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Crohn's Disease: A Literature Review of Clinical Manifestations, Diagnosis, Management, and Radiological Findings

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Abstract
Crohn's disease is a chronic inflammatory bowel disease characterized by transmural and discontinuous inflammation of the gastrointestinal tract. Its diverse clinical manifestations and progressive course can pose challenges in diagnosis and management, while persistent inflammation can lead to strictures, fistulas, abscesses, and intestinal obstruction. This literature review aims to summarize the clinical manifestations, diagnosis, management, and radiological features of Crohn's disease. Literature was retrieved from PubMed, Google Scholar, and ScienceDirect using keywords related to Crohn's disease, inflammatory bowel disease, diagnosis, management, radiology, computed tomography enterography, and magnetic resonance enterography. English-language publications from 2019 to 2025 were selected based on their relevance to the topic. The review findings indicate that Crohn's disease typically presents with diarrhea, abdominal pain, and weight loss. Diagnosis requires the integration of clinical, laboratory, endoscopic, histopathological, and imaging findings. Management focuses on controlling inflammation, achieving remission, preventing complications, and improving quality of life through individualized therapy and a treat-to-target approach. Radiological imaging plays a crucial role in assessing the extent, activity, and complications of the disease. Computed tomography enterography and magnetic resonance enterography can reveal intestinal wall thickening, increased contrast uptake in the intestinal wall, ulcers, strictures, fistulas, and abscesses. Overall, the integration of clinical and radiological assessments is essential to support accurate diagnosis, appropriate management, and long-term monitoring of Crohn's disease.

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1. INTRODUCTION

Crohn's disease is a type of inflammatory bowel disease (IBD) characterized by chronic, transmural, and discontinuous inflammation, resulting in skip lesions throughout the gastrointestinal tract [1]. The disease arises from a complex interaction among genetic and environmental factors, gut microbiota, and immune dysregulation [2]. Although the disease burden has historically been higher in industrialized countries, the incidence of Crohn's disease continues to increase in regions undergoing industrialization and westernization, including Asia, Africa, South America, and Latin America [3,4]. Its prevalence has exceeded 0.3% in North America, Europe, and Oceania [5]. Crohn's disease predominantly affects young adults and exhibits a bimodal age distribution, with peak incidence occurring at 15–30 years and 40–50 years of age, while an increasing incidence has also been observed among children and adolescents [3,6].

Clinically, Crohn's disease can affect any part of the gastrointestinal tract, most commonly the terminal ileum and colon, and is characterized by transmural inflammation, with granulomas potentially identified on histopathological examination [3]. The disease generally follows a

relapsing-remitting course, with manifestations including diarrhea, abdominal pain, weight loss, and fever, and may be accompanied by extraintestinal manifestations involving the joints, skin, and eyes [7,8]. Persistent chronic inflammation can lead to complications such as strictures, fistulas, abscesses, intestinal obstruction, and the need for surgical intervention [9]. These conditions may also adversely affect patients' quality of life, social functioning, sleep quality, productivity, and mental health [10].

The pathogenesis of Crohn's disease involves an abnormal immune response to the gut microbiota influenced by genetic and environmental factors, dysbiosis, and disruption of the intestinal barrier [2,11]. More than 200–250 IBD susceptibility loci have been identified, including NOD2, ATG16L1, and IL23R, which are involved in the regulation of immune responses and intestinal barrier function [12]. Environmental factors such as smoking, early-life antibiotic exposure, dietary patterns, nonsteroidal anti-inflammatory drug (NSAID) use, and environmental exposures associated with industrialization also contribute to disease risk [3]. Interactions among these factors may result in dysbiosis, characterized by reduced microbial diversity and decreased abundance of protective bacteria such as Faecalibacterium prausnitzii, thereby contributing to persistent mucosal inflammation [11].

The diagnosis of Crohn's disease remains challenging because no single clinical finding is pathognomonic. Diagnostic delays may persist for months to years and increase the risk of complications, including intestinal obstruction and surgery [13,14]. Therefore, diagnosis requires a multimodal approach incorporating clinical evaluation, laboratory biomarkers, endoscopy with histopathological biopsy, and imaging modalities such as magnetic resonance imaging (MRI), computed tomography (CT), and ultrasonography (US) [3,15]. These investigations not only contribute to establishing the diagnosis but also help determine disease location and extent, assess inflammatory activity, and detect complications. Differentiating Crohn's disease from other conditions with similar manifestations, particularly intestinal tuberculosis in endemic regions, is also important because misdiagnosis may affect treatment selection and patient outcomes [16,17].

