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Editorial Board Member of *World Journal of Gastrointestinal Surgery*, Michele Ammendola, MD, Research Associate, Surgical Oncologist, Science of Health Department, Digestive Surgery Unit, University of "Magna Graecia" Medical School, Catanzaro 88100, Italy. michele.ammendola@unicz.it

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The primary aim of *World Journal of Gastrointestinal Surgery* (*WJGS, World J Gastrointest Surg*) is to provide scholars and readers from various fields of gastrointestinal surgery with a platform to publish high-quality basic and clinical research articles and communicate their research findings online.

WJGS mainly publishes articles reporting research results and findings obtained in the field of gastrointestinal surgery and covering a wide range of topics including biliary tract surgical procedures, biliopancreatic diversion, colectomy, esophagectomy, esophagostomy, pancreas transplantation, and pancreatectomy, *etc.*

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Observational Study

Surgical and non-surgical risk factors affecting the insufficiency of ileocolic anastomosis after first-time surgery in Crohn's disease patients

Jaroslav Cwaliński, Filip Lorek, Łukasz Mazurkiewicz, Michał Mazurkiewicz, Wojciech Lizurej, Jacek Paszkowski, Hanna Cholerzyńska, Wiktoria Zasada

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Jaroslav Cwaliński, Filip Lorek, Łukasz Mazurkiewicz, Michał Mazurkiewicz, Wojciech Lizurej, Jacek Paszkowski, Hanna Cholerzyńska, Wiktoria Zasada, Department of General, Endocrinological Surgery and Gastroenterological Oncology, Poznan University of Medical Sciences, Poznan 60-355, Poland

Corresponding author: Jaroslav Cwaliński, MD, PhD, Research Scientist, Surgeon, Department of General, Endocrinological Surgery and Gastroenterological Oncology, Poznan University of Medical Sciences, Przybyszewskiego 49, Poznan 60-355, Poland.

jaroslaw.cwalinski@usk.poznan.pl

Abstract

BACKGROUND

Crohn's disease (CD) often necessitates surgical intervention, particularly when it manifests in the terminal ileum and ileocecal valve. Despite undergoing radical surgery, a subset of patients experiences recurrent inflammation at the anastomotic site, necessitating further medical attention.

AIM

To investigate the risk factors associated with anastomotic insufficiency following ileocecal resection in CD patients.

METHODS

This study enrolled 77 patients who underwent open ileocolic resection with primary stapled anastomosis. Patients were stratified into two groups: Group I comprised individuals without anastomotic insufficiency, while Group II included patients exhibiting advanced anastomotic destruction observed endoscopically or those requiring additional surgery during the follow-up period. Surgical and non-surgical factors potentially influencing anastomotic failure were evaluated in both cohorts.

RESULTS

Anastomotic insufficiency was detected in 12 patients (15.6%), with a mean time interval of 30 months between the initial surgery and recurrence. The predominant reasons for re-intervention included stenosis and excessive perianastomotic

lesions. Factors associated with a heightened risk of anastomotic failure encompassed prolonged postoperative obstruction, anastomotic bleeding, and clinically confirmed micro-leakage. Additionally, patients in Group II exhibited preoperative malnutrition and early recurrence of symptoms related to CD.

CONCLUSION

Successful surgical outcomes hinge on the attainment of a fully functional anastomosis, optimal metabolic status, and clinical remission of the underlying disease. Vigilant endoscopic surveillance following primary resection facilitates the timely identification of anastomotic failure, thereby enabling noninvasive interventions.

Key Words: Crohn's disease; Ileocolic resection; Anastomotic insufficiency; Endoscopic surveillance; Surgery; Risk factors

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Core Tip: Our study underscores the critical role of surgical intervention in managing Crohn's disease (CD) complications. Notably, we emphasize the importance of meticulous patient selection, precise surgical techniques, and comprehensive postoperative care to mitigate recurrence risks. Key findings reveal the significance of achieving a wide, fully functional anastomosis, maintaining metabolic balance, and achieving clinical remission. Moreover, our study highlights the value of organized endoscopic surveillance in early detection of anastomotic failure, facilitating minimally invasive interventions. These insights promise to enhance CD management, reducing recurrence rates and improving patient outcomes.

