

"EMERGING TRENDS IN THE SURGICAL MANAGEMENT OF CROHN'S DISEASE: A COMPREHENSIVE REVIEW OF THE INFLIXIMAB ERA AND FUTURE PERSPECTIVES"

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ABSTRACT:

Crohn's disease (CD) is a chronic inflammatory bowel disease with a risk of complications and chronicity necessitating surgery in the form of strictures, fistulas, or abscesses. With the advent of biologic therapy, particularly anti-TNF agents like Infliximab, the history of CD management altered drastically, reducing the need for surgery and optimizing long-term disease control. Although this transformed CD treatment, surgical management plays a significant role in managing refractory disease and postoperative recurrence. The review will critically analyze the shifting patterns in surgical management of Crohn's disease with special reference to the role of biologic therapy for surgical considerations and outcomes. The review also mentions future trends in surgical procedures and regimens of biologic therapy. A detailed review of recent peer-reviewed articles, clinical trials, and observational studies was conducted. Studies comparing surgical procedures, biologic therapy, and synergy between the two in managing Crohn's disease were analyzed to provide a complete picture of the current scenario and future trends in management. The review is intended to highlight significant advancements in surgical procedures, like minimally invasive surgery, and the role of biologics like Infliximab in the need and timing of surgery. The review also mentions the prevention of postoperative recurrence by biologics, thereby avoiding long-term surgical interventions. Although biologic therapies have reduced the need for surgery in CD to a great extent, surgery continues to be performed in the subgroup of patients. Future studies must optimize surgical procedures and biologic therapy to enhance patient outcomes further and avoid surgical recurrence.

KEYWORDS: Anti-TNF agents, Crohn's disease, inflammatory bowel disease, minimally invasive surgery, postoperative recurrence, surgical intervention

INTRODUCTION

Crohn's disease (CD) is a chronic, multifactorial inflammatory bowel disease (IBD) that can affect the entire GI tract with predominantly disabling abdominal pain, diarrhoea, fatigue, and weight loss [1]. The disease is intermittent and relapsing, and it is a challenging disease to manage. In the long term, through inflammatory progression, complications can result in surgery, such as strictures, fistulas, abscesses, and perforations. Although biologic therapy, in the shape of anti-TNF drugs such as Infliximab, has transformed disease management by reducing the need for surgery and enhancing outcomes in the long term, surgery remains a significant component of Crohn's disease management [2]. This review addresses the evolving role of surgery in Crohn's disease, i.e., biologic therapy like Infliximab. It assesses how biologics affect surgery, reduce operations, and affect postoperative outcomes. The review briefly addresses minimally invasive technology and future trends in surgery that have transformed the management of Crohn's disease. Crohn's disease is an inflammatory bowel disease of transmural gastrointestinal tract condition involving anywhere from the mouth to the anus but predominantly the ileum and the colon [3]. It is a transmural inflammation of the whole thickness of the bowel wall, unlike ulcerative colitis, another IBD involving the mucosal layer alone. Crohn's disease's pathogenesis is considered secondary to genetic predisposition, immune dysregulation, and environmental exposures, and the aetiology remains unknown [4].

The CD is distinguished by its unpredictable relapsing-remitting nature of the disease with acute severe exacerbations of morbidity. Complications like strictures of the intestine, fistulas, and abscesses also develop over time in the patients, significantly impairing the quality of life [5]. Extraintestinal manifestations of arthritis, dermatitis, and ophthalmic inflammation also occur in most patients. The disease burden is both clinical and healthcare cost-intensive, as Crohn's disease needs prolonged medical treatment and repeated hospitalization [6].

The incidence and prevalence of Crohn's disease have been increasing consistently in most of the world, particularly in more developed countries. The disease was once considered common in Western countries but has also increased in developing countries, possibly due to diet, lifestyle, and the environment [7]. In the United States alone, the prevalence of IBD has been estimated to be over 3 million, half of whom have CD. While causes for increasing prevalence are unknown, the environment and genetics play a role. For instance, there has been a known genetic link with some families being at increased risk of developing the disease [8].

