Challenging Crohn's Disease: Surgical Complexity and Outcomes in Colonic vs Non-Colonic Resections in a Large Single-Centre Cohort

Ann. Ital. Chir., 2026: 1–9
https://doi.org/10.62713/aic.4538

Andrea Micalef[1], Gloria Zaffaroni[2], Anna Fortini[1], Francesco Colombo[2], Andrea Bondurri[2], Piergiorgio Danelli[2,3], Anna Maffioli[2,3]

[1]Residency in General Surgery, Università degli Studi di Milano, 20122 Milan, Italy
[2]Department of General Surgery, Azienda Socio-Sanitaria Territoriale Fatebenefratelli-Sacco, Luigi Sacco University Hospital, 20157 Milan, Italy
[3]Department of Biomedical and Clinical Sciences "DIBIC", Università degli Studi di Milano, 20122 Milan, Italy

AIM: The surgical management of colonic Crohn's disease (CD) remains controversial, with segmental resections possibly associated with a higher rate of recurrence and postoperative complications, while total proctocolectomy reduces recurrence but increases the risk of permanent stoma formation. This study compares surgical outcomes and complications in CD patients undergoing colonic resections (any colectomy with or without concomitant ileal/ileocaecal surgery) vs non-colonic resections (ileal or ileocaecal resections and/or small-bowel strictureplasties without colectomy), with particular emphasis on intra-abdominal septic complications (IASC), non-IASC events, and length of stay (LOS) in hospital.

METHODS: This monocentric observational study analysed consecutive adult patients with histologically confirmed CD who underwent intestinal surgery between January 2012 and April 2024 at Luigi Sacco University Hospital. Patients were divided into two groups according to the index operation. Group A included patients undergoing colonic resection, with or without concomitant ileal or ileocaecal resections and/or small-bowel strictureplasties. Group B included patients undergoing ileal or ileocaecal resection and/or small-bowel strictureplasties without any associated colonic resection. Outcomes included 30-day postoperative complications, LOS, and readmission rates. Statistical analysis was performed using chi-square, Wilcoxon rank-sum tests, and regression models.

RESULTS: Of 461 patients, 90 (19.5%) underwent colonic resections (Group A), while 371 (80.5%) had non-colonic resections (Group B). Overall, complications occurred in 36.2% of patients, with significantly higher rates in Group A than in Group B (48.9% vs 33.2%; p = 0.005). IASC were more frequent in Group A (18 out of 90 patients, 20.0%) than in Group B (37 out of 371 patients, 10.0%) (p = 0.008). The median LOS was 11 days overall, with a statistically significant difference between the groups (Group A: 12 days; Group B: 11 days, p = 0.012). In addition, we observed a significantly higher 30-day reoperation rate in Group A compared with Group B (14.4% vs 6.5%; p = 0.012). Thirty-day readmission rates were low and did not differ significantly between the groups (3.3% vs 1.3%, p = 0.365). Colonic resection, disease phenotype, and American Society of Anesthesiologists score were identified as independent risk factors for postoperative complications and prolonged LOS. There were no significant differences in the 30-day readmission rates among the groups, and no 30-day mortality cases were observed.

CONCLUSIONS: In this large single-centre cohort, colonic resections were associated with higher postoperative complication rates, increased IASC and longer LOS compared with non-colonic resections. These differences likely reflect greater baseline disease complexity and operative burden in patients requiring colonic resection, rather than a causal effect of the resection site alone, highlighting the need for individualised, phenotype-informed surgical decision-making. Further multicentre research is recommended to refine the surgical management of colonic CD.

Keywords: Crohn's disease; colonic resection; postoperative complications; intra-abdominal septic complications; length of stay

Introduction

Crohn's disease (CD) is a chronic inflammatory bowel disease (IBD) that can affect the entire mucosal surface of any part of the gastrointestinal tract, with 25% of patients having disease confined to the large bowel [1,2]. The optimal surgical management of colonic CD remains under debate, with different surgical strategies depending on the affected tract and disease phenotype. Surgical procedures include segmental colectomy, subtotal colectomy, total proctocolectomy, and restorative proctocolectomy, with no strong evidence indicating that one procedure is superior to another [2–8]. The European Crohn's and Colitis Organisation guidelines and a position statement from the Italian Society of Colorectal Surgery advocate that segmental colectomy is appropriate for patients with a single involved colonic segment in CD [9–12]. Current evidence suggests that segmental colectomy is associated with higher rates of disease recurrence and a greater need

Submitted: 10 January 2026 Revised: 25 March 2026 Accepted: 24 April 2026 Published: 26 June 2026
Correspondence to: Anna Maffioli, Department of General Surgery, Azienda Socio-Sanitaria Territoriale Fatebenefratelli-Sacco, Luigi Sacco University Hospital, 20157 Milan, Italy; Department of Biomedical and Clinical Sciences "DIBIC", Università degli Studi di Milano, 20122 Milan, Italy (e-mail: anna.maffioli@unimi.it).
Editor: Eugen Tarcoveanu

for re-resection compared with more extensive procedures, whereas total proctocolectomy significantly reduces recurrence rates but requires permanent stoma formation, with relevant consequences for quality of life [13–15]. Although different colectomy strategies—segmental, subtotal, or total proctocolectomy—have been proposed for colonic CD, current evidence does not clearly favour one approach over another, and the choice is often driven by disease extent and severity. Beyond the type of colectomy itself, clinical experience suggests that colonic involvement is associated with more complex surgery and poorer short-term outcomes than ileal or ileocaecal disease [9,16–18].