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INTRODUCTION

The predominant sites affected by Crohn's disease (CD) are commonly the terminal ileum and the ileocecal region, with over 80% of cases potentially requiring ileocecal resection[1-3]. While surgery is not typically the initial treatment of choice, a considerable proportion of CD patients will inevitably require surgical interventions over their lifetime[1,4]. Colon or ileocecal strictures, being irreversible, often manifest with recurrent obstructive symptoms, warranting surgical intervention[1]. Septic complications arising from advanced CD may precipitate the need for surgery when medical therapies are insufficient[5]. Surgical interventions frequently encompass the management of abscesses and fistulas[1,5].

Given that approximately 87% of patients with stricturing ileocecal CD will eventually undergo surgery, ileocolic resection is undoubtedly the prevailing surgical technique for managing this condition. Subsequently, around 30% of patients may develop an anastomotic stricture postoperatively, potentially necessitating resection if endoscopic balloon dilatation proves ineffective[3]. In cases of limited nonstricturing ileocecal CD, early surgical intervention may confer benefits in terms of improving quality of life and reducing treatment expenditures compared to initiating biological therapies[6,7]. Furthermore, early bowel resection may correlate with reduced rates of relapse and decreased reliance on maintenance biologic therapies, particularly among subpopulations resistant to biologic treatments[8].

Surgery constitutes an integral component of the therapeutic approach to managing CD, with up to 47% of patients undergoing intestinal resection within a decade of diagnosis[9]. The aim of this study is to determine both surgical and non-surgical risk factors contributing to intestinal anastomosis failure subsequent to ileocecal resection in the context of CD.

MATERIALS AND METHODS

This prospective study was conducted in the authors' Surgery Department from 2014 to 2021 on a group of 77 patients, who underwent surgical intervention for intestinal complications associated with CD. Each participant underwent an open ileocolic resection with primary antiperistaltic side-to-side anastomosis using surgical staples measuring 80 or 100 mm in length. Indications for the procedure included advanced ileocecal inflammation leading to obstruction, intraperitoneal abscesses, or fistulas unresponsive to conservative therapies. Patients with loop ostomy or after Hartman's procedure and those with resection of other parts of the intestine were excluded from the study. Additionally, patients experiencing postoperative complications requiring revision surgery were excluded from further analysis. Subsequently, a comprehensive five-year follow-up was conducted to assess the risk of anastomotic failure recurrence, incorporating biannual outpatient clinic visits for medical history review and physical examination, supplemented by annual colonoscopies.

The patients were divided into two groups based on the postoperative course. Group I consisted of patients with an unobstructed intestinal passage and absence of anastomotic insufficiency, while Group II included individuals with advanced anastomotic destruction corresponding to Rutgeerts grade 4 as determined by colonoscopy, as well as those requiring surgical intervention before the conclusion of the five-year follow-up. In instances where colonoscopic findings indicated anastomotic stenosis or raised suspicions of obstruction, abscesses or fistulas, diagnostic assessments were augmented by abdominal computed tomography and/or magnetic resonance enterography. Furthermore, adjustments to the frequency of endoscopic examinations and overall clinical management were made as deemed necessary. Decisions regarding the initiation or modification of pharmacological treatments for CD were tailored to individual patient needs based on clinical considerations.

Disease activity in all patients was assessed using the Harvey-Bradshaw index biannually, with additional evaluations conducted immediately prior to any surgical or endoscopic interventions. Subsequently, both surgical and non-surgical risk factors potentially influencing anastomotic failure were evaluated in both patient groups (Table 1).

Statistical analyses were performed using Statistical (Statsoft version 6.0), employing Student's *t*-test and Fisher's exact test, with a significance threshold set at $P < 0.05$.