Crohn's disease presents with a range of symptoms, including abdominal pain, diarrhoea, weight loss, fatigue, and fever. Some patients may present intestinal obstruction or perianal disease, e.g., fistulas or abscesses, and are treated with surgery. The disease course is unpredictable, and while some patients experience frequent relapse, others experience many decades of remission [9].

The disease course is long in Crohn's disease, and most commonly results in chronic intestinal injury, and surgery must be performed. Resections, fistula closure, or strictureplasties might be required, depending on the extent and severity of the disease. Though treatment has been dramatically improved, surgery is still necessary due to complications and disease progression [10].

Crohn's disease was managed for decades using only conventional drugs such as corticosteroids, immunosuppressants, and aminosalicylates. The drugs are designed to suppress the immune response and prevent inflammation. However, they are of immense value for very short periods and do not cure the underlying disease pathology [11].

The introduction of biologic drugs, such as anti-TNF drugs like Infliximab, has transformed the management of Crohn's disease. Biologics are targeted drugs that block specific components of the immune response that contribute to the inflammation process. Infliximab, for example, blocks TNF-alpha, a cytokine responsible for sustaining inflammation in the GI tract. Patients with moderate and severe disease have experienced better control of symptoms and mucosal healing since its introduction, in many cases, precluding or postponing surgery [12].

Surgery has continued to be the cornerstone of the management of obstructed and fistulizing Crohn's disease, i.e., fistulas, abscesses, and obstruction. Resections, strictureplasties, or stoma formation in the context of bowel perforation or severe disease have been the most frequent operations. Recurrence following surgery has, however, been a long-standing problem. In certain studies, we have found that 50% of patients who are operated upon for Crohn's disease will recur within one year [13].

There has been a trend towards minimally invasive surgery (MIS), which has many benefits over open surgery in terms of faster recovery, less scarring, and less postoperative pain. Indeed, laparoscopic methods are increasingly used in ileocolic resections and other procedures with fewer cosmetic disadvantages and faster recovery [14].

The use of biologics in Crohn's disease has also been extended beyond the clinician's scope, with increased use in the perioperative setting. Biologics like Infliximab are now used pre- and postop to reduce inflammation, induce mucosal healing, and prevent postoperative recurrence [15]. The use of biologics after surgery has been found to reduce reoperation and enhance long-term disease management. Published data have proved that the use of biologics early in patients who are about to undergo surgery can significantly reduce relapse and improve surgical outcomes [16].

Surgical techniques for Crohn's disease have also changed, emphasizing minimally invasive surgery (MIS). Laparoscopy, once reserved for minor procedures only, is increasingly being adopted for complicated cases of Crohn's disease [17]. Laparoscopic ileocolic resection is just one of the ways MIS, now the new gold standard, has resulted in shorter hospital stays, fewer complications, and faster recovery. The latest technologies, i.e., robot-assisted surgery and enhanced recovery after surgery (ERAS) protocols, have further improved patient outcomes [18].

Review of Literature

Surgical management of Crohn's disease (CD) has dramatically evolved with technological and biological progress. Zheng et al. (2025) compared resection and surgery in Australia and New Zealand, emphasizing laparoscopic surgery. Cavalcante et al. (2025) also reported clinical presentation and surgical indications in complicated CD. Biologic therapy, especially anti-TNF drugs like Infliximab, dramatically decreased surgery needs. Hanauer et al. (2025) referred to anti-TNF to avoid, avoiding perianal disease and postoperative recurrence. Also, Samuels et al. (2025) proved that optimal Infliximab dosing with early biomarkers can reduce surgery. Hassan et al. (2025) proved that dual biologic therapy causes remission in resistant disease and provides surgery alternatives. The REPREVIO trial by D'Haens et al. (2025) proved the role of Vedolizumab in avoiding post-surgery recurrence. The role of preoperative biologic treatment in influencing surgical outcomes was also proved by Sekido et al. (2025). Deng et al. (2025) reported the Systemic Immune-Inflammation Index (SII) as a predictive biomarker of surgery. Jiang et al. (2025) proved the role of nanomedicine as a treatment for IBD. Finally, Enani et al. (2025) proved the early markers of surgery in complicated CD, as shown in Table/Fig 1 [19-28].