Crohn's disease currently has no curative treatment. Management aims to control inflammation, achieve steroid-free clinical and endoscopic remission, and prevent long-term complications through a treat-to-target and tight-control approach [19]. Monitoring objective biomarkers such as C-reactive protein (CRP) and fecal calprotectin allows treatment adjustments based on disease activity rather than clinical symptoms alone. This approach has been shown to be more effective in achieving mucosal healing than symptom-based treatment adjustment alone, as demonstrated in the CALM trial, in which mucosal healing was achieved in 46% of patients compared with 30%. Given the heterogeneity of disease phenotype and severity, as well as the limitations of surgery in preventing disease recurrence, treatment selection should be tailored to each patient's risk profile and prognostic factors [20,21].

Given the complex characteristics, chronic course, and diverse risk of complications associated with Crohn's disease, a comprehensive diagnostic approach is required to accurately characterize the disease. In this context, imaging plays an important role in evaluating intestinal involvement, inflammatory activity, complications, and structural changes in Crohn's disease. Understanding the various imaging modalities is essential to support accurate diagnosis, assessment of disease severity, monitoring of treatment response, and determination of appropriate management strategies.

2. RESEARCH METHODS

This study used a literature review to collect and review scientific sources related to Crohn's disease, especially its clinical characteristics, diagnosis, management, and radiological findings. The literature search was conducted using several electronic databases, namely PubMed, Google Scholar, and ScienceDirect. The search used combinations of keywords such as "Crohn's Disease," "Inflammatory Bowel Disease," "IBD," "intestinal inflammation," "radiology," "imaging features," "CT enterography," and "MR enterography."

The literature search started by identifying relevant publications based on the selected keywords. The identified literature was then reviewed based on its relevance to the topic and objectives of this article. Literature published within the last 10 years was prioritized, while older publications were included when they provided important basic information relevant to the discussion. Scientific journal articles and relevant medical textbooks were also used as supporting sources.

The selected literature was then reviewed to obtain information about the clinical characteristics, pathogenesis, diagnosis, management, complications, and radiological findings of Crohn's disease. Particular attention was given to imaging methods, including intestinal ultrasound (IUS), computed tomography enterography (CTE), and magnetic resonance enterography (MRE). The information obtained from the selected literature was compared and summarized according to the topics discussed and then presented as a narrative review, with particular emphasis on the radiological findings of Crohn's disease.

3. RESEACH RESULTS AND DISCUSSION

3.1 Definition

Crohn's disease is a chronic inflammatory condition classified as inflammatory bowel disease (IBD) and can affect any part of the gastrointestinal tract, from the oral cavity to the anus [1]. Its pathogenesis is multifactorial and involves genetic susceptibility, environmental factors, and an abnormal immune response to the gut microbiota [1]. Histopathologically, the disease is characterized by transmural granulomatous inflammation involving the entire thickness of the intestinal wall and occurring in a discontinuous pattern known as skip lesions [22]. This transmural pattern of inflammation also increases the risk of structural complications, such as fistulas, strictures, and abscesses [22].

3.2 Epidemiology

Crohn's disease is more common in industrialized countries, particularly North America, Northern Europe, Western Europe, and New Zealand. The disease has a bimodal age distribution, with the main peak of incidence occurring at 15–30 years of age and a second peak at 40–60 years [23]. Although its prevalence has historically been higher in Western countries, the incidence of Crohn's disease is increasing in several developing regions, particularly in Asia, Africa, and Australasia, which are experiencing industrialization and changes in lifestyle [24]. This shift suggests that environmental factors and modern lifestyle changes may contribute to the changing global epidemiology of Crohn's disease [24].

3.3 Etiology

Crohn's disease is a type of inflammatory bowel disease (IBD) with a complex and multifactorial etiology. The exact cause of the disease is still not fully understood. However, studies suggest that Crohn's disease develops through interactions among genetic factors, impaired intestinal epithelial barrier function, changes in the gut microbiota or dysbiosis, and immune system dysregulation [2,25]. Genetic factors increase an individual's susceptibility to the disease, particularly through changes in the NOD2, ATG16L1, and IL23R genes. The NOD2 gene is involved in recognizing bacterial peptidoglycan, while ATG16L1 is involved in autophagy and the removal of intracellular microorganisms. Meanwhile, IL23R plays a role in immune regulation, particularly involving Th1 and Th17 cells [2,12]. Changes in NOD2 and ATG16L1 may impair Paneth cell function and autophagosome formation, reducing mucosal defense against microorganisms and increasing the risk of chronic intestinal inflammation [26].