The therapeutic interventions adhered strictly to the principles of medical ethics and the standards of good medical practice. Given the retrospective nature of our study design, it did not necessitate independent approval from the regional bioethics committee. Prior to any medical procedures, patients provided informed written consent. The authors have read the STROBE Statement—checklist of items, and the manuscript was prepared and revised according to the STROBE Statement—checklist of items.

RESULTS

The cohort comprised 77 patients, consisting of 37 females and 40 males, with ages ranging from 18 to 73 years. Among them, 60 cases underwent elective hospitalization, whereas 11 necessitated emergency surgery. The duration from CD diagnosis to ileocolic resection varied from 3 months to 24 years, with a mean duration of 5 years. Notably, in 8 patients (10.4%), CD diagnosis was confirmed postoperatively *via* histopathological analysis. Prior to surgery, 18 patients received biological therapy, while 45 required immunosuppressants and/or steroids due to disease severity (Table 2). The primary indications for surgery predominantly included stenosis and abscesses, with other etiologies each accounting for less than 10% of cases (Table 3).

Following surgical resection, 38 patients (49.4%) underwent ileo-transverse anastomosis, while 34 (44.2%) underwent ileo-ascending colon reconstruction. In 2 cases, a four-week ileostomy was created during the initial surgery. Postoperative complications, primarily obstruction and anastomotic bleeding, were observed in 13 patients (Table 4). The mean duration of postoperative hospitalization was 8 days (5-22 days).

Among the patients, 65 (84.4%) belonged to group I, characterized by uneventful postoperative courses, while 12 (15.6%) were classified into group II, marked by advanced anastomotic insufficiency. The mean interval between initial surgery and anastomotic insufficiency recurrence was 30 months (7-52 months). Stenosis and excessive perianastomotic inflammation were the predominant reasons for re-intervention (Table 5). Treatment modalities encompassed anastomosis resection with concurrent reconstruction in 8 patients (10.4%) and endoscopic balloon dilation (EBD) in 3 patients (3.9%). One patient from group II remained under observation following total clinical remission post-pharmacological treatment.

Elevated risks of anastomosis failure were correlated with prolonged postoperative obstruction, anastomotic bleeding, and clinically confirmed micro-leakage. Additionally, patients in group II exhibited preoperative malnutrition and early recurrence of CD-related symptoms postoperatively, as indicated by higher Harvey-Bradshaw scores during subsequent follow-up assessments (Figure 1).

DISCUSSION

The primary indications for ileocecal resection vary based on demographic factors, geographical region, and treatment approach. In the Netherlands, stricturing disease accounts for the majority of recommendations, affecting approximately 48.8% of CD patients, while in Southeast Asia, nearly 32.5% undergo surgery due to penetrating disease[10]. Regardless of initial symptoms, chronic complications such as progressive narrowing, malnutrition, abscesses, or fistulas often necessitate definitive surgical intervention[11,12]. Inadequate clinical surveillance or treatment may lead to emergency procedures, typically prompted by persistent obstruction, bleeding, or peritonitis[11,12]. Additionally, patient preference for surgery over continued drug therapy serves as an additional indication. In cases of limited, non-stricturing ileocecal disease, laparoscopic resection is a viable alternative to infliximab therapy[13].

Surgical recurrence, defined as the need for additional intestinal resection postoperatively, occurs in approximately 25% of patients within 5 years and 35% within 10 years following initial surgery[14]. Major risk factors include a penetrating disease phenotype, a history of at least 2 previous CD-related intestinal resections, the total duration of the disease, and active cigarette smoking[15]. Endoscopic recurrence, characterized by Rutgeerts score, affects up to 90% of cases with neoterminal ileum within the first 12 postoperative months, while clinical recurrence, assessed by CDAI, affects 20%-40% within the first year and up to 50% within 5 years postoperatively[16].