However, there is still limited high-quality evidence directly comparing postoperative outcomes between colonic resections and ileal/ileocaecal surgery in CD, especially in large single-centre cohorts with homogeneous data collection. To address this gap, the present study focuses on a large single-centre cohort of consecutive patients undergoing their first intestinal resection for CD, comparing surgical complexity and short-term outcomes between those requiring any colonic resection and those undergoing non-colonic ileal or ileocaecal resections without colectomy.

Methods

Study Design and Setting

The study was designed as a monocentric observational cohort study conducted at an academic tertiary referral centre, the Department of General Surgery, Luigi Sacco University Hospital. Data were collected from a maintained, pseudo-anonymised database based on clinical charts and follow-up visit records. All consecutive adult patients ($\geq$18 years) undergoing intestinal surgery for histologically confirmed CD at our institution between January 2012 and April 2024 were screened for eligibility. Both elective and emergency procedures were included, while purely perianal procedures were excluded.

All patients diagnosed with CD who underwent surgery between January 2012 and April 2024, with a minimum follow-up of 6 months documented by at least one clinical visit, were evaluated.

The study was approved by the Ethics Committee of Milano Area 1 (approval number: 1247703013039) and was conducted in accordance with the ethical standards of the Declaration of Helsinki. Data were reported according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines (**Supplementary Material**) [19].

Inclusion and Exclusion Criteria

All patients aged 18 years or older who underwent intestinal surgery for CD at the study centre during the study period were eligible. Eligible procedures included ileal resection, ileocaecal resection, segmental colectomy, subtotal colectomy, total colectomy, proctocolectomy, and small-bowel strictureplasty, performed either alone or in combination.

Patients were excluded if they had a history of intestinal resection for CD, lacked histological confirmation of CD, or underwent only perianal procedures without bowel resection (e.g., fistulotomy, seton placement, abscess drainage) or ostomy formation without concurrent intestinal resection.

Study Endpoints and Outcome Measures

The primary endpoint was the 30-day postoperative complication rate, including both intra-abdominal septic complications (IASC) and non-IASC events. IASC were defined as anastomotic leak, intra-abdominal abscess, or other radiologically or intra-operatively documented infectious collections requiring antibiotics and/or drainage, or enterocutaneous fistula formation [20,21]. All remaining complications not fulfilling the IASC criteria were classified as non-IASC and included, for example, wound infections, postoperative ileus, respiratory complications, urinary tract infections, and minor cardiovascular events. All complications (IASC and nonIASC events), reoperations, and readmissions were recorded as 30day, patientlevel binary outcomes (yes/no). Secondary endpoints were length of stay (LOS), defined as the number of days from surgery to discharge, 30-day reoperation, and 30-day readmission. Complications were graded according to the Clavien–Dindo classification.

Patients were divided into two groups according to the presence of any colonic resection at the index operation:

- Group A (colonic resection): patients undergoing any colonic resection (segmental colectomy, subtotal colectomy, total colectomy, or proctocolectomy), with or without concomitant ileal or ileocaecal resections and/or small-bowel strictureplasties.
- Group B (non-colonic resection): patients undergoing ileal or ileocaecal resection and/or small-bowel strictureplasties without any colonic resection.

Variables, Data Sources, and Bias

Data collected included baseline characteristics and demographics, the Charlson Comorbidity Index (CCI), the American Society of Anesthesiologists (ASA) score, indications for surgery, and operative details [22,23]. Preoperative medical therapy was also recorded from clinical charts and follow-up records; however, it was not included as a primary exposure variable in the regression models. For descriptive and regression analyses, the ASA score was dichotomised as $\leq$2 vs $>$2, with the $>$2 category corresponding to ASA class III or higher. This threshold was chosen *a priori* to distinguish patients with clinically relevant systemic disease or physiological compromise. Thirty-day morbidity, including any complication occurring during the hospital stay or within 30 days of surgery, LOS—defined as the duration of hospitalisation from the day of surgery to discharge—and the readmission rate within 30 days of discharge were recorded.

Potential sources of bias include selection bias arising from the exclusion of patients with less than 6 months of follow-

Table 1. Descriptive characteristics of 461 patients who underwent intestinal resection for CD.

Characteristics	Overall (n = 461)	Group A (n = 90)	Group B (n = 371)	*p*-value
Age (years), Median (IQR)	40 (28, 54)	39 (29, 52)	41 (28, 55)	1.000
Sex				0.032
Female	175 (38.0%)	43 (47.8%)	132 (35.6%)	
Male	286 (62.0%)	47 (52.2%)	239 (64.4%)	
ASA score				0.030
≤2	348 (75.5%)	60 (66.7%)	288 (77.6%)	
>2	113 (24.5%)	30 (33.3%)	83 (22.4%)	
Charlson Comorbidity Index				0.023
0	250 (54,2%)	48 (53.3%)	202 (54.5%)	
1	89 (19.3%)	16 (17.8%)	73 (19.7%)	
2	63 (13.8%)	17 (18.9%)	46 (12.4%)	
3	31 (6.7%)	2 (2.2%)	29 (7.8%)	
4	17 (3.7%)	6 (6.7%)	11 (2.9%)	
5	10 (2.1%)	0 (0.0%)	10 (2.7%)	
6	1 (0.2%)	1 (1.1%)	0 (0.0%)	
Disease localisation				<0.001
Ileocaecal	362 (78.5%)	0 (0.0%)	362 (97.6%)	
Colonic	38 (8.2%)	38 (42.2%)	0 (0.0%)	
Colonic & ileocaecal	52 (11.3%)	52 (57.8%)	0 (0.0%)	
Ileal	9 (2.0%)	0 (0.0%)	9 (2.4%)	
Disease behaviour				0.158
Stricturing	275 (59.7%)	48 (53.3%)	227 (61.2%)	
Penetrating	56 (12.1%)	16 (17.8%)	40 (10.8%)	
Stricturing & penetrating	130 (28.2%)	26 (28.9%)	104 (28.0%)	
Year of surgery				0.292
2012–2016	228 (49.5%)	49 (54.4%)	179 (48.3%)	
2017–2024	233 (50.5%)	41 (45.6%)	192 (51.7%)	

