



From gut to liver: Exploring the relationship between inflammatory bowel disease and metabolic dysfunction-associated steatotic liver disease

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Abstract

Inflammatory bowel disease (IBD), comprising Crohn's disease and ulcerative colitis, is a chronic condition marked by relapsing inflammation of the gastrointestinal tract. Metabolic dysfunction-associated steatotic liver disease (MASLD) emphasizes the interplay between metabolic alterations and modern lifestyle factors in its pathogenesis. Emerging evidence suggests that individuals with IBD are at increased risk for MASLD, driven by shared mechanisms, including gut dysbiosis, chronic systemic inflammation, and compromised intestinal barrier function. However, MASLD frequently remains underdiagnosed in this population. The gut microbiota plays a central role in modulating these interactions, influencing both intestinal permeability and metabolic regulation. Key pathophysiological mechanisms include alterations in short-chain fatty acid production, particularly reduced butyrate synthesis; disruption of bile acid signaling path-

ways *via* farnesoid X receptor and Takeda G protein-coupled receptor 5 receptors; and activation of pro-inflammatory cascades through toll-like receptor 4 in the liver. These events lead to increased intestinal permeability, translocation of microbial products, and amplification of hepatic inflammation. This review synthesizes current knowledge on the shared pathophysiological pathways linking IBD and MASLD—focusing on dysbiosis, barrier dysfunction, and inflammation—and underscores their clinical relevance. Understanding the gut–liver axis provides opportunities for early diagnosis and integrated management strategies, aiming to reduce disease burden and improve patient outcomes.

Key Words: Metabolic dysfunction-associated steatotic liver disease; Gut microbiota; Ulcerative colitis; Crohn's disease; Inflammatory bowel disease

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Core Tip: This review explores the complex interplay between inflammatory bowel disease (IBD) and metabolic dysfunction-associated steatotic liver disease, two increasingly prevalent conditions with shared key pathophysiological mechanisms. Chronic inflammation, gut dysbiosis, and intestinal barrier dysfunction are central to both diseases and interconnected through the gut–liver axis. Understanding this relationship highlights the importance of metabolic monitoring, lifestyle interventions, and early screening of hepatic and cardiovascular complications in patients with IBD.

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INTRODUCTION

Inflammatory bowel disease (IBD) is a multifactorial disorder involving genetic susceptibility, immune dysregulation, and gut microbiota alterations[1,2]. Although primarily manifesting as intestinal inflammation, IBD is associated with systemic complications, including metabolic disorders and liver diseases[3]. Among these, metabolic dysfunction-associated steatotic liver disease (MASLD)—formerly nonalcoholic fatty liver disease (NAFLD)—has gained attention due to overlapping mechanisms and increasing prevalence. The renaming to MASLD emphasizes its metabolic etiology and removes stigmatizing language[3]. Patients with IBD show heightened cardiovascular risk and increased all-cause mortality, especially in the presence of metabolic syndrome. Lifestyle factors, including diet and physical activity, influence both IBD course and MASLD development. Recognizing the overlap between these diseases is crucial for implementing effective preventive strategies[4–6].

Despite growing recognition of the gut–liver axis, the interplay between IBD and MASLD remains underexplored in clinical guidelines and real-world practice. Most existing literature examines these diseases in isolation, with limited synthesis of their shared mechanisms and implications for clinical management[3,4]. Therefore, this review aims to (1) Elucidate the common pathophysiological pathways linking IBD and MASLD; (2) Highlight the role of the gut–liver axis in mediating their interaction; and (3) Discuss clinical implications, including diagnostic challenges, risk stratification, and potential therapeutic strategies. By addressing this gap, we aim to support a more integrated approach to care for patients affected by both conditions.

MASLD

The nomenclature from NAFLD has been revised by the medical community to MASLD. The Delphi consensus suggests that the term MASLD is insufficient to describe the disease pathogenesis and risk factors[7]. MASLD is currently defined as evidence of hepatic steatosis identified *via* biopsy or imaging examinations in a patient with cardiometabolic criteria (Figure 1) and no evidence of other causes of liver steatosis[7]. This new definition highlights the metabolic disorders correlated with systemic inflammation and gut dysbiosis.