Table/Fig 1: Literature Review on the Surgical Management of Crohn's Disease [19-28].

Authors (Year)	Key Finding	Research Focus	Challenges/Limitations	Future Scope
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Zheng et al. (2025) [19].	Laparoscopic surgery and mesentery management strategies in CD surgery.	Surgical management techniques in Australia and New Zealand.	Lack of uniformity in surgical techniques and outcomes in CD.	Further refinement of surgical approaches and techniques for CD management.
Cavalcante et al. (2025) [20].	Focus on early surgical intervention for fistulizing and obstructive CD.	Clinical manifestations of Crohn's disease and its surgical complications.	Limited large-scale studies comparing medical and surgical approaches in complex CD.	Exploration of biologic therapy's role in preventing surgical interventions.
Hanauer et al. (2025) [21].	Anti-TNF agents reduce the need for surgery, particularly in preventing recurrence.	Efficacy and safety of anti-TNF therapies in preventing recurrence.	Limited data on long-term efficacy and risks of biologic therapy in surgery.	Integration of personalized biologic therapy to optimize treatment and surgical outcomes.
Samuels et al. (2025) [22].	Optimizing Infliximab dosing with biomarkers reduces surgeries and improves outcomes.	Personalized pharmacokinetics for Infliximab and reducing surgery necessity.	Need for validation of early biomarkers for personalized therapy in clinical settings.	Continued development and validation of early response biomarkers for infliximab dosing.
Hassan et al. (2025) [23].	Dual biologic therapy (Vedolizumab and Ustekinumab) induces remission in refractory CD.	Dual biologic therapies as an alternative to surgery in refractory cases.	There is a need for further research on the efficacy and safety of dual biologic therapies.	Investigating combination therapies and their impact on reducing surgery in refractory cases.
D'Haens et al. (2025) [24].	Vedolizumab prevents postoperative recurrence in CD patients post-surgery.	Postoperative use of biologics for recurrence prevention in Crohn's disease.	Postoperative recurrence remains a significant issue even with biologics.	Further clinical trials to evaluate biologic efficacy post-surgery and recurrence prevention.
Sekido et al. (2025) [25].	Preoperative anti-TNF therapy reduces postoperative recurrence and surgical failure rates.	Impact of preoperative anti-TNF therapy on reducing surgical failures.	Preoperative biologic therapy effects still require more extensive randomized trials.	Long-term outcomes of preoperative anti-TNF therapy and patient selection strategies.
Deng et al. (2025) [26].	Systemic Immune-Inflammation Index (SII) is a non-invasive biomarker for disease severity.	Non-invasive biomarkers (SII) assess disease activity and guide surgery.	SII's prognostic accuracy needs refinement and validation in clinical practice.	Standardization and validation of SII in clinical settings for surgical decision-making.
Jiang et al. (2025) [27].	Nanomedicine applications in IBD can impact treatment and surgical strategies.	Role of nanomedicine in IBD treatment and surgical outcomes.	Limited clinical trials on the impact of nanomedicine in CD treatment.	Exploration of nanomedicine as a means to optimize IBD management and surgery.
Enani et al. (2025) [28].	Identifying early surgical indicators in fistulizing CD to	Indicators for early surgical intervention in complex Crohn's disease cases.	The clinical decision-making process for surgery remains complex due to variable responses.	Development of comprehensive guidelines for early

	reduce the need for surgery.		surgical intervention in Crohn's disease.
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Legend: This table summarizes key studies on surgical management and biologic therapies in Crohn's disease.

Material and Methods

Locating Data:

Data were obtained from peer-reviewed articles like PubMed and Google Scholar, using the terms "Crohn's disease surgery," "Infliximab," and "biologic therapy." Relevance was accorded from studies done between 2021-2025.