Group A comprised patients undergoing any colonic resection, whereas Group B included patients undergoing ileocaecal or ileal resection and/or small-bowel strictureplasty without colonic resection. Continuous variables are presented as medians (IQR), while categorical variables are expressed as counts and percentages (%).

ASA >2 indicates ASA class III or higher. Year of surgery categories refer to procedures performed between 2012–2016 and 2017–April 2024.

ASA, American Society of Anesthesiologists; IQR, interquartile range.

up, and information bias related to the use of data extracted from clinical charts and outpatient visit records. The 6-month threshold was chosen because the institutional database is structured around scheduled postoperative visits at 6 months and beyond, thereby ensuring complete and consistent capture of perioperative data for the included patients. For the primary short-term outcomes (30-day complications, LOS, reoperation, and readmission), follow-up was complete for all patients, as these events are routinely recorded during the index admission and early postoperative period. Out-of-hospital events were tracked through outpatient clinic visits and, where necessary, telephone contact; however, complications managed entirely at other hospitals may not have been captured. Residual confounding related to disease phenotype, severity, emergency surgery, and concomitant procedures cannot be excluded despite multivariable adjustment, particularly for IASC, where the number of events was limited.

Statistical Analysis

Categorical variables are presented as frequencies and percentages and compared using Pearson's chi-square test or Fisher's exact test, as appropriate. Continuous variables are expressed as medians with interquartile ranges (IQRs), according to their distribution and compared using the Wilcoxon rank-sum test. Non-parametric summaries and tests were uniformly applied to ensure robustness without assuming normality of the distributions.

Univariable logistic regression models were employed to assess predictors of binary outcomes, namely overall 30-day complications (yes/no) and 30-day IASC (yes/no). LOS was analysed using Poisson regression with a log link, and results are reported as incidence rate ratios (IRRs) with 95% confidence intervals (CIs). Overdispersion was assessed by comparing the residual deviance with the degrees of freedom; no relevant overdispersion was detected, and standard Poisson models were therefore retained. Candi-

Table 2. Surgical procedures performed in Group A (colonic resection) and Group B (non-colonic resection).

Procedures (Group A)	N = 90	Procedures (Group B)	N = 371
Colonic resection	53 (59.0%)	Ileocaecal resection	256 (69.0%)
Colonic resection + ileocaecal resection	25 (27.8%)	Ileocaecal resection + stricturoplasty	25 (6.7%)
Colonic resection + ileal resection	3 (3.3%)	Stricturoplasty	23 (6.2%)
Colonic resection + stricturoplasty	3 (3.3%)	Ileal resection	23 (6.2%)
Colonic resection + ileal resection + stricturoplasty	3 (3.3%)	Ileal resection + stricturoplasty	19 (5.1%)
Colonic resection + ileocaecal resection + ileal resection	1 (1.1%)	Ileal resection + ileocaecal resection	17 (4.6%)
Colonic resection + ileocaecal resection + stricturoplasty	1 (1.1%)	Ileal resection + ileocaecal resection + stricturoplasty	8 (2.2%)
Colonic resection + ileocaecal resection + ileal resection + stricturoplasty	1 (1.1%)		

Table 3. Types of colonic resections performed within Group A (colonic resection).

Type of colectomy	N = 90
Right hemicolectomy	17 (18.9%)
Total colectomy	17 (18.9%)
Left hemicolectomy	15 (16.7%)
Sigmoidectomy	11 (12.2%)
Sigmoidectomy + proctectomy	7 (7.8%)
Right hemicolectomy + transverse colon resection	6 (6.7%)
Right colon segmental resection	3 (3.3%)
Left hemicolectomy + proctectomy	3 (3.3%)
Right colon segmental resection + sigmoidectomy	2 (2.2%)
Total proctocolectomy	2 (2.2%)
Subtotal colectomy	2 (2.2%)
Left colon segmental resection	2 (2.2%)
Right hemicolectomy + sigmoidectomy	1 (1.1%)
Left hemicolectomy + transverse colon resection	1 (1.1%)
Right colon segmental resection + left colon segmental resection	1 (1.1%)

date variables for the multivariable models were selected *a priori* based on clinical relevance and univariable associations ($p < 0.05$), and included age, sex, ASA score (>2 vs ≤2), disease behaviour, disease localisation, surgical approach, and colonic resection (Group A vs Group B). Multivariable models were built using a stepwise selection procedure while respecting events-per-variable constraints, particularly for IASC. Collinearity was evaluated using variance inflation factors, and highly collinear variables were not included simultaneously in the same model. Missing data for covariates were rare (all <5%) and were handled using complete-case analysis.