Table 1 Potential surgical and non-surgical risk factors of anastomosis insufficiency after first-time ileocolic resection in Crohn's disease patients

Surgical risk factors	Non-surgical risk factors
Stapler length	Duration of CD before surgery
Postsurgical complications	Biological treatment before surgery
Obstruction > 3 days	Malnutrition before surgery (BMI < 20)
Anastomotic bleeding	
Anastomotic (micro) leakage ¹	

¹Defined as increased inflammatory markers and pathological discharge from the drain or confirmed in computed tomography.
CD: Crohn's disease; BMI: Body mass index.

Table 2 Patient characteristics, n (%)

Characteristics	
Age (mean)	18-73 years (35.5)
Sex	37 women, 40 men
CD diagnosed before surgery/postoperatively confirmed CD	69 (89.6)/8 (10.4)
Pharmacological therapy before first-time resection: Biological treatment; non-biological treatment ¹	18 (23.4); 45 (58.4)

¹Steroids and/or immunosuppressants.
CD: Crohn's disease.

Table 3 Indication for primarily ileocolic resection in Crohn's disease patients

Indication	n (%)
Stenosis	41 (53.2)
Abscess	29 (37.7)
Fistula	6 (7.8)
Perforation	1 (1.3)

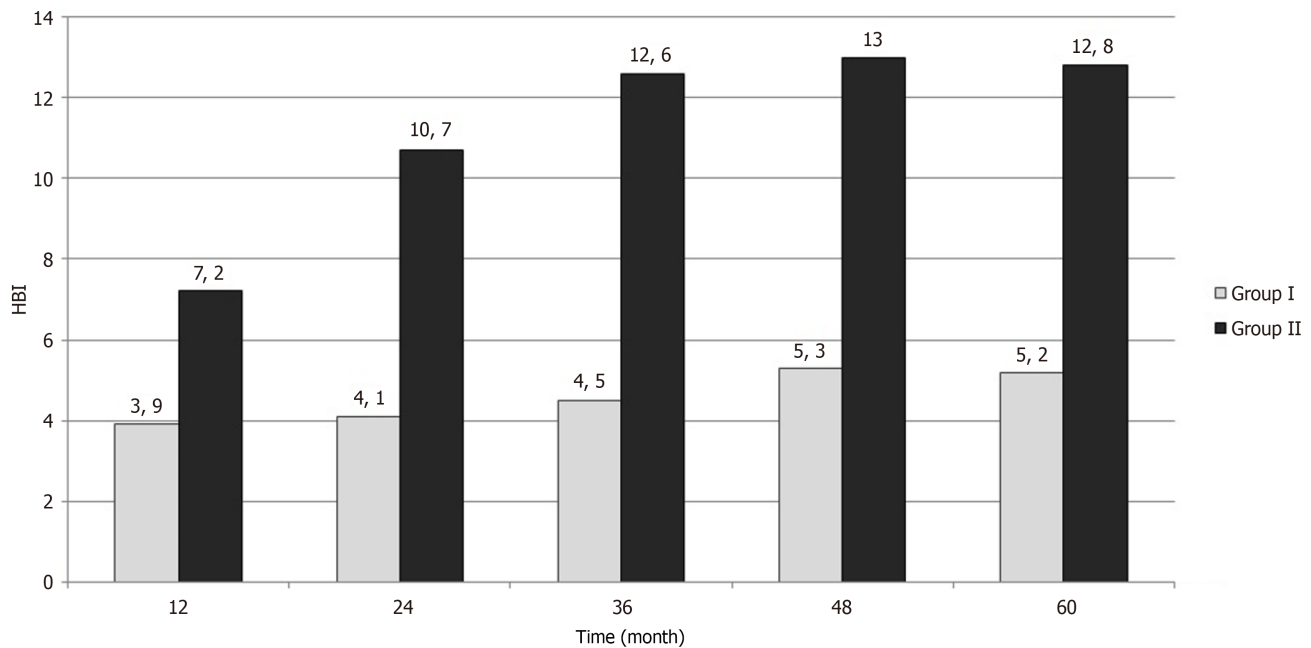
Table 4 Postoperative complications after primarily ileocolic resection in Crohn's disease patients