The prevalence of MASLD is rising worldwide, estimated at 30% in 2019, with over 1.6 billion people affected by the disease[8,9]. The incidence of MASLD has also increased worldwide, which may be explained by its causal association with metabolic syndrome, characterized by obesity, hypertension, hyperglycemia, and dyslipidemia[7]. MASLD may also be influenced by the presence of other concomitant liver disorders associated with alcohol consumption (> 20 g and 30 g per day for women and men, respectively, referred to as metabolic alcoholic liver disease), chronic use of hepatotoxic substances, and genetics[10]. These characteristics may favor the development of cirrhosis, which may result in the need for liver transplantation, with a higher risk of early post-transplant complications in these patients[11].

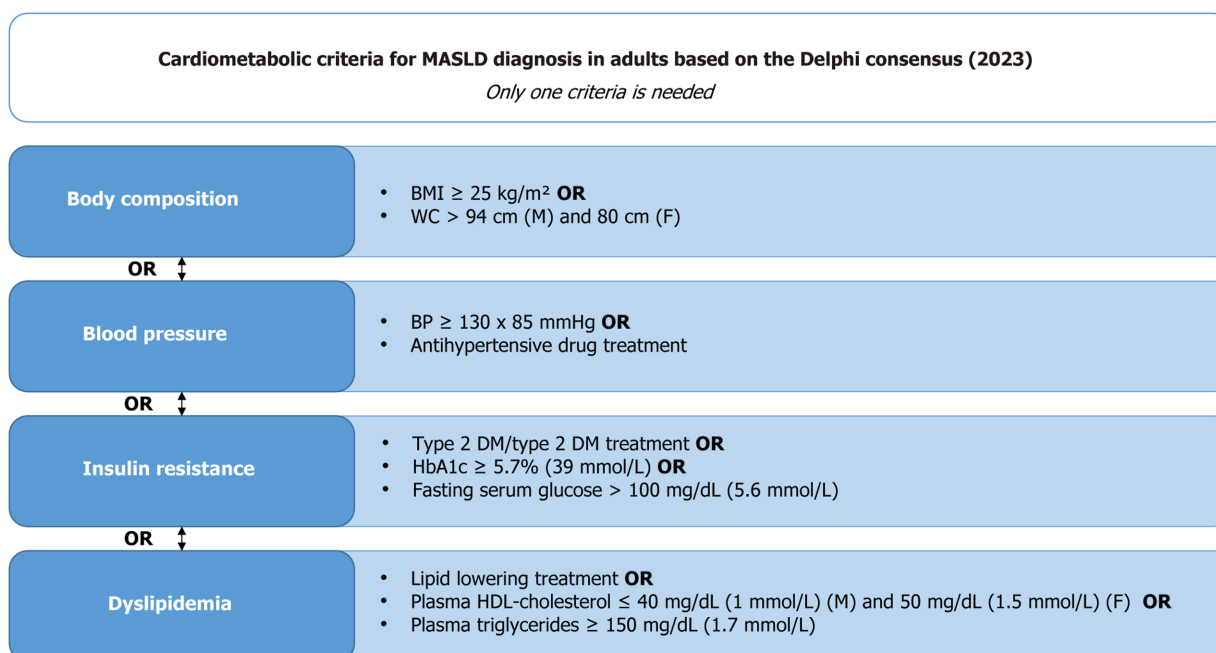


Figure 1 Cardiometabolic criteria for the diagnosis of metabolic dysfunction-associated steatotic liver disease in adults. Diagnosis requires the presence of at least one of the following conditions: Altered body composition (body mass index ≥ 25 kg/m² or increased waist circumference adjusted for sex and ethnicity), elevated blood pressure, signs of insulin resistance (type 2 diabetes mellitus or markers), or dyslipidemia (use of lipid-lowering medication, reduced high-density lipoprotein-cholesterol, or elevated triglycerides). Adapted from the Delphi Consensus Statement (2023). BMI: Body mass index; BP: Blood pressure; DM: Diabetes mellitus; HbA1c: Glycated hemoglobin; HDL: High-density lipoprotein; MASLD: Metabolic dysfunction-associated steatotic liver disease; WC: Waist circumference.

Recent studies have shown that, although obesity is an independent risk factor for MASLD, waist circumference measurements are more sensitive than body mass index (BMI) measurements. The role of metabolic alterations in the pathogenesis of MASLD is well known. Excess abdominal fat is associated with insulin resistance, a significant source of free fatty acids that contribute to disease progression. Additionally, other factors may be associated with MASLD, including an unbalanced diet and metabolic disorders such as type 2 diabetes mellitus, which affect lipid metabolism and exacerbate hepatic steatosis[12-14].