Odds ratios (ORs) with 95% CIs are reported for logistic regression models, and IRRs with 95% CIs for Poisson regression models. All statistical analyses were two-sided, with a significance threshold of $p < 0.05$. Analyses were conducted using R software (version 4.1.3, R Foundation for Statistical Computing, Vienna, Austria) for Statistical Computing and Graphics.

Results

Study Population and Baseline Characteristics

A total of 580 patients with a histological diagnosis of CD were evaluated. After excluding 119 patients with a history of previous gastrointestinal resection, 461 patients were included in the analysis. Detailed demographic and clinical characteristics, including the ASA score and disease phenotypes, are presented in Table 1.

Operative Details and Procedures

Ninety patients (19.5%) underwent colonic resection and were classified as Group A, while the remaining 371 patients (80.5%) were assigned to Group B.

The surgical procedures performed in the two groups are shown in Table 2. In Group A, 53 patients (59.0%) underwent isolated colonic resection, whereas in Group B, 256 patients (69.0%) received isolated ileocaecal resection.

Table 3 provides a detailed breakdown of the types of colonic resections performed within Group A. Both right hemicolectomy and total colectomy were performed in 17 cases each (18.9%).

Primary and Secondary Outcomes

Surgical details and outcomes for the two groups are summarised in Table 4. Overall, complications occurred in 167 patients (36.2%), with a significantly higher proportion observed in Group A (44 patients, 48.9%) than in Group B (123 cases, 33.2%; $p = 0.005$). IASC occurred in 55 patients (11.9%), with a higher prevalence in Group A (18

Table 4. Surgical details and postoperative outcomes.

Characteristics	Overall (n = 461)	Group A (n = 90)	Group B (n = 371)	*p*-value
Surgical approach				0.404
Laparotomic surgery	53 (11.5%)	14 (15.6%)	39 (10.5%)	
Laparoscopic surgery	408 (88.5%)	76 (84.4%)	332 (89.5%)	
Conversion to open surgery	25 (6.1%)	5 (6.6%)	20 (6.0%)	
Surgery duration (minutes), Median (IQR)	150 (120, 180)	180 (150, 240)	140 (120, 180)	<0.001
Stoma creation				<0.001
No	423 (91.8%)	57 (63.3%)	366 (98.7%)	
Yes	38 (8.2%)	33 (36.7%)	5 (1.3%)	
Complications				0.005
No	294 (63.8%)	46 (51.1%)	248 (66.8%)	
Yes	167 (36.2%)	44 (48.9%)	123 (33.2%)	
IASC				0.008
No	406 (88.1%)	72 (80.0%)	334 (90.0%)	
Yes	55 (11.9%)	18 (20.0%)	37 (10.0%)	
Non-IASC				0.016
No	343 (74.4%)	58 (64.4%)	285 (76.8%)	
Yes	118 (25.6%)	32 (35.6%)	86 (23.2%)	
Clavien-Dindo				0.014
<3	412 (89.4%)	74 (82.2%)	338 (91.1%)	
≥3	49 (10.6%)	16 (17.8%)	33 (8.9%)	
Reoperation in 30 days				0.012
No	424 (92.0%)	77 (85.6%)	347 (93.5%)	
Yes	37 (8.0%)	13 (14.4%)	24 (6.5%)	
LOS (days), Median (IQR)	11 (10, 17)	12 (10, 21)	11 (9, 16)	0.012
Readmission in 30 days				0.365
No	453 (98.3%)	87 (96.7%)	366 (98.7%)	
Yes	8 (1.7%)	3 (3.3%)	5 (1.3%)	

Group A: patients undergoing any colonic resection; Group B: patients undergoing ileocaecal or ileal resection and/or small-bowel strictureplasty without colonic resection. Data are shown as medians (IQR) for continuous variables or as counts and percentages (%) for categorical variables.

All complications, IASC, non-IASC events, reoperations, and readmissions are reported as 30-day patient-level outcomes.

LOS, length of stay; IASC, intra-abdominal septic complications.

of 90 patients, 20.0%) compared to Group B (37 of 371 patients, 10,0%) (p = 0.008). Non-IASC complications were observed in 118 patients (25.6%), with a markedly higher prevalence in Group A than in Group B (35.6% vs 23.2%, respectively), reaching statistical significance (p = 0.016). Because IASC and non-IASC were coded as separate patient-level outcomes, the two categories were not mutually exclusive, and some patients experienced both types of complication. Non-IASC complications mainly included wound infections, postoperative ileus, respiratory complications, urinary tract infections, and minor cardiovascular events.

The median LOS was 11 days (IQR 10–17), with a median of 12 days (IQR 10–21) in Group A and 11 days (IQR 9–16) in Group B, respectively (p = 0.012). No 30-day postoperative mortality was reported. Moreover, no statistically significant differences in the development of postoperative complications were identified between the two time periods analysed (2012–2016 vs 2017–2024), with an OR of 1.023 (95% CI 0.699–1.496; p = 0.908). We observed low 30-day readmission rates with no significant difference between groups (Group A 3.3% vs Group B 1.3%; p = 0.365). In addition, we observed a significantly higher 30-day reoperation rate in Group A compared with Group B (14.4% vs 6.5%; p = 0.012).