In addition to genetic factors, impaired epithelial barrier function and changes in the composition of the gut microbiota also contribute to the development of Crohn's disease. Damage to the intestinal epithelium can increase mucosal permeability, a condition commonly referred to as a leaky gut. This condition allows antigens, toxins, and bacteria to pass through the mucosal

barrier into the lamina propria, triggering a pro-inflammatory immune response [2]. These changes may be worsened by gut microbiota dysbiosis, which is characterized by reduced diversity of protective microorganisms and decreased production of short-chain fatty acids (SCFAs). Reduced SCFA production may impair tight junction function and weaken mucosal defense by reducing the production of antimicrobial peptides in the intestine [27,28]. The entry of microbial antigens through the damaged intestinal barrier can then activate immune cells and increase the release of pro-inflammatory cytokines, such as TNF-α, IL-23, and IL-12. Increased levels of these inflammatory mediators can maintain a continuous immune response and contribute to chronic inflammation of the intestinal wall [29].

3.4 Risk Factors

Risk factors for Crohn's disease involve a complex interaction between environmental and genetic factors. Several environmental factors are associated with an increased risk of the disease, including smoking, antibiotic use during early life, a diet high in fat and sugar, and repeated use of nonsteroidal anti-inflammatory drugs (NSAIDs) [3,31]. These factors may affect the balance of the gut microbiota and contribute to dysbiosis and changes in the intestinal immune response [11,32].

Genetic factors also contribute to an individual's susceptibility to Crohn's disease. The NOD2/CARD15 gene is one of the genetic factors most strongly associated with the disease, while subsequent studies have identified more than 200–250 IBD susceptibility loci, including ATG16L1 and IL23R, which are involved in autophagy and regulation of the intestinal immune response [12,31]. In addition, sex differences have been reported to be associated with disease occurrence, with some studies in Asia showing that Crohn's disease is more commonly diagnosed in males than females. This difference may be related to the effects of hormones on immune system regulation [34]. Overall, Crohn's disease is a multifactorial disease that develops through interactions between genetic susceptibility and various environmental exposures.

3.5 Pathophysiology

The pathophysiology of Crohn's disease (CD) involves a complex interaction among genetic factors, environmental exposure, gut microbiota imbalance, and an abnormal immune response [2], [12]. The disease process begins with damage to the intestinal epithelial and mucus layers, which increases mucosal permeability, commonly known as a leaky gut [2]. Environmental factors such as smoking, stress, and certain medications may interact with genetic susceptibility, including changes in the NOD2 or MUC1 genes, and eventually affect the tight junctions between epithelial cells [12]. Loss of intestinal barrier integrity allows various antigens and bacteria from the intestinal lumen to enter or move into the lamina propria [2].

Under normal conditions, invading bacteria are quickly removed by the innate immune system. However, in patients with CD, bacterial clearance is impaired, making the removal of bacteria less effective [2]. Dysfunction of autophagy and damage to Paneth cells reduce the production of natural antimicrobial peptides, such as α-defensins, which weakens the body's ability to control bacteria in the intestinal mucosa [26]. Continuous accumulation of antigens and bacteria in the lamina propria then triggers and maintains chronic inflammation in the intestinal tissue [2].

An imbalance in the gut microbiota, or dysbiosis, may further worsen this condition [35]. Patients with CD show reduced microbial diversity and lower levels of beneficial bacteria that produce short-chain fatty acids (SCFAs), such as Faecalibacterium prausnitzii, Roseburia intestinalis, and Akkermansia muciniphila [35]. In contrast, pro-inflammatory and opportunistic bacteria, such as adherent-invasive E. coli (AIEC), Ruminococcus gnavus, enterotoxigenic Bacteroides fragilis (ETBF), and Fusobacterium, may increase in number [35]. In addition to bacterial changes, gut microbiota imbalance may involve an increase in fungi, particularly Candida albicans, as well as changes in viruses, including Caudovirales bacteriophages, and

archaea, such as Methanosphaera stadtmanae, which may also contribute to worsening intestinal inflammation [35].