MASLD diagnosis requires a stepwise and multimodal approach. Initial assessment typically involves non-invasive imaging modalities such as ultrasound or transient elastography, which help identify steatosis and estimate liver stiffness. These tools are frequently complemented by validated scoring systems, including the fibrosis-4 index (FIB-4) and MASLD fibrosis scores, to stratify fibrosis risk. However, it is important to note that normal findings in these tests do not exclude disease[3,7,15]. In cases where non-invasive evaluations yield inconclusive results or when clinical suspicion persists despite normal tests, liver biopsy remains the gold standard for definitive diagnosis and staging. It provides detailed histological information, which is particularly important in patients with suspected advanced fibrosis or concomitant liver conditions[7,15].

Additionally, genetic predisposition plays a role in disease susceptibility. The patatin-like phospholipase domain-containing protein 3 I148M variant has been consistently associated with increased hepatic fat accumulation and fibrosis progression, although its application as a prognostic tool in routine clinical practice remains under investigation[16-19].

Currently, no pharmacologic therapy is specifically approved for MASLD. However, several anti-diabetic agents—including glucagon-like peptide-1 receptor agonists, sodium-glucose co-transporter-2 inhibitors, and pioglitazone—have demonstrated benefits in improving insulin sensitivity, reducing hepatic steatosis, and lowering cardiovascular risk[20,21]. Lifestyle intervention remains the cornerstone of treatment, with evidence showing that $\geq 10\%$ weight loss can significantly reduce steatosis, inflammation, and fibrosis. Adopting a Mediterranean diet, reducing ultra-processed foods, and engaging in regular physical activity are all associated with improvements in hepatic and metabolic parameters[12,22].

Beyond conventional approaches, emerging therapies targeting metabolic and inflammatory pathways are under investigation. These include fibroblast growth factor analogs, thyroid hormone receptor- β agonists, and bile acid modulators such as obeticholic acid. Moreover, advances in precision medicine—including genomics, lipid omics, and gut microbiome profiling—may enable more personalized strategies tailored to individual risk profiles and disease phenotypes. Ongoing clinical trials are expected to clarify the role of these novel treatments[23-27].

GUT MICROBIOTA, INTESTINAL BARRIER, AND CHRONIC INFLAMMATION

The human gastrointestinal tract harbors a complex and dynamic ecosystem of microorganisms—including bacteria, archaea, fungi, and viruses—collectively known as the gut microbiota. These microbes play essential roles in digestion, vitamin production, immune regulation, and maintenance of intestinal homeostasis. Under physiological conditions, gut microbiota contributes to a balanced immune environment and supports the structural and functional integrity of the intestinal barrier[28,29].

In both IBD and MASLD, this balance is disturbed. Dysbiosis—characterized by reduced microbial diversity and depletion of beneficial taxa, including *Faecalibacterium prausnitzii* and *Akkermansia muciniphila*—is a hallmark of both diseases. These species are prominent producers of short-chain fatty acids (SCFAs), particularly butyrate, which provide energy for colonocytes, reinforce tight junctions, and exert anti-inflammatory effects. The loss of butyrate-producing bacteria impairs barrier function and promotes mucosal immune activation[28,30-32].

The intestinal barrier comprises the following four key layers: (1) The mucus layer; (2) A single layer of epithelial cells joined by tight junctions; (3) Underlying immune cells within the lamina propria; and (4) The gut vascular barrier[33]. Damage to any of these structures increases permeability and enables the translocation of microbial products—such as lipopolysaccharide (LPS), peptidoglycans, and bacterial DNA—into the portal circulation. These microbial-derived molecules act as pathogen-associated molecular patterns (PAMPs) and can activate inflammatory signaling cascades in distant organs, particularly the liver[33,34].

GUT-LIVER AXIS

In states of chronic intestinal inflammation—whether related to IBD or other causes—the persistent immune activation contributes to barrier dysfunction, sustains dysbiosis, and increases systemic exposure to microbial antigens[35,36]. Elevated levels of biomarkers, including zonulin and intestinal fatty acid-binding protein, reflect increased intestinal permeability. The liver, continuously exposed to this influx *via* the portal vein, mounts inflammatory and fibrotic responses that promote the development and progression of MASLD[36-38].