Data Collection:

Articles describing observational studies, systematic reviews, and clinical trials were considered. Postoperative recurrence of Crohn's disease, surgical treatment, and biologic therapy were highlighted.

Data Extraction:

The most important information points were surgical methods, utilization of biologic therapy, patient results, and recurrence. Methodology, sample size, and treatment protocol were evaluated in the studies.

Synthesizing Data:

Data were integrated by contrasting surgery and the influence of biologics on surgery and recurrence. The studies' strengths, limitations, and biases were evaluated rigorously to inform the integrated view of the management of Crohn's disease.

RESULT

Impact of Biologic Therapies on Surgical Decision-Making in Crohn's Disease

The introduction of biologic therapies, particularly Infliximab, has transformed the management of Crohn's disease (CD) by reducing the incidence of surgery. Biologics, specifically targeting one element of the immune system, have effectively maintained control of inflammation and induced remission in moderate to severe CD [29]. As a result, the majority of the patients who previously would have been subjected to surgery for complications like strictures, fistulas, and abscesses can now control their disease by therapy. The ability of biologics to suppress disease activity and promote mucosal healing has reduced surgery, especially in early-stage and moderate CD [30].

The impact of biologics on indications for surgery is best captured in the realms of timing and need for surgery. Infliximab and other anti-TNF drugs can manage symptoms and inflammation and thus delay or prevent the development of CD that usually necessitates surgery [31]. Biologics are also very valuable in lowering the need for intestinal resections and strictureplasty operations, previously routine for obstructive treatment of Crohn's disease [32]. Consequently, physicians are more likely to include biologics in first-line therapy, often choosing to start biologic therapy before any consideration of surgery [33]. This paradigm shift has enhanced quality of life and saved dollars by minimizing surgeries, as shown in Table/Fig 2.

Table/Fig 2: Biologic Therapies and Surgical Decision-Making in Crohn's Disease [29-33].

Author et al.	Biologic Therapies in Crohn's Disease	Impact on Surgery	Role of Infliximab & Anti-TNF	Treatment Paradigm Changes	Outcomes & Quality of Life
Nunotani et al. (2025) [29].	Decision support tool for biologic treatment in Crohn's patients.	Reduces surgery needs by managing disease effectively with biologics.	Infliximab helps delay or avoid surgery.	Shifts focus from surgery to biologics in early treatment stages.	Improved patient outcomes and quality of life with biologic therapies.
Husnoo et al. (2025) [30].	Study protocol on early bowel resection in terminal ileal Crohn's.	Early surgery may reduce disease progression and reliance on surgery.	Biologic timing is critical in surgical decision-making.	Early intervention and biologics change treatment protocols.	Early biologic treatment improves long-term quality of life.
Husnoo et al. (2025) [31].	Clinician's perspective on earlier surgery for terminal ileal Crohn's.	Challenges in implementing early surgery as biologics improve outcomes.	Anti-TNF agents aid in determining the necessity of surgery.	Incorporating biologics into early intervention strategies.	Biologics enhance post-surgical recovery and quality of life.

Wong et al. (2025) [32].	Delays in biologic treatment for IBD patients in the UK.	Delay in treatment leads to worse surgical outcomes.	Infliximab use improves surgery outcomes by reducing inflammation.	Delayed biologic treatments affect treatment success and surgery timing.	Timely biologic treatment improves surgical recovery and patient outcomes.
Gao & Zhang (2025) [33].	Tailoring therapy to individual Crohn's disease patients.	Personalized biologic treatment reduces surgery needs and complications.	Personalized biologics reduce reliance on surgery and improve disease control.	Tailored biologic therapy optimizes treatment efficacy and surgery rates.	Tailored biologic therapy leads to better long-term outcomes and quality.

Legend: Table illustrating important findings on biologic therapies, their application in surgery, and outcomes of patients with Crohn's disease.