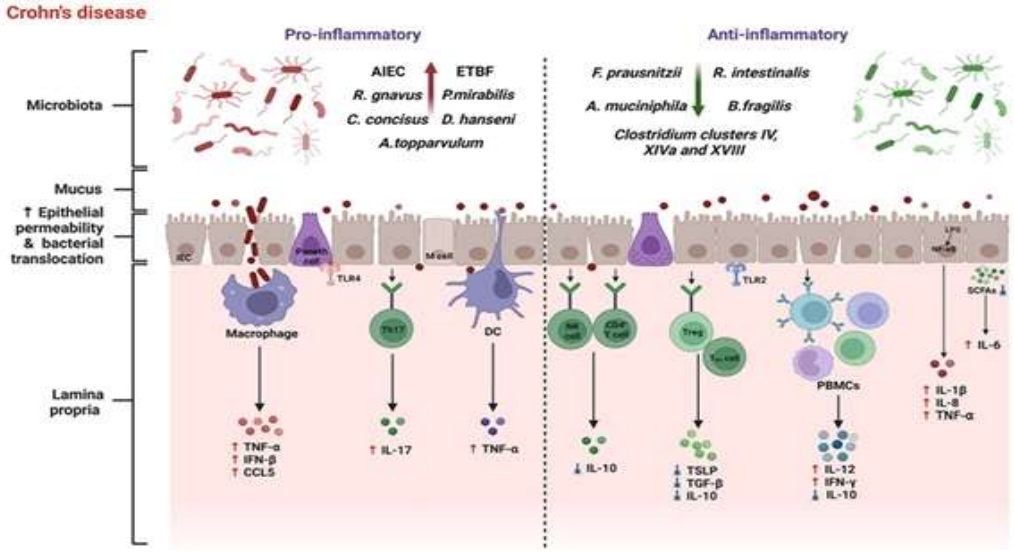

Figure 1. Interaction Between Gut Microbiota and Host Immunity in the Pathophysiology of Crohn's Disease

Over time, impaired innate immunity and dysbiosis promote the activation of the adaptive immune system, with changes in the immune response over the course of the disease [2], [35]. In the early phase, inflammation is mainly associated with a Th1 immune response, characterized by increased production of pro-inflammatory cytokines such as IFN-γ, TNF-α, and IL-12 [2]. However, in the later and more chronic phase, the immune response develops into a mixed Th1, Th2, and Th17 pattern, with increased levels of cytokines such as IL-13, IL-33, and IL-23 [35]. Continuous tissue damage caused by Th1/Th17 responses and reduced regulatory T-cell (Treg) function may eventually lead to long-term complications, including fibrosis, stenosis, and fistula formation in patients with CD [35].

3.6 Clinical Manifestations

The clinical manifestations of Crohn's disease (CD) are highly variable because transmural inflammation can cause both systemic symptoms and local tissue complications [36]. The most common symptoms are chronic diarrhea and abdominal pain. The pain is often felt in the right lower abdomen and may become worse after meals [36]. As inflammation progresses and nutrient absorption is impaired, patients may also experience weight loss, fatigue, fever, anemia, and growth failure in children [36]. Deeper tissue damage may also lead to fistula formation, which is one of the characteristic structural complications of the disease [36].

In addition to intestinal symptoms, CD may also cause extraintestinal manifestations involving various organs. These include arthropathy, both axial and peripheral; skin disorders such as pyoderma gangrenosum and erythema nodosum; eye disorders such as uveitis, scleritis, and episcleritis; and hepatobiliary involvement, including primary sclerosing cholangitis (PSC) [36].

3.7 Diagnosis

The diagnosis of Crohn's disease (CD) is based on the integration of clinical symptoms, laboratory tests, endoscopy, imaging, and histopathology because no single test can be used as a definitive diagnostic standard [36], [37]. Diagnosis can be challenging because its manifestations may resemble several other gastrointestinal diseases, such as irritable bowel syndrome, intestinal tuberculosis, and Behçet's enterocolitis. Therefore, a comprehensive evaluation is needed to determine disease location, extent, activity, and complications [15].

Laboratory tests are performed as part of the initial evaluation and may include complete blood count, C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), albumin, and fecal calprotectin to assess inflammation and the patient's general condition [36], [3]. Fecal calprotectin can help detect intestinal inflammation and distinguish inflammatory bowel disease from non-inflammatory conditions. However, laboratory tests and biomarkers cannot be used alone to confirm the diagnosis and should be combined with other examinations.

Ileocolonoscopy with biopsy is a key examination for evaluating mucosal involvement and should generally include examination of the colon and terminal ileum [38], [36]. Findings may include skip lesions, linear ulceration, cobblestone mucosa, and rectal sparing [38], [36]. Histopathological examination of biopsy specimens may show focal inflammation, crypt architectural distortion, and non-caseating granulomas in some patients. However, granulomas are not always present and therefore cannot be used as the sole basis for diagnosis [15]. In selected cases, small bowel capsule endoscopy (SBCE) may be considered to evaluate small intestinal mucosa that cannot be reached by conventional endoscopy. However, it should be avoided when a stricture or intestinal obstruction is suspected [37].

Imaging plays an important role in evaluating transmural involvement and parts of the gastrointestinal tract that cannot be adequately assessed by endoscopy. Magnetic resonance enterography (MRE) can evaluate bowel wall thickening, transmural inflammation, strictures, fistulas, and other complications without radiation exposure. In contrast, computed tomography enterography (CTE) is particularly useful in acute conditions and for evaluating complications such as abscesses, perforation, and obstruction [39], [40], [37]. Intestinal ultrasound (IUS) can also be used as a noninvasive examination to assess disease activity and monitor treatment response [39], [36]. In patients with suspected perianal involvement, pelvic MRI can be used to detect fistulas and abscesses [36], [41]. Intestinal tuberculosis should remain an important differential diagnosis, particularly in regions with a high prevalence of tuberculosis [38], [16]. Therefore, integration of endoscopy, histopathology, and imaging is necessary to comprehensively characterize the disease and support decisions regarding treatment and prognosis.