This intricate relationship underscores how gut microbiota composition and intestinal barrier integrity are central to the shared pathophysiology of intestinal and metabolic liver diseases[38,39]. The dysregulation of this system represents a mechanistic bridge linking localized gastrointestinal inflammation to systemic metabolic and hepatic consequences[35,37].

The gut and liver maintain a close bidirectional relationship *via* the portal vein, biliary tract, and systemic circulation. This connection enables not only nutrient transport but also the exchange of microbial metabolites, hormones, and immunological signals. The gut-liver axis integrates dietary, microbial, and immune-derived inputs that regulate bile acid synthesis, lipid metabolism, and hepatic inflammation[40-42].

Bile acids, synthesized in the liver and modified by gut microbes, are central mediators of this axis. Primary bile acids, including cholic and chenodeoxycholic acids, are conjugated and secreted into the intestine, where bacterial enzymes convert them into secondary bile acids[41]. These molecules activate nuclear receptors, such as the farnesoid X receptor (FXR), and membrane-bound receptors, including Takeda G protein-coupled receptor 5 (TGR5), influencing epithelial integrity, immune tolerance, and antimicrobial peptide production. The disruption of bile acid homeostasis in MASLD and IBD contributes to inflammation and microbial imbalance. Reduced FXR and TGR5 signaling is associated with increased gut permeability and a pro-inflammatory intestinal environment. Conversely, liver dysfunction in MASLD can alter bile acid synthesis and composition, promoting dysbiosis and further compromising the gut barrier[43-46].

Furthermore, microbial-derived metabolites, including SCFAs (*e.g.*, butyrate), LPS, and trimethylamine N-oxide, can exert direct effects on hepatic stellate cells, Kupffer cells, and hepatocytes. These interactions contribute to steatosis, fibrosis, and insulin resistance, perpetuating the cycle of gut-liver injury[47-49].

Overall, the gut-liver axis represents a dynamic immunometabolic interface. Its dysfunction[46] plays a pivotal role in linking chronic intestinal disorders with hepatic metabolic injury, offering opportunities for therapeutic modulation through dietary, microbial, and pharmacological interventions[50-54].

RELATIONSHIP BETWEEN MASLD AND IBD

The prevalence of MASLD among patients with IBD is higher than that in the general population, particularly between 20% and 40%, based on various cohort studies. Importantly, this association persists even after adjusting for classical risk factors, including BMI and diabetes[55-57].

Several factors contribute to the increased risk of developing MASLD, including chronic systemic inflammation, alterations in the gut microbiota, intestinal permeability, and the metabolic effects of long-term corticosteroid use. Moreover, nutritional alterations such as sarcopenic obesity and insulin resistance are common in IBD and further predispose patients to MASLD (Table 1)[5,6,55-59].

Multiple overlapping mechanisms help explain this link. Chronic systemic inflammation characteristic of IBD contributes to hepatic injury by sustaining cytokine release and oxidative stress. Additionally, intestinal dysbiosis and increased permeability facilitate microbial translocation and hepatic immune activation. Long-term corticosteroid use, common in IBD management, may further promote insulin resistance, central adiposity, and hepatic steatosis. Sarcopenic obesity, micronutrient deficiencies, and alterations in bile acid metabolism compound these risks[48,58]. Furthermore,

Table 1 Factors associated with the development of metabolic dysfunction-associated steatotic liver disease in patients with inflammatory bowel disease

Associated factor	Evidence/commentary
Obesity	Observed even in patients with IBD in clinical remission
Insulin resistance	Central mechanism in the pathophysiology of MASLD, aggravated by chronic inflammation
Prolonged use of corticosteroids	Associated with changes in lipid metabolism and fat distribution
Metabolic syndrome	High prevalence in patients with IBD and MASLD
Chronic low-grade inflammation	May contribute to liver changes even with IBD in remission
Intestinal dysbiosis	Affects hepatic homeostasis <i>via</i> the gut–liver axis
Previous malnutrition with rapid refeeding	Can lead to hepatic steatosis due to liver overload
Sedentary lifestyle	Reduced energy expenditure contributes to the accumulation of liver fat
Use of methotrexate or azathioprine	Drugs with potential hepatotoxic impact

IBD: Inflammatory bowel disease; MASLD: Metabolic dysfunction-associated steatotic liver disease.

common dietary factors in Western populations, including excessive consumption of refined carbohydrates, saturated fatty acids, and food additives, can exacerbate intestinal inflammation and dysbiosis, intensifying microbial invasion and the production of pro-inflammatory metabolites that reach the liver *via* the portal vein, establishing a vicious cycle that interconnects the pathogenesis of IBD and MASLD[58]. **Figure 2** outlines the reciprocal interactions among the intestinal microbiota, bile acid signaling, barrier function, and hepatic inflammation linking IBD and MASLD.