Complication	n (%)
Sub-ileus	12 (15.6)
Anastomotic bleeding	10 (13)
Pneumonia/hydrothorax	8 (10.4)
Wound infection	4 (5.2)
Anastomotic leakage (minor or suspected)	3 (3.9)
Intra-peritoneal abscess	2 (2.6)

Fumery *et al*[17] highlighted that up to 23% of patients encountered postoperative complications following one-stage ileocecal resection, with half of these complications classified as severe. The risk of secondary intra-abdominal abscess is notably elevated in cases of preceding corticosteroid therapy lasting up to 4 weeks before surgery and in individuals with impaired nutritional status[17]. Notably, gender, age, disease phenotype, and cigarette smoking did not exhibit significant associations with the overall postoperative complication rate[17]. Similarly, prior intestinal resection, the presence of anoperianal lesions, and the Harvey-Bradshaw index were not found to impact the final surgical outcome[17]. Adequate nutritional support, withdrawal of corticosteroids, and management of intra-abdominal sepsis appear pivotal in reducing the incidence of postoperative complications, particularly anastomotic leakage[18]. Conversely, high-risk

Table 5 Indication for re-intervention due to anastomotic insufficiency

Indication	n (%)
Stenosis	5 (42)
Inflammatory lesions	4 (33)
Abscess	2 (17)
Fistula	1 (8)

**Figure 1** Mean value of the Harvey-Bradshaw index score in the years following first-time surgery in group I and II. HBI: Harvey-Bradshaw index.

surgery disproportionately affects malnourished patients with low hemoglobin and albumin levels, even after anti-TNF or steroid therapy[18,19].

A staple side-to-side anastomosis using wide staplers represents the preferred surgical approach, exhibiting lower rates of anastomotic failure and overall postoperative complications compared to other suturing techniques[20]. Choy *et al*[21] demonstrated a significantly higher incidence of anastomotic failure in procedures without the use of a stapler when comparing stapled to hand-sewn side-to-side ileocolic anastomosis. Consequently, the 2019 ECCO guidelines strongly endorse the stapling technique, emphasizing that wider anastomoses are associated with reduced rates of clinical and surgical recurrence[13]. Recent studies suggest that the Kono-S approach exhibits recurrence rates at least comparable to conventional side-to-side anastomosis, with many indicating its potential superiority, pending confirmation by ongoing trials[7,22,23]. The mesenteric-origin theory lends support to the Kono-S procedure, positing that its performance at a distance from the mesentery, the primary site of inflammatory activity, may contribute to its efficacy[24]. Some studies even propose mesenteric excision as a means to further mitigate postoperative recurrence of CD[22,23,25].

Another technique, ileocolic nipple valve anastomosis, offers the advantage of preventing colonic content reflux into the neoterminal ileum, potentially averting complications such as chronic diarrhea resulting from ileocecal valve loss[26]. However, its viability remains to be determined conclusively, pending randomized controlled trials[26]. Oversewing staple lines following primary ileocolic resections may also mitigate the risk of anastomotic complications. According to Widmar *et al*[27], this additional step significantly reduces adverse postoperative events, such as anastomotic leak, bleeding, intra-abdominal abscess, or bowel obstruction, thereby potentially averting reoperation due to septic complications. Strictureplasty presents an alternative to bowel resection, offering a safe procedure associated with a lower risk of short bowel syndrome development[28]. However, despite its prompt symptom resolution, strictureplasties are linked to a higher recurrence rate, particularly among children and young adults with CD[29].

In cases where contraindications are absent, laparoscopic procedures stand as the method of choice for managing uncomplicated CD with ileocecal failure. This approach not only reduces the duration of bowel obstruction but also minimizes postoperative fasting periods and shortens hospital stays[12]. Conversely, laparotomy, whether initially employed or following conversion from laparoscopy, is favored for more complex scenarios, particularly those involving accompanying fistulas, abscesses, or extensive inflammation. Open surgery offers superior visualization in the operative

field and enables safer tissue preparation, facilitating the excision of inflammatory tumors in close proximity to organs and vessels. However, the physical and metabolic trauma associated with open procedures prolongs the time required for implementing pharmacotherapy and discharge[30,31].