3.8 Radiological Findings

Imaging plays an important role in the diagnosis, assessment of disease activity and phenotype, monitoring of treatment response, and detection of complications in Crohn's disease (CD). Unlike endoscopy, which primarily evaluates the mucosal surface, cross-sectional imaging can assess transmural bowel involvement and extraluminal structures. Commonly used imaging modalities include intestinal ultrasound (IUS), computed tomography enterography (CTE), and magnetic resonance enterography (MRE), with the choice depending on the patient's clinical condition [14], [42], [43].

Fluoroscopy

Fluoroscopy, including barium follow-through and barium enema, was historically used to evaluate CD. Typical findings include cobblestone appearance, linear or longitudinal ulcers, mucosal irregularity, luminal narrowing caused by inflammation or fibrosis, and the string sign in severe ileal strictures [14]. Although fluoroscopy can demonstrate characteristic features of CD, its use has become more limited because MRE, CTE, and IUS can provide additional information about transmural involvement and extraluminal complications [14], [43].

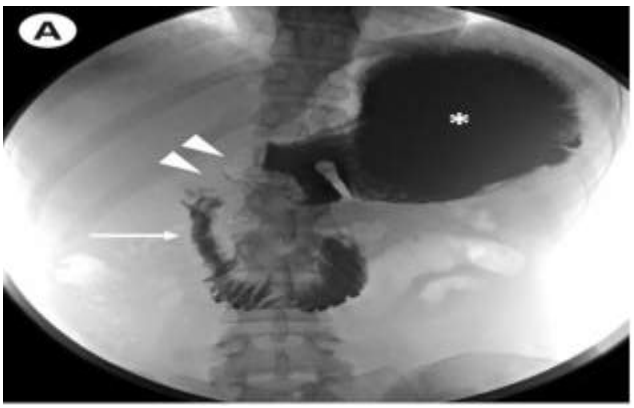

Figure 2. Fluoroscopy in Crohn's disease. (Cicero & Mazziotti, 2021)

Intestinal Ultrasound (IUS)

IUS is a noninvasive imaging modality that does not use ionizing radiation, allowing it to be performed repeatedly for CD monitoring. Major findings include bowel wall thickening, generally with a bowel wall thickness (BWT) >3 mm, loss of normal bowel wall stratification, and increased vascularity on Color Doppler. IUS can also detect strictures, inflammatory masses, fistulas, mesenteric changes, and free fluid [14], [44]. The use of contrast-enhanced ultrasound (CEUS) may provide additional information about bowel wall perfusion and enhancement [14]. In addition to diagnosis, IUS is increasingly used to monitor disease activity and treatment response over time [45]. A meta-analysis by Pruijt et al. reported good diagnostic accuracy for detecting intra-abdominal complications, with sensitivity and specificity of 81% and 90% for strictures, 87% and 95% for inflammatory masses, and 67% and 97% for fistulas.

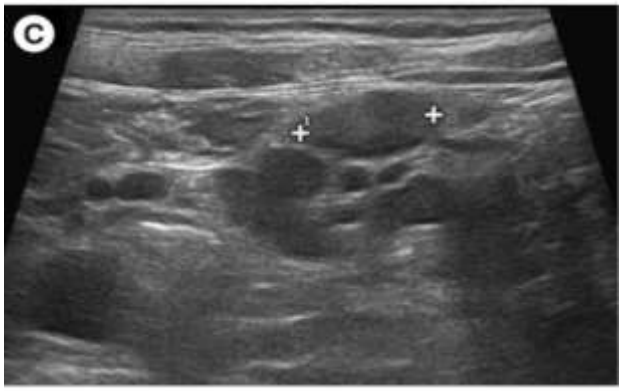

Figure 3. Ultrasonography in Crohn's disease. (Cicero & Mazziotti, 2021)

Computed Tomography Enterography (CTE)

CTE provides high spatial resolution and has a relatively short examination time. In CD, CTE can demonstrate bowel wall thickening, mural hyperenhancement, submucosal edema, strictures, and proximal bowel dilatation. Active disease may be indicated by increased mesenteric vascularity (comb sign) and fat stranding. CTE can also detect lymphadenopathy and complications such as fistulas, abscesses, obstruction, and perforation [14], [43]. Its rapid acquisition and ability to detect complications make CTE particularly useful in acute conditions. However, radiation exposure should be considered, especially in young patients requiring repeated examinations. Therefore, MRE or IUS may be preferred when available [42], [43].

