Western series. Emergency surgery was associated with a higher rate of major complications compared to elective surgery. Thirty-day mortality was 10%, predominantly in patients with advanced disease and poor physiological reserve. These findings highlight the importance of pre-operative optimisation, early diagnosis and appropriate patient selection in the surgical management of colorectal malignancy. A larger multicentre study inclusive of minimally invasive approaches is warranted to validate these findings.

Conflicts of Interest

The authors declare no conflict of interest.

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