Abenavoli *et al*[60] provided an updated overview of this intersection, highlighting that even lean individuals with IBD exhibit higher MASLD prevalence than matched controls, reinforcing the role of inflammation and microbiota beyond obesity as driving factors. Similarly, Rodriguez-Duque *et al*[56] found IBD to be an independent risk factor for liver fibrosis, regardless of metabolic comorbidities.

Patients with IBD have higher serum levels of pro-inflammatory cytokines, such as interleukins (IL)-6, IL-15, IL-22, and tumor necrosis factor- α (TNF- α), than individuals without IBD. Notably, adipose tissue produces a higher proportion of inflammatory cytokines, and their excess, especially in the abdominal region, may be associated with a reduced response to the therapy. Therefore, it is important that patients with IBD have their weight and BMI assessed and that their waist circumference be monitored[14,61]. Moreover, MASLD in the context of IBD is associated with worse cardiometabolic outcomes, increased hospitalization rates, and higher healthcare utilization. Despite these risks, screening for liver involvement in IBD remains inconsistent. Early assessment using elastography or fibrosis scores (*e.g.*, FIB-4 and MASLD fibrosis score) should be considered, particularly in patients with longstanding disease, elevated inflammatory markers, or concurrent metabolic risk factors[14].

Management requires a comprehensive, multidisciplinary approach. Nutritional counseling and lifestyle modifications, especially those targeting body composition and dietary patterns—are fundamental. Where possible, corticosteroid-sparing strategies and the use of biologics or small molecules with favorable metabolic profiles should be preferred. The integration of hepatology and gastroenterology expertise is essential to optimize care, reduce complications, and improve long-term outcomes[62,63].

This growing body of evidence highlights the importance of incorporating MASLD awareness into IBD clinical pathways. Further research is warranted to explore whether targeted therapies for gut inflammation can mitigate hepatic outcomes and whether modulating the microbiota and bile acid metabolism may offer dual benefits across the gut–liver axis[14,64].

RELATIONSHIP BETWEEN THE GUT–LIVER AXIS, IBD, MASLD, AND GUT MICROBIOTA

The gut–liver axis serves as the central interface linking intestinal inflammation and metabolic liver disease. In individuals with IBD, persistent disruption of gut homeostasis—characterized by immune dysregulation and microbiota imbalance—creates a permissive environment for hepatic injury (**Figure 2**). When compounded by metabolic stressors, this dysfunction establishes a trajectory toward MASLD progression[65].

Recent integrative models emphasize the synergistic roles of gut microbiota-derived metabolites, including microbial-associated molecular patterns, bile acid derivatives, and tryptophan catabolites, in shaping liver inflammation and fibrosis[66–68]. These molecules not only modulate hepatic immune responses but also influence intestinal epithelial signaling, creating a feedback loop that perpetuates barrier breakdown and systemic inflammation.

Among the SCFAs, butyrate is particularly pivotal owing to its anti-inflammatory, immunomodulatory, and barrier-enhancing properties 1–3[66–68]. Butyrate serves as the principal energy source for colonocytes and promotes the expression of tight junction proteins, thereby reinforcing mucosal integrity and limiting intestinal permeability[69–71].