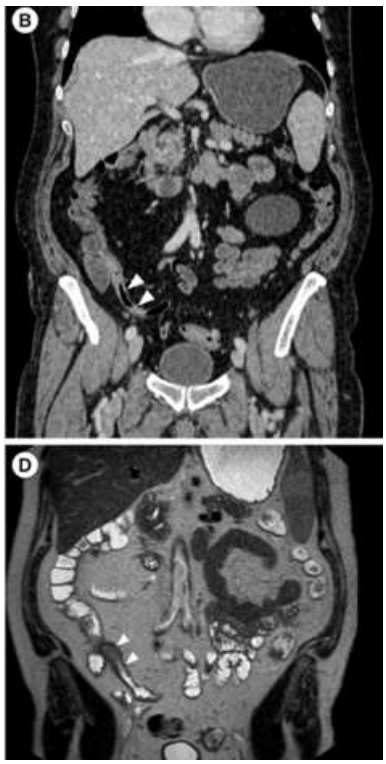

Figure 4. Enterography in Crohn's disease. (Cicero & Mazziotti, 2021)

Magnetic Resonance Enterography (MRE)

MRE is an important imaging modality for evaluating CD because it can assess the bowel and surrounding tissues without ionizing radiation. Findings may include bowel wall thickening, mural hyperenhancement, intramural edema, ulceration, restricted diffusion, increased mesenteric vascularity, and lymphadenopathy [14], [45]. MRE can also help determine disease phenotype. Active inflammation is generally characterized by edema, hyperenhancement, restricted diffusion, and increased vascularity. The penetrating phenotype is characterized by fistulas or abscesses, whereas the fibrostenotic phenotype may show bowel wall thickening with relatively low T2 signal intensity and lower enhancement [14]. Because it does not use ionizing radiation, MRE is also suitable for repeated evaluation and monitoring of treatment response [45].

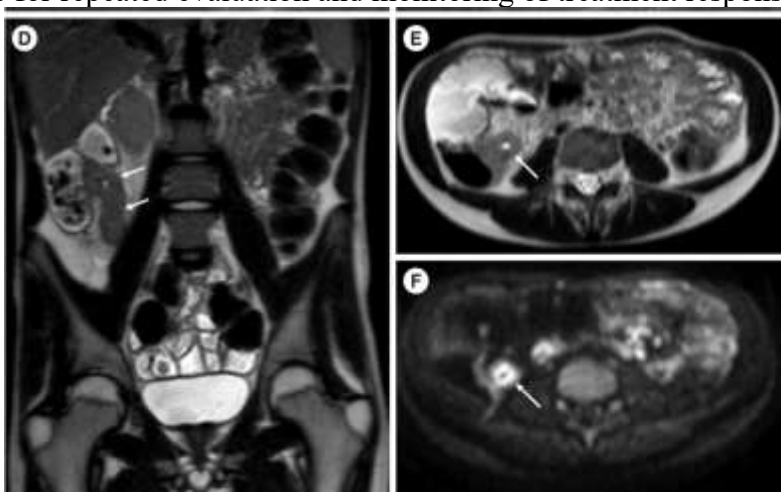

Figure 5. MRE in Crohn's disease. (Cicero & Mazziotti, 2021)

Small Intestinal Contrast Ultrasonography (SICUS)

SICUS is an ultrasound technique that uses oral contrast to improve small bowel distension and visualization. It can help determine the location and length of affected bowel segments and

detect strictures, fistulas, and inflammatory masses without radiation exposure [46], [44]. Although SICUS has potential for evaluating small bowel involvement and CD complications, it is currently used mainly as an additional examination rather than a primary imaging modality.

Selection of Imaging Modality

The choice of imaging modality in CD should be based on the clinical condition, disease location and phenotype, monitoring needs, availability of facilities, and risk of radiation exposure. IUS is suitable for rapid assessment and repeated monitoring, MRE provides comprehensive evaluation without radiation and is particularly useful in patients requiring repeated examinations, whereas CTE is more useful in acute conditions and for evaluating complications such as obstruction, abscesses, and perforation [42], [45]. Therefore, no single imaging modality is superior in all clinical situations, and a multimodal approach should be used according to the individual patient's needs.

3.9 Differential Diagnosis

Crohn's disease may present with features that resemble various gastrointestinal disorders. Therefore, diagnosis should be based on a combination of clinical findings, laboratory tests, endoscopy, imaging, and histopathology [3], [47]. Important differential diagnoses include ulcerative colitis (UC), intestinal tuberculosis (ITB), and intestinal Behçet's disease (BD). Infectious diseases and malignancies should also be considered according to the patient's clinical presentation.