Predictors of Complications and LOS

Overall Complications

Univariate analysis showed that the requirement for colonic resection (Group A) was significantly associated with complications (OR: 1.929; 95% CI: 1.208–3.078; p = 0.006). Additionally, penetrating and stricturing–penetrating phenotypes were associated with higher complication rates compared to stricturing disease, with ORs of 2.081 (95% CI: 1.158–3.735; p = 0.014) and 1.639 (95% CI: 1.063–2.525; p = 0.025), respectively. An ASA score >2 was also independently associated with overall complications, with an OR of 2.098 (95% CI: 1.362–3.236; $p < 0.001$).

Multivariable analysis (Table 5) confirmed that the need for colonic resection, disease phenotype, and ASA score were independent predictors of complications.

Table 5. Multivariate analysis of the occurrence of complications.

Characteristic	OR	95% CI	*p*-value
Colonic resection			
No		Reference	
Yes	1.729	1.069, 2.792	0.025
ASA score >2	2.058	1.324, 3.205	0.001
Disease behaviour			
Stricturing		Reference	
Penetrating	2.060	1.132, 3.746	0.017
Stricturing & penetrating	1.639	1.054, 2.547	0.028

OR, odds ratio.

Intra-Abdominal Septic Complications (IASC)

Univariate analysis identified the need for colonic resection (OR: 2.257; 95% CI: 1.195–4.142; $p = 0.010$) and an ASA score >2 (OR: 2.308; 95% CI: 1.269–4.134; $p = 0.005$) as significant risk factors for IASC. Regarding disease phenotype, patients with stricturing–penetrating disease exhibited a significantly higher risk of IASC compared to those with stricturing disease (OR: 2.130; 95% CI: 1.139–3.970; $p = 0.017$). While penetrating disease alone showed an elevated OR of 2.003 (95% CI: 0.836–4.451; $p = 0.100$), this association did not reach statistical significance.

Given that only 55 IASC events were recorded (18 in Group A and 37 in Group B), the multivariable analysis was restricted to colonic resection and an ASA score >2 to comply with events-per-variable constraints. Although disease behaviour was associated with IASC in the univariable analysis, it was not included in the multivariable model to avoid overfitting (Table 6). In multivariable analysis, ASA score >2 was also independently associated with IASC (OR 2.159, 95% CI 1.178–3.892; $p = 0.011$). Colonic resection remained independently associated with IASC (OR 2.084, 95% CI 1.093–3.856; $p = 0.022$).

Table 6. Multivariate analysis for IASC.

Characteristic	OR	95% CI	*p*-value
Colonic resection			
No		Reference	
Yes	2.084	1.093, 3.856	0.022
ASA score >2	2.159	1.178, 3.892	0.011

Length of Stay (LOS)

The association between colonic resection and prolonged LOS was evaluated using a Poisson regression model, which yielded an IRR of 1.162 (95% CI: 1.096–1.231; $p < 0.001$).

Additional Poisson regression models were fitted to assess the impact of ASA score and disease phenotype on LOS. An ASA score >2 was associated with a significantly increased LOS, with an IRR of 1.126 (95% CI: 1.066–1.189; $p < 0.001$). Similarly, disease phenotype exerted a significant influence on LOS, with IRRs of 1.437 (95% CI: 1.341–1.540; $p < 0.001$) for penetrating disease and 1.216 (95% CI: 1.152–1.284; $p < 0.001$) for stricturing–penetrating disease, compared with stricturing disease.

Multivariable Poisson regression analysis (Table 7) confirmed that colonic resection, an ASA score >2, and disease phenotype were independent risk factors for prolonged LOS.

Table 7. Multivariable Poisson regression for LOS.

Characteristic	IRR	95% CI	*p*-value
Colonic resection			
No		Reference	
Yes	1.116	1.052, 1.184	<0.001
ASA score >2	1.121	1.061, 1.184	<0.001
Disease behaviour			
Stricturing		Reference	
Penetrating	1.425	1.329, 1.527	<0.001
Stricturing & penetrating	1.212	1.147, 1.280	<0.001

IRR, incidence rate ratio.

Discussion

The descriptive statistics of the present study highlight that the analysed cohort aligns significantly with trends documented in the existing literature. Specifically, the incidence of colonic CD in our study population, calculated at 19.5%, is slightly lower than the approximately 25% frequently cited in prior research [1]. This variance may stem from demographic differences or referral biases specific to the centre. Despite this minor discrepancy, the consistency in the distribution of disease phenotypes and patient age within the cohort reinforces the credibility of these findings.

From a clinical standpoint, the key message of this study is that patients requiring colonic resection for CD represent a subgroup characterised by greater surgical complexity and poorer shortterm outcomes than those undergoing noncolonic ileal/ileocaecal resections. This is reflected by longer operative times, a higher frequency of stoma creation, increased rates of combined procedures, and greater postoperative morbidity and LOS in Group A.

Both the CCI and ASA scores were examined in the present study. While the CCI offers a broad framework for assessing long-term mortality risk, it appeared less applicable to this predominantly young cohort (median age 40 years) with minimal chronic comorbidities. The median CCI score of zero further reflects the limited utility of this tool in populations with a low systemic disease burden [22]. Despite the

generally young and otherwise healthy nature of the cohort, the ASA score provided a more appropriate assessment by focusing on perioperative risk factors, including complications directly linked to CD, as previously highlighted in the literature [23]. The ASA score was identified as an independent risk factor for both overall postoperative complications and LOS. This finding is consistent with that of Wickramasinghe *et al*. [24], who developed the *Crohn's Postoperative Length of Stay Calculator*, where the ASA score constitutes a key parameter.