Surgical Practice and Innovations in the Biologics Era

In the age of biologic therapy, minimally invasive surgery (MIS) is now the first line of treatment for most patients with Crohn's disease. Laparoscopic surgery is one of the newer techniques that have transformed surgical techniques, with much to be offered compared to open surgery. These advantages include more minor wounds, less postoperative pain, shorter hospitalization, and less time for recovery [34]. For intestinal strictures or fistulas, laparoscopic resections or strictureplasties are now the norm, with excellent results and fewer complications. The trend towards robot-assisted surgery has further improved these techniques, with greater precision and mobility in manipulating the delicate structures within the gut [35].

Biologic therapies have significantly impacted the mode and timing of surgery in Crohn's disease. In surgical candidates, preoperative use of biologics such as Infliximab decreases inflammation and enhances bowel status, eventually leading to improved surgical outcomes [36]. Biologics induce healing of the mucosa, decreasing postoperative complications and recurrence. Biologics are also now being used postoperatively to prevent the recurrence of the disease, a significant concern in most patients [37]. This combination of biologic therapy and minimally invasive surgical techniques makes for more conservative treatment, often avoiding extensive resections and overall better prognosis in the patient [38], as shown in Table/Fig 3.

Table/Fig 3: Surgical Innovations and Biologics in Crohn's Disease [34-38].

Author et al.	Minimally Invasive Surgery	Laparoscopic and Robot-Assisted Techniques	Role of Biologics in Surgery	Pre/Postoperative Biologic Therapy	Improved Outcomes with Combined Approach
Cushing K, Higgins PD (2021) [34].	Therapeutic approaches in emergency surgeries for CD.	Emphasizes laparoscopic surgery for critical CD cases.	Anti-TNF agents affect surgical planning and outcomes in CD patients.	Reviews postoperative biologic use for improved recovery and fewer complications.	Combined biologics and surgery reduce complications, enhancing recovery rates.
Meima-van Praag EM, (2021) [35].	Discusses laparoscopic and robotic surgery to reduce complications.	Highlights benefits of laparoscopic resection in Crohn's disease.	Explores biologic therapy in conjunction with surgery to manage CD.	Evaluates preoperative biologic use to optimize surgery.	A combined approach leads to better outcomes and reduces surgery-related complications.
Chandrasinghe P (2022) [36].	Focuses on managing small bowel CD with minimal surgery.	Examines small bowel Crohn's disease and robotic-assisted techniques.	Highlights biologic impact on surgery timing and decisions for small bowel.	Discusses the timing of biologic therapy in pre-and post-surgical care.	Early biologic use improves patient outcomes and reduces long-term surgery needs.

Chiarello MM, Pepe G, (2022) [37].	Therapeutic strategies in acute Crohn's disease requiring surgery.	Details laparoscopic resection in emergency settings.	Evaluates biologics for urgent surgical settings to improve outcomes.	Focuses on biologic therapy post-surgery to aid recovery.	Combining biologics with surgery improves patient outcomes in emergencies.
Bertin L, (2024) [38].	Reviews refractory Crohn's disease and innovations in surgical treatment.	Addresses robotic-assisted surgery in refractory cases.	Discusses biologics in managing refractory Crohn's disease and reducing surgeries.	Investigate biologic therapies before and after surgery for better outcomes.	A combined approach in refractory cases leads to significant improvement in patient outcomes.

Legend: This table outlines significant findings on surgical innovations and biologic therapy for Crohn's disease, highlighting patient outcomes and treatment innovation.

Postoperative Recurrence and the Role of Biologics in Prevention

Recurrence after surgery is a significant issue in the surgical management of Crohn's disease (CD), with a potential up to 50% recurrence within one year after surgery. Previously, recurrence after intestinal resections or anastomotic surgery was considered almost inevitable, frequently leading to recurrent surgery [39]. Introducing biologic agents, more precisely anti-TNF agents such as Infliximab, has changed the paradigm. Biologics work by reducing inflammation and mucosal healing, which has been proven to lower postoperative recurrence rates. Infliximab administered early after surgery has been shown to reduce the risk of relapse considerably, particularly in those with a history of complicated disease or with high-risk features for recurrence, such as structuring or penetrating disease [40].