Intestinal tuberculosis (ITB) is an important differential diagnosis, particularly in regions with a high prevalence of tuberculosis. Both CD and ITB may involve the terminal ileum and show granulomatous inflammation, making them difficult to distinguish clinically [48], [47]. Findings that support ITB include caseous necrosis, positive acid-fast bacilli (AFB) testing, and lymph node calcification, although the sensitivity of these findings is limited. Microbiological testing, interferon-γ release assays (IGRA), and integration of clinical, endoscopic, histopathological, and imaging findings can improve diagnostic accuracy [47], [49].

CD should also be differentiated from UC and intestinal BD. UC generally causes continuous inflammation that mainly involves the colon and rectum, whereas CD has a skip-lesion pattern and can affect any part of the gastrointestinal tract [3], [48]. In intestinal BD, ulcers are generally round or oval and are more commonly found in the ileocecal region, whereas CD may show longitudinal ulcers, cobblestone mucosa, and transmural changes [50], [51]. Primary intestinal lymphoma may also mimic CD clinically and radiologically. Histopathological examination and immunohistochemistry are therefore required when malignancy is suspected [52], [53]. Overall, differential diagnosis of CD requires integration of multiple diagnostic modalities to establish the diagnosis and accurately characterize the disease.

Table 1. Differential Diagnosis of Crohn's Disease

Differential Diagnosis	Supporting Findings	Differences from *Crohn's Disease*
Intestinal tuberculosis (ITB)	Granulomatous inflammation, ileocecal involvement, and chronic gastrointestinal symptoms	Caseous necrosis, positive acid-fast bacilli (AFB) or microbiological tests, and lymph node calcification may support ITB
Ulcerative colitis (UC)	Diarrhea and colonic inflammation	Inflammation is generally continuous and begins in the rectum, unlike the *skip lesions* seen in CD
Intestinal Behçet's disease	Gastrointestinal ulceration, particularly in the ileocecal region	Ulcers are generally few in number, round or oval in shape, and do not show the typical *cobblestone* appearance

Primary intestinal lymphoma	Abdominal pain, diarrhea, weight loss, and gastrointestinal lesions	Requires histopathological confirmation and immunohistochemical examination
Gastrointestinal infection	Diarrhea, abdominal pain, and fever	Can be confirmed through stool examination and microbiological testing according to the suspected infection
Celiac disease	Chronic diarrhea and malabsorption	Mainly affects the small intestine and requires appropriate serological and histopathological examinations

3.10 Complications of Crohn's Disease

Crohn's disease (CD) can cause intestinal, perianal, and extraintestinal complications due to chronic transmural inflammation. Major intestinal complications include strictures and obstruction, fistulas, abscesses, and perianal disease, while extraintestinal manifestations may involve the joints, skin, eyes, hematological system, and metabolic system [20], [16].

Intestinal and Perianal Complications

Chronic inflammation of the intestinal wall can cause wall thickening and fibrosis, leading to stricture formation and intestinal obstruction. Strictures may be predominantly inflammatory, fibrotic, or a combination of both. Inflammatory strictures may respond to medical therapy, whereas fibrotic strictures causing significant obstruction may require endoscopic dilation or surgery [20], [19].

Transmural inflammation may also progress to fistula formation, creating abnormal connections between the intestine and other organs, other parts of the intestine, the skin, or the perianal region. Fistulas may be associated with abscesses and represent one of the major forms of perianal disease in CD. Management depends on the location and complexity of the disease and may include medical therapy, drainage, seton placement, or surgery [20], [19]. Other perianal complications include anal fissures, which may be multiple, atypical, and difficult to heal [16], [19].

Extraintestinal Manifestations

Extraintestinal manifestations of CD can involve several organs, particularly the joints, skin, and eyes. Musculoskeletal manifestations include peripheral arthritis, axial spondyloarthritis, enthesitis, and ankylosing spondylitis. Common skin manifestations include erythema nodosum and pyoderma gangrenosum, while ocular complications may include episcleritis and uveitis [20], [16].

In addition, chronic inflammation and impaired absorption may cause anemia and nutritional deficiencies, including deficiencies of iron, vitamin B12, folate, and vitamin D. Patients are also at risk of reduced bone mineral density, osteoporosis, and fractures, particularly in the presence of malnutrition, vitamin D and calcium deficiency, and long-term corticosteroid use [20], [16]. Chronic inflammation also increases the risk of venous thromboembolism, particularly during active disease [20], [16].

Metabolic Complications

Small intestinal involvement and impaired absorption in CD may increase the risk of kidney stones and gallstones. Kidney stones may be associated with changes in oxalate absorption and fluid loss due to chronic diarrhea, whereas altered bile acid metabolism and ileal involvement may contribute to gallstone formation [20], [16].

Overall, CD complications are closely associated with chronic inflammation and disease phenotype. Strictures, fistulas, abscesses, and perianal involvement are important complications

that should be recognized because they may affect prognosis and determine the need for medical, endoscopic, or surgical intervention.