Application of the Montreal classification revealed notable limitations in categorising disease phenotypes for the purpose of this study. A critical issue was the ambiguity surrounding the definition of "ileocolonic disease", particularly with respect to caecal involvement. This lack of clarity often led to misclassification, thereby compromising the distinction between isolated ileocaecal disease and broader ileocolonic manifestations. To mitigate this, patients were stratified according to the presence of colonic involvement necessitating surgical intervention. Consequently, ileocaecal resections performed for terminal ileitis were categorised under Group B, reflecting ileal disease. This approach aligns with the findings of Lin *et al*. [25], who demonstrated that colonic involvement displayed greater predictive value than the Montreal classification in forecasting surgical outcomes.

The distinction in surgical approaches between Groups A (colonic resections) and B (non-colonic resections) underscores the complexity associated with the management of colonic CD. In Group A, 69 of 90 patients (76.7%) underwent segmental resections, whereas the remaining 21 patients (23.3%) required more extensive procedures, such as subtotal colectomy or proctocolectomy. Conversely, Group B predominantly comprised ileocaecal resections and strictureplasties.

The analysis revealed no significant temporal impact on complication rates, confirming the consistent surgical expertise of our unit as a referral centre for IBD. Notably, the laparoscopic surgery rate (88.5%) was considerably higher than the 50% reported in a previous study across both groups, with a low conversion rate to laparotomy (6.1%) [26]. Enhanced preoperative imaging may further optimise patient selection for laparoscopic procedures, thus minimising the need for conversion, which has been associated with poorer outcomes. The high rate of laparoscopic interventions also reflects ongoing advancements in minimally invasive techniques and their wider adoption in the management of complex cases.

Furthermore, colonic resections in this cohort were frequently accompanied by additional small-bowel procedures, further increasing operative complexity. In Group A, 41.0% of patients underwent colonic resection combined with ileal and/or ileocaecal resections and/or strictureplasties, whereas 31.0% of patients in Group B underwent more than one small-bowel procedure. This translated into longer median operative times (180 vs 140 min) and a higher rate of stoma formation (36.7% vs 1.3%) in the colonic resection group, underscoring the multifactorial basis of the increased morbidity observed following colonic resections [26]. In addition, the severity of complications, as classified by the Clavien–Dindo system, was significantly higher in Group A (17.8% vs 8.9%, $p = 0.014$), which was reflected in the increased reoperation rate (14.4% vs 6.5%, $p = 0.012$) [27]. These findings should be interpreted in the context of potential confounding by indication. Patients undergoing colonic resection more frequently presented with extensive colonic involvement, complex (penetrating or stricturing–penetrating) disease, and combined ileal and colonic procedures, all of which inherently increase surgical difficulty and risk. Although the multivariable models adjusted for ASA score, disease behaviour, and colonic resection, residual confounding due to unmeasured aspects—such as disease severity, emergency status, and cumulative operative burden—remains likely. For this reason, colonic resection is interpreted here as a marker of a more complex disease–surgery scenario, rather than as an inherently harmful strategy.

Overall, colonic resections were associated with higher complication rates, more severe adverse events, and longer hospital stays compared with non-colonic surgery. These findings are consistent with those reported by Kappenberger *et al*. [16], who also documented elevated postoperative complication rates following colonic resections. However, the inclusion of patients with prior surgeries in their study may have influenced these outcomes. Similarly, another study has reported higher complication rates, including IASC, in colonic resections relative to ileocaecal resections [17]. Noticeably, their classification of right hemicolectomy as equivalent to ileocaecal resections differs from the present methodology, highlighting the need for standardisation in classification approaches.

In conclusion, likely due to the increased disease complexity and higher complication rates, multivariate analysis identified colonic resection as an independent risk factor for extended hospital stays. Specifically, patients undergoing colonic resections exhibited an average increase of 11.6% in hospitalisation duration compared to those who did not undergo the procedure.

This study has several limitations. First, the singlecentre design in a tertiary referral unit limits external validity, as the case mix and level of surgical expertise may not be representative of other settings. Second, confounding by indication remains a major concern: patients undergoing colonic resection presented with more complex disease, and although adjustment was performed for key covariates, residual confounding related to disease severity, emergency surgery, and concomitant procedures is likely. Third, reliance on institutional charts and clinic records may have led to underascertainment of complications managed entirely at other hospitals, despite efforts to capture outofhospital events. Fourth, the requirement for at least 6 months of follow-up may have introduced selection bias, although

30day outcomes were available for all patients. Finally, the limited number of IASC events constrained the multivariable modelling and precluded more detailed analyses of specific risk factors. In addition, patients with previous intestinal resections were excluded to obtain a more homogeneous cohort and to minimise the confounding effects of highly complex reoperative surgery. However, this approach may have resulted in the selection of a population with a lower cumulative disease burden than that typically encountered in routine clinical practice; therefore, the findings mainly apply to patients undergoing primary intestinal resections for CD. Although preoperative medical therapy was systematically recorded in the database, the study was not specifically designed or sufficiently powered to evaluate the independent impact of individual drug regimens on postoperative outcomes. Consequently, these variables were used mainly for clinical characterisation and preoperative optimisation rather than as principal covariates in the multivariable models. Similarly, nutritional status indicators (e.g., body mass index and serum albumin) and systemic inflammatory markers were not consistently available and, therefore, could not be reliably incorporated into the regression models. This limitation may have resulted in residual confounding, as medical therapy, malnutrition, and inflammation are known to impact postoperative outcomes in CD. Nevertheless, the consistency of these findings with the existing literature provides a robust foundation for further investigation. Expansion of the cohort through multicentre collaborations may facilitate more granular analyses, particularly regarding phenotypic and procedural variables.