The gold standard for postoperative evaluation entails ileocolonoscopy conducted within six months to one year following surgery, utilizing the modified Rutgeerts' score as a basis[32,33]. Common sites of relapse include the anastomosis and neoterminal ileum[34]. If no recurrence is detected, colonoscopic surveillance should continue every 1-3 years, tailored to individual patient needs and clinical circumstances[16]. De Cruz *et al*[35] demonstrated that patients undergoing ileocolonoscopy six months postoperatively, with subsequent treatment adjustments based on observed changes, experienced an 18% reduction in endoscopically assessed recurrences at 18 months compared to those following a standard treatment course.

EBD, electroincision, or stent placement offer crucial alternatives to surgical management for CD-associated strictures [36]. Clinically significant strictures, characterized by luminal narrowing resistant to endoscope passage, may necessitate intervention. Although the treatment of asymptomatic patients with incidental strictures remains contentious, Shen *et al* [37] recommended EBD as an effective and safe method for strictures below 4-5 cm in length, not exceeding four in close proximity[37]. Electroincision, involving the opening or removal of strictured tissue using electrocautery, is a viable option for patients with EBD-refractory strictures. Subsequent endoscopic clipping of electroincised strictures mirrors the approach of surgical stricturoplasty. In cases where these methods fail, fully covered removable metal stents can be applied, albeit judiciously, particularly in patients with concurrent deep ulcerations, fistulas, or abscesses adjacent to intestinal strictures[37].

Endoscopic dilatation serves as a viable option for patients with anastomotic stricture following primary ileocecal resection, allowing for the postponement of surgery when deemed appropriate[38,39]. de'Angelis *et al*[40] advocate EBD as a safe and effective procedure for managing CD-related strictures of varying origins and dimensions. They propose EBD as a complementary approach to surgery, facilitating the achievement of a symptom-free condition. For strictures resistant to EBD or pharmacotherapy, surgical stricturoplasty emerges as the method of choice, particularly for patients at risk of developing short-bowel syndrome[12,13]. Contraindications to surgical stricturoplasty include phlegmon in the bowel wall, perforation, intractable hemorrhage with mucosal disease, dysplasia or cancer, as well as severe malnutrition [12,41].

CONCLUSION

Surgical intervention for CD primarily focuses on addressing complications, given the absence of a singular strategy to comprehensively resolve all drawbacks. Long-term disease management may prove challenging, marked by a notable recurrence rate necessitating subsequent surgeries. Among the most common procedures in CD is resection of the terminal ileum and ileocecal valve. Hence, meticulous patient selection, surgical technique, and postoperative care are pivotal considerations for potential re-intervention. The efficacy of treatment hinges largely on achieving a wide, fully functional anastomosis, maintaining proper metabolic balance, and achieving clinical remission of the disease. Additionally, well-structured endoscopic surveillance plays a critical role in early detection of anastomotic failure, facilitating minimally invasive interventions. We anticipate that our collective experience will enhance the surgical management of CD, thereby mitigating the risks associated with higher recurrence rates.

FOOTNOTES

Author contributions: Cwaliński J conducted study conception and design; Mazurkiewicz Ł, Mazurkiewicz M, and Lizurej W conducted data collection; Cwaliński J, Mazurkiewicz Ł, Mazurkiewicz M, and Lizurej W analysis and interpretation of results; Cwaliński J, Lorek F, Paszkowski J, Cholerzyńska H, and Zasada W conducted draft manuscript preparation. All authors reviewed the results and approved the final version of the manuscript.

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Country of origin: Poland

ORCID number: Jaroslaw Cwaliński 0000-0001-8606-9495; Jacek Paszkowski 0000-0002-0484-6981; Hanna Cholerzyńska 0000-0001-9905-783X; Wiktoria Zasada 0000-0001-9329-3495.

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