3.11 Management

The main goals of treatment are to control intestinal inflammation, reduce symptoms such as pain, diarrhea, and bleeding, achieve and maintain clinical remission, and prevent long-term complications such as strictures, fistulas, and malnutrition.

Pharmacological Management

a. Corticosteroids

Corticosteroids are used for induction of remission rather than long-term maintenance therapy. They are effective in suppressing acute inflammation but are associated with adverse effects such as osteoporosis, hypertension, and infection [54]. Corticosteroids are generally used to control symptoms during active CD. Treatment is commonly initiated with prednisone at an initial dose of 40–60 mg, depending on disease severity. When clinical improvement or remission occurs, the dose is gradually reduced. This approach aims to control symptoms while minimizing the adverse effects associated with prolonged corticosteroid use.

b. Immunosuppressants

Immunomodulators such as azathioprine, 6-mercaptopurine, and methotrexate may be used for maintenance therapy, particularly in patients who require a steroid-sparing strategy. Their use requires appropriate monitoring because of potential adverse effects, including myelosuppression, hepatotoxicity, and infection.

c. Biologics and Small Molecules

Biologic therapy is an important component of CD management, particularly in patients with moderate-to-severe disease or inadequate response to conventional therapy. Anti-TNF agents such as infliximab, adalimumab, and certolizumab pegol are effective in patients with refractory CD and are also used in fistulizing CD. Anti-integrin therapy, such as vedolizumab, provides more selective effects in the gastrointestinal tract. Anti-IL-12/23 therapy, such as ustekinumab, is another therapeutic option, particularly when previous biologic therapy has failed [54].

d. Antibiotics

Antibiotics such as metronidazole or ciprofloxacin may be used in selected patients with complications such as fistulas, abscesses, or secondary infection. Their use should be based on the clinical indication and the presence of infection or specific complications.

Non-Pharmacological Management

Non-pharmacological management focuses on nutritional support and lifestyle modification. A balanced diet and appropriate supplementation of vitamin B12, vitamin D, folate, and iron are important for patients with nutritional deficiencies or anemia. In children, enteral nutrition can also be used as a strategy to induce remission. Smoking cessation is particularly important because smoking can worsen disease progression and increase the risk of relapse.

Surgical Management

Surgery is not curative for CD but may be required when complications do not respond adequately to medical therapy. Indications may include strictures causing significant obstruction, intestinal perforation, severe bleeding, or abscesses that require intervention. Surgical options include segmental resection, stricturoplasty, and abscess drainage. However, postoperative recurrence remains possible; therefore, appropriate medical therapy and postoperative monitoring are important to reduce the risk of disease recurrence.

Monitoring and Follow-up

Monitoring patients with CD requires a combination of clinical, laboratory, endoscopic, and imaging assessments. Clinical symptoms such as diarrhea, abdominal pain, and weight loss should be assessed regularly, while inflammatory biomarkers such as CRP and fecal calprotectin can be used to evaluate disease activity. Endoscopy is important for assessing mucosal healing as a long-term treatment target, while imaging such as MRE or CTE may be required when complications such as strictures or fistulas are suspected. Appropriate monitoring allows treatment to be adjusted according to disease activity and treatment response.

3.12 Prognosis

Patients with CD who are at higher risk of a more severe disease course generally have several characteristics, including younger age at diagnosis (<30 years), active or recently discontinued smoking, elevated CRP or fecal calprotectin levels, deep ulcers on colonoscopy, extensive intestinal involvement, perianal disease, extraintestinal manifestations, and a history of intestinal resection [55], [56]. Despite optimal treatment, some patients may experience reduced quality of life because of the chronic and relapsing nature of the disease. Prognosis may also be worse when complications such as malignancy and hepatobiliary disorders occur. Patients with structural or penetrating complications may require surgery, and some may undergo repeated surgical procedures during the course of the disease [1].

4. CONCLUSION

Crohn's disease is a chronic inflammatory disorder of the gastrointestinal tract with a multifactorial etiology involving interactions among genetic factors, gut microbiota, environmental exposures, and immune dysregulation. Its clinical manifestations may include both gastrointestinal and extraintestinal symptoms, with a disease course that can lead to various complications, including strictures, fistulas, abscesses, and colorectal malignancy. Diagnosis requires a multimodal approach involving clinical assessment, physical examination, laboratory tests, endoscopy and histopathology, and appropriate imaging based on the patient's condition, together with exclusion of other diseases with similar manifestations.

Currently, there is no curative treatment for CD. However, appropriate pharmacological therapy, lifestyle and risk-factor modification, and endoscopic or surgical intervention when indicated can help control disease activity, reduce symptoms, maintain quality of life, and prevent complications. Therefore, long-term monitoring is required to assess treatment response, detect complications at an eraly stage, and reduce the rsik of disease recurrence.

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