Conclusions

In our experience, colonic resections in CD are associated with higher overall morbidity, a greater incidence of IASC, and prolonged hospital stay compared with non-colonic resections. These findings should not be interpreted as evidence that the colonic site per se causes worse outcomes; rather, they likely reflect the greater baseline disease burden and operative complexity among patients requiring colonic surgery, in whom extensive disease, fistulising behaviour, and combined procedures are more common. Surgical strategies should therefore be individualised, with careful integration of disease phenotype, extent, and patient-specific factors into the decision-making process.

The high rate of laparoscopic procedures in this cohort reflects the effectiveness of minimally invasive techniques, supported by advanced preoperative imaging. However, the limitations of the Montreal classification system suggest a need for refinement to improve the prediction of surgical outcomes.

While the sample size limits generalisability, the findings align with the existing literature and provide a basis for larger, multicentre studies aimed at further refining risk stratification and treatment strategies in colonic CD.

Availability of Data and Materials

The datasets generated and analysed during the current study are not publicly available due to institutional and privacy regulations but are available from the corresponding author upon reasonable request.

Author Contributions

AMi: conceptualisation, writing—original draft, formal analysis, writing—review and editing, methodology. GZ: conceptualisation, writing—original draft, formal analysis, writing—review and editing, visualisation. AF: conceptualisation, writing—original draft, formal analysis, writing—review and editing. FC: formal analysis, writing—review and editing. AB: formal analysis, writing—review and editing. PD: formal analysis, writing—review and editing, supervision. AMa: conceptualisation, writing—original draft, formal analysis, writing—review and editing, project administration. All authors have been involved in revising the manuscript critically for important intellectual content. All authors gave final approval of the version to be published. All authors have participated sufficiently in the work to take public responsibility for appropriate portions of the content and agreed to be accountable for all aspects of the work in ensuring that questions related to its accuracy or integrity.

Ethics Approval and Consent to Participate

The study was approved by the Ethics Committee of Milano Area 1 (approval number: 1247703013039) and was conducted in accordance with the ethical standards of the Declaration of Helsinki. The requirement for individual patient consent was waived by the Ethics Committee of Milano Area 1 due to the retrospective observational design of the study and the use of anonymised data derived from an institutional database.

Acknowledgment

The authors would like to thank the nursing staff and the surgical team of the Department of General Surgery for their contribution to patient care and data collection.

Funding

This research received no external funding.

Conflict of Interest

Anna Maffioli and Andrea Bondurri are serving as the Editorial Board members of this journal. We declare that Anna Maffioli and Andrea Bondurri had no involvement in the peer review of this article and have no access to information regarding its peer review. Other authors declare no conflict of interest.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.62713/aic.4538.

References

[1] Gajendran M, Loganathan P, Catinella AP, Hashash JG. A comprehensive review and update on Crohn's disease. Disease-a-Month. 2018; 64: 20–57. https://doi.org/10.1016/j.disamonth.2017.07.001.

[2] Guy TS, Williams NN, Rosato EF. Crohn's disease of the colon. The Surgical Clinics of North America. 2001; 81: 159–168, ix. https://doi.org/10.1016/s0039-6109(05)70278-4.

[3] Angriman I, Pirozzolo G, Bardini R, Cavallin F, Castoro C, Scarpa M. A systematic review of segmental vs subtotal colectomy and subtotal colectomy vs total proctocolectomy for colonic Crohn's disease. Colorectal Disease. 2017; 19: e279–e287. https://doi.org/10.1111/codi.13769.

[4] Tamizifar B, Adibi P, Hadipour M, Mohamadi V. A systematic review and meta-analysis of prevalence and clinical features of upper gastrointestinal (UGI) tract Crohn's disease in adults compared to non-UGI types. JGH Open. 2023; 7: 325–336. https://doi.org/10.1002/jgh3.12888.

[5] Longo WE, Ballantyne GH, Cahow CE. Treatment of Crohn's colitis. Segmental or total colectomy? Archives of Surgery. 1988; 123: 588–590. https://doi.org/10.1001/archsurg.1988.01400290070011.

[6] Tekkis PP, Purkayastha S, Lanitis S, Athanasiou T, Heriot AG, Orchard TR, *et al*. A comparison of segmental vs subtotal/total colectomy for colonic Crohn's disease: a meta-analysis. Colorectal Disease. 2006; 8: 82–90. https://doi.org/10.1111/j.1463-1318.2005.00903.x.

[7] Heriot A, Smith P. Current Status of Segmental Colectomy in Select Crohn's Disease Patients. Clinics in Colon and Rectal Surgery. 2019; 32: 249–254. https://doi.org/10.1055/s-0039-1683906.

[8] Lee JL, Yu CS, Lim SB, Park IJ, Yoon YS, Kim CW, *et al*. Surgical Treatment of Crohn Colitis Involving More Than 2 Colonic Segments: Long-Term Outcomes From a Single Institution. Medicine. 2016; 95: e3793. https://doi.org/10.1097/MD.0000000000003793.

[9] Adamina M, Minozzi S, Warusavitarne J, Buskens CJ, Chaparro M, Verstockt B, *et al*. ECCO Guidelines on Therapeutics in Crohn's Disease: Surgical Treatment. Journal of Crohn's & Colitis. 2024; 18: 1556–1582. https://doi.org/10.1093/ecco-jcc/jjae089.