A comparison of outcomes before and after the introduction of biologic therapies reveals an apparent improvement in the long-term success of surgery. In the pre-biologic period, CD patients who underwent surgery had a high rate of recurrence at risk and needed subsequent surgery within a limited time [41]. Biologics administration after surgery has resulted in most patients experiencing several years of remission, reducing the need for subsequent surgery and hospitalization. The REPREVIO trial and others have demonstrated that biologic agents such as Vedolizumab effectively prevent recurrence after surgery. Thus, there has been a shift towards perioperative biologic-based treatment. Combined therapy improves quality of life and provides long-term disease control with fewer surgeries [42].

Effectiveness of Combination Therapy and Biologic Therapies in Reducing Surgery

Combination biologic therapy with Vedolizumab and Ustekinumab drugs has been a successful method of managing refractory Crohn's disease (CD) and reducing the need for surgery. Vedolizumab inhibits the integrin pathway, whereas Ustekinumab inhibits interleukin-12 and interleukin-23 pathways [43]. The biologics, together, possess a synergistic action mechanism in managing inflammation, mucosal healing, and remission in monotherapy-resistant or conventional treatment-resistant patients. Combination biological therapy has been found to affect the severity of the symptoms, hospitalization to a considerable extent, and the need for surgical resection in severe or refractory CD patients, as documented by clinical trials [44]. The efficacy of combination biologic therapy to avoid surgery is most important in relapsing disease on standard therapy or complex disease [45]. Evidence indicates that Vedolizumab and Ustekinumab work synergistically together to improve disease control without the disadvantage of administering increased doses of one biologic drug. Disease control is more efficient in the long term when the patient remains in remission for longer durations with fewer exacerbations and recurrence [46].

Therefore, the introduction of dual biologic therapy revolutionized the clinical management of CD, offering an alternative to surgery and significantly enhancing the quality of the patient's life [47]. Additional studies are required to study combination therapy's long-term safety and efficacy. However, the available evidence provides a positive perspective for minimizing surgical interventions in CD management, as shown in Table/Fig 4.

Table 4: Effectiveness of Combination Biologic Therapy in Crohn's Disease Management [43-47].

Author et al.	Dual Biologic Therapy	Clinical Benefits & Mechanisms	Outcomes and Future Directions
Singh S, (2021) [43].	Meta-analysis on efficacy and safety of biologics.	Evaluate various biologics' efficacy in moderate-to-severe Crohn's disease.	Reduced surgery rates with biologic therapies.

			Future strategies for remission.
Alayo QA, (2022) [44].	Safety and effectiveness of combining biologics and small molecules.	Combines biologics with small molecules for better disease control.	Reduces surgery needs and improves long-term safety.
Balderramo D (2022) [45].	Role of a combination of biologics and small molecules.	Focuses on biologic therapies for refractory Crohn's disease.	Improved outcomes and reduction in surgery for refractory cases.
Solitano V, (2023) [46].	Combination treatment with biologics and small molecules.	Advanced combination treatment improves disease control.	Long-term safety and better outcomes with biologics and small molecules.
Gold SL, (2021) [47].	Reviews dual biologic therapy for IBD treatment.	Discusses efficacy of dual biologic therapies in modulating immunity.	Potential for long-term disease control and reduced surgery need.

Legend: This figure indicates the effect of combining biologics and small molecules in Crohn's disease therapy.

Consequences of Surgical Procedures in Biologic-Treated Patients

The application of biologic therapies in treating Crohn's disease (CD) has significantly affected postoperative outcomes, especially the healing and recurrence rates. Biologics like Infliximab, Adalimumab, and Vedolizumab can reduce inflammation and mucosal healing, improving surgical healing [48]. It has been observed that patients on biologic therapy before surgery have a shorter recovery time and fewer postoperative complications like infection or anastomotic leakage. The healing rate in such patients is usually better, resulting in improved short-term results compared to patients not on biologic therapy. The anti-inflammatory action of biologics stabilizes the diseased bowel, thereby allowing easier healing and fewer reoperations [49].