[10] Pellino G, Keller DS, Sampietro GM, Angriman I, Carvello M, Celentano V, *et al*. Inflammatory bowel disease position statement of the Italian Society of Colorectal Surgery (SICCR): Crohn's disease. Techniques in Coloproctology. 2020; 24: 421–448. https://doi.org/10.1007/s10151-020-02183-z.

[11] SICCR Current status of Crohn's disease surgery collaborative. Surgical treatment of colonic Crohn's disease: a national snapshot study. Langenbeck's Archives of Surgery. 2021; 406: 1165–1172. https://doi.org/10.1007/s00423-020-02038-z.

[12] Lightner AL, Vogel JD, Carmichael JC, Keller DS, Shah SA, Mahadevan U, *et al*. The American Society of Colon and Rectal Surgeons Clinical Practice Guidelines for the Surgical Management of Crohn's Disease. Diseases of the Colon and Rectum. 2020; 63: 1028–1052. https://doi.org/10.1097/DCR.0000000000001716.

[13] Fichera A, McCormack R, Rubin MA, Hurst RD, Michelassi F. Long-Term Outcome of Surgically Treated Crohn's Colitis: A Prospective Study. Diseases of the Colon & Rectum. 2005; 48: 963–969. https://doi.org/10.1007/s10350-004-0906-3.

[14] Prabhakar LP, Laramee C, Nelson H, Dozois RR. Avoiding a Stoma: Role for Segmental or Abdominal Colectomy in Crohn's Colitis. Diseases of the Colon & Rectum. 1997; 40: 71–78. https://doi.org/10.1007/BF02055685.

[15] Handler M, Dotan I, Klausner JM, Yanai H, Neeman E, Tulchinsky H. Clinical recurrence and re-resection rates after extensive vs. segmental colectomy in Crohn's colitis: a retrospective cohort study. Techniques in Coloproctology. 2016; 20: 287–292. https://doi.org/10.1007/s10151-016-1440-8.

[16] Kappenberger AS, Schardey J, Wirth U, Kühn F, Werner J, Zimmermann P. Clinical outcomes and perioperative morbidity and mortality following segmental resections of the colon for Crohn's colitis. International Journal of Colorectal Disease. 2024; 39: 36. https://doi.org/10.1007/s00384-024-04596-w.

[17] Galata C, Kienle P, Weiss C, Seyfried S, Reißfelder C, Hardt J. Risk factors for early postoperative complications in patients with Crohn's disease after colorectal surgery other than ileocecal resection or right hemicolectomy. International Journal of Colorectal Disease. 2019; 34: 293–300. https://doi.org/10.1007/s00384-018-3196-2.

[18] Feuerstein JD, Cheifetz AS. Crohn Disease: Epidemiology, Diagnosis, and Management. Mayo Clinic Proceedings. 2017; 92: 1088–1103. https://doi.org/10.1016/j.mayocp.2017.04.010.

[19] von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies. Bulletin of the World Health Organization. 2007; 85: 867–872. https://doi.org/10.2471/BLT.07.045120.

[20] Morar PS, Hodgkinson JD, Thalayasingam S, Koysombat K, Purcell M, Hart AL, *et al*. Determining Predictors for Intra-abdominal Septic Complications Following Ileocolonic Resection for Crohn's Disease-Considerations in Pre-operative and Peri-operative Optimisation Techniques to Improve Outcome. Journal of Crohn's & Colitis. 2015; 9: 483–491. https://doi.org/10.1093/ecco-jcc/jjv051.

[21] Huang W, Tang Y, Nong L, Sun Y. Risk factors for postoperative intra-abdominal septic complications after surgery in Crohn's disease: A meta-analysis of observational studies. Journal of Crohn's & Colitis. 2015; 9: 293–301. https://doi.org/10.1093/ecco-jcc/jju028.

[22] Charlson ME, Carrozzino D, Guidi J, Patierno C. Charlson Comorbidity Index: A Critical Review of Clinimetric Properties. Psychotherapy and Psychosomatics. 2022; 91: 8–35. https://doi.org/10.1159/000521288.

[23] Wolters U, Wolf T, Stützer H, Schröder T. ASA classification and perioperative variables as predictors of postoperative outcome. British Journal of Anaesthesia. 1996; 77: 217–222. https://doi.org/10.1093/bja/77.2.217.

[24] Wickramasinghe D, Adegbola S, Sahnan K, Morar P, Carvello M, Di Candido F, *et al*. A scoring system to predict a prolonged length of stay after surgery for Crohn's disease. Colorectal Disease. 2021; 23: 1205–1212. https://doi.org/10.1111/codi.15567.

[25] Lin SN, Zheng DP, Qiu Y, Zhang SH, He Y, Chen BL, *et al*. Classifying Crohn's disease into colon-involving versus non-colon-involving groups is a better predictor of clinical outcomes than the Montreal classification. Therapeutic Advances in Gastroenterology. 2020; 13: 1756284820968732. https://doi.org/10.1177/1756284820968732.

[26] Connelly TM, Clancy C, Duraes LC, Cheong JY, Cengiz B, Jia X, *et al*. Laparoscopic surgery for complex Crohn's disease: perioperative and long-term results from a propensity matched cohort. International Journal of Colorectal Disease. 2022; 37: 1885–1891. https://doi.org/10.1007/s00384-022-04218-3.

[27] Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Annals of Surgery. 2004; 240: 205–213. https://doi.org/10.1097/01.sla.0000133083.54934.ae.