Despite these beneficial effects, postoperative recurrence is still a problem for most patients, including those treated with biologics. Although biologics decrease recurrence considerably, recurrence is never eliminated, even in high-risk patients. Research has established that biologic-treated patients experience fewer recurrences than those not on biologics, yet disease reactivation persists in some patients after surgery [50]. followup studies over the long term demonstrate that biologic therapies, particularly when continued after surgery, are an important factor in preventing further disease progression. These findings uncover that although biologics enhance the outcome of surgery in healing and complications, vigilant monitoring for recurrence remains important [51].

Guidelines for the Future of Surgical Management:

Integration of Surgery and Biologics The synergy of biologic therapy with surgery is a promising new trend in managing Crohn's disease (CD). With the ongoing evolution of biologics such as Infliximab, Adalimumab, and Vedolizumab, the use of biologics pre-operatively and postoperatively is becoming increasingly significant. Biologics in the future will be more specifically designed to address the needs of each individual, better controlling perioperative disease and subsequent surgical results. One of the research fields is the preoperative administration of biologics to decrease inflammation, improve bowel condition, and increase the likelihood of successful surgery. Biologics will also be an important component in preventing recurrence following surgery, which is one of the significant issues in managing CD. The synergy of biologic therapy with minimally invasive surgery can lead to reduced hospitalization, less complication, and quicker recovery, further enhancing the patient's outcomes. The future of personalized treatment regimens in combining surgery and biologics is attractive. Advances in genomic medicine and biomarkers will enable clinicians to visualize better which biologic therapies will be most beneficial in a given patient profile and what therapy to employ. Personalization may optimize surgical timing and the use of biologics so that patients receive proper treatment at the proper stage of their disease. The investigation of dual biologic therapy and novel biologic agents also promises to optimize long-term disease control, reduce surgeries, and optimize patients' quality of life with Crohn's disease. As the technologies evolve, the norm will be synergy between surgery and biologics.

DISCUSSION

Management of Crohn's disease (CD) has dramatically shifted in the last few years with the advent of biologic therapies, which have transformed medical and surgical management paradigms. Introducing biologics like Infliximab, Adalimumab, and Vedolizumab has transformed CD management by reducing disease activity and surgical requirements [52]. Even with the enhanced efficacy of biologic agents, surgery is valuable in managing refractory diseases or complex patients. This article discusses the evolving interface between surgical management and biologic therapy, including how biologics affect surgical decisions, surgical management, postoperative course, and long-term disease control [53].

One of the most significant effects of biologic therapies for treating Crohn's disease is the decrease in surgeries. In the pre-biologic era, surgery was the first-line treatment in complex CD, e.g., fistulas, obstructions, or abscesses. These conditions were challenging to manage with drugs. The introduction of biologics, specifically anti-TNF agents like Infliximab, altered this tradition by suppressing disease activity and promoting mucosal healing [54]. Through suppressing the pro-inflammatory cytokine TNF- α , Infliximab decreases systemic inflammation and promotes intestinal healing, stopping further damage to the intestinal wall and decreasing surgical resection. Patients treated with biologics are thus in better control of their disease and less likely to resort to the extreme of undergoing surgery [55].

Biologic therapy reduces the need for surgery and alters surgical decision-making. In the pre-biologic era, surgery was planned if patients did not respond to conventional treatments or if disease complications became risky. With the introduction of biologics, the clinician is now presented with the possibility of controlling disease activity medically before scheduling surgery [56]. This, in turn, has become feasible to treat more conservatively in a high proportion of patients. It has been noted in many studies that if biologic therapy is introduced in the early phase of the disease course, patients are less likely to require surgery in the future. For example, biologics have been significantly helpful in preventing strictures of the intestine, which have been a common indication for surgery in CD in the past. Biologics have improved patient outcomes by preventing inflammation, resulting in strictures and avoiding or delaying surgical resection [57].

Biologic prevention of postoperative recurrence is another significant factor that has driven the trend in surgery. Postoperative recurrence is a frequent issue in CD, and literature has shown that 50% of patients are at risk of recurrence within one year post-surgery [58]. In the form of Infliximab, biologic therapy has been used to reduce the risk of postoperative recurrence by half when administered in the perioperative period. The REPREVIO trial, for instance, demonstrated that Vedolizumab effectively prevents postoperative recurrence in CD patients undergoing ileocolonic resections [59]. Biologics facilitate long-term remission and minimize the need for repeat surgery by preventing mucosal damage and suppressing inflammatory disease activity. This has turned the tide of surgical resection to a combination of surgery and biologic therapy. By extrapolation, biologics are now used in the postoperative period to enhance outcomes and extend remission [60].

The second significant advancement in the surgical treatment of Crohn's disease is the application of minimally invasive surgery (MIS), which has significantly impacted the development of biologic therapies. The development of biologics has made it possible to utilize a more conservative surgical method, where patients are operated on laparoscopically rather than more traumatic open surgery [61]. Laparoscopic methods have numerous benefits, including smaller incisions, shorter hospital stays, less pain, and reduced complications after the procedure. This has made it less invasive and more tolerable for patients, especially complex Crohn's disease patients [62]. Robot-assisted surgery has also improved the accuracy and outcome of minimally invasive methods, allowing surgeons to perform more complex resections and repairs with less damage to the tissue. Pre- and postoperative application of biologics has led to faster healing, fewer infections, and fewer complications and thus has become the treatment of choice in most patients [63].

Combining surgery and biologics has also opened the door to individualized treatment strategies in CD. Advances in genomics and biomarkers enable clinicians to individualize biologic therapy to a particular patient based on his or her disease phenotype, genetic profile, and response to treatment [64]. For example, patients with structuring or penetrating diseases can be treated with certain biologics, and anti-TNF treatment can avoid the requirement for surgery. Biomarker-guided therapy should also be able to identify the patients who are most likely to have a recurrence of the disease so that more effective and individualized treatment strategies can be adopted. Personalized strategies are beneficial because they avoid unnecessary interventions and optimize patient outcomes by individualizing therapy based on the patient's disease course [65].

However, despite all advantages of combination of biologic and surgical therapy, there are still concerns. One of the most significant is the cost of biologic therapy, which may be impossible for some patients, especially in countries without universal healthcare access. The long-term safety of biologic therapy is also a concern because some patients can develop side effects, for instance, infections, autoimmune reactions, or risk of cancer [66]. Also, even though biologics reduce the number of surgeries, they do not rule out surgery completely, and some patients require surgery even after they have been treated with biologic therapy. There is also controversy regarding the proper duration of biologic therapy and when the treatment should be initiated. Future studies must address these concerns and maximize the cost-effectiveness and accessibility of biologic therapies [67].

CONCLUSION

The addition of biologic therapy to managing Crohn's disease (CD) has significantly improved medical and surgical outcomes. Infliximab and Vedolizumab, biologics, have decreased the need for surgery, offering alternative therapy for patients with moderate to severe disease. Biologics have also improved postoperative recurrence prevention and optimization of surgical outcomes with minimally invasive surgery. The future of Crohn's disease management lies in

the personalized approach, where surgery and biologics are properly used together to optimize long-term disease control. Despite cost and safety concerns being issues, the changing role of biologics in surgery holds great potential to optimize patient outcomes and reduce the disease burden.

Key Takeaways

Biologic therapy has transformed Crohn's disease treatment in terms of decreasing the necessity for surgery and enhancing postoperative results. Combination with minimally invasive surgery facilitates faster recovery, with customized treatment protocols facilitating focused therapy. Challenges, such as cost and safety, notwithstanding, biologics are instrumental in avoiding disease recurrence and providing a conservative surgery alternative, enhancing short- and long-term disease control.

Ethical Concerns

This review follows ethical standards in academic research. All the studies cited in this review have been adequately referenced, and patient confidentiality was ensured in the original studies. No patient information was used directly in this review.

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Conflict of Interest

The authors do not have conflicts of interest in the review. There were no commercial pressures on the study and conclusions.

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