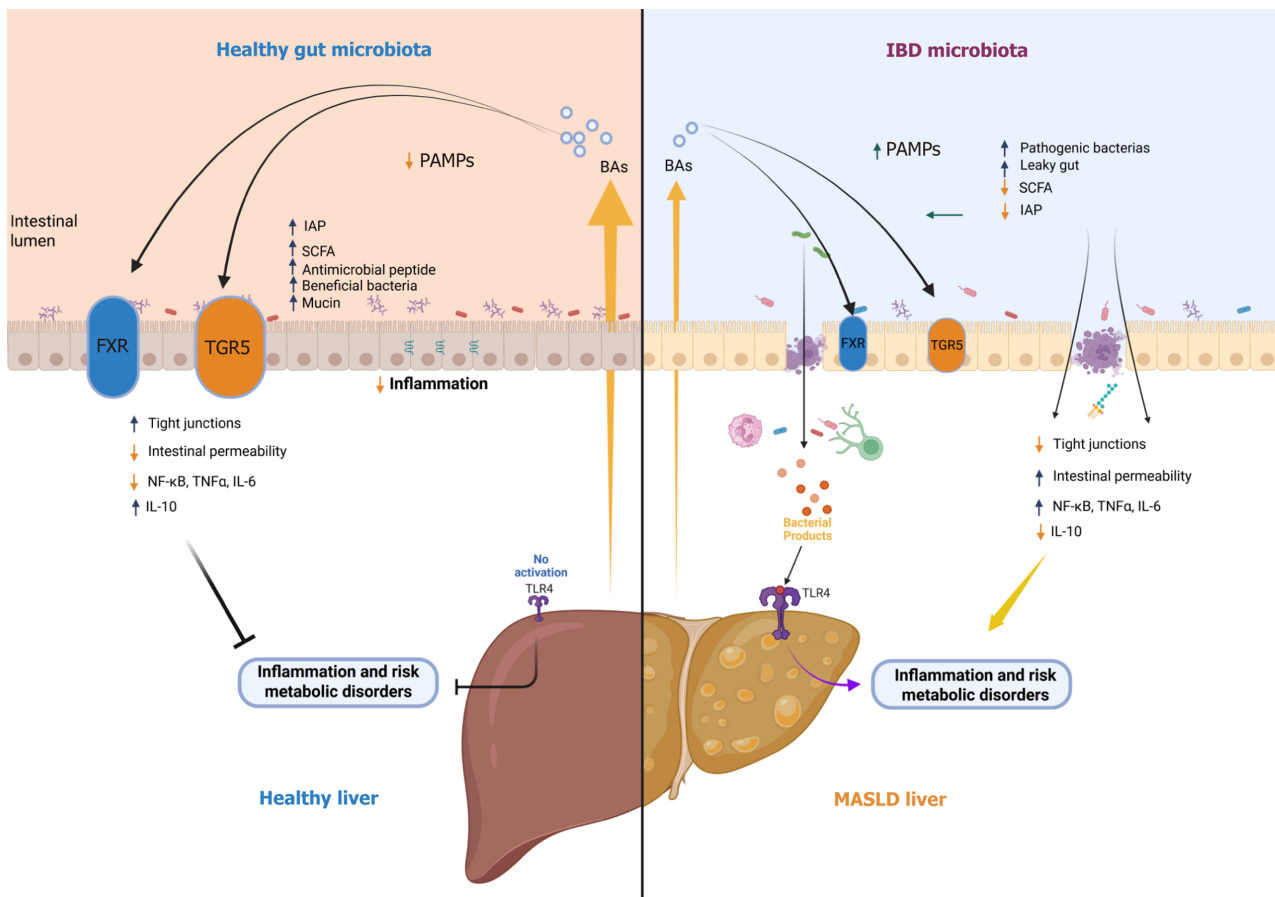


Figure 2 Gut-liver axis in health and disease: Reciprocal interactions between intestinal microbiota, bile acid signaling, barrier function, and hepatic inflammation linking inflammatory bowel disease and metabolic dysfunction-associated steatotic liver disease. This schematic illustrates the bidirectional crosstalk of the gut-liver axis under physiological and pathological conditions. In an eubiotic state (left panel), a balanced gut microbiota produces short-chain fatty acids (SCFAs) such as butyrate, which reinforce intestinal barrier integrity by promoting tight junction expression and intestinal alkaline phosphatase (IAP) activity. This environment limits intestinal permeability and prevents the translocation of pathogen-associated molecular patterns into the portal circulation. Additionally, bile acids activate the farnesoid X receptor and Takeda G protein-coupled receptor 5, modulating anti-inflammatory pathways; reducing nuclear factor-kappa B, tumor necrosis factor-alpha, and interleukin (IL)-6 signaling; and enhancing IL-10 production, thereby preserving hepatic and intestinal homeostasis. In contrast, intestinal dysbiosis observed in inflammatory bowel disease (IBD) (right panel) is characterized by reduced microbial diversity, loss of beneficial SCFA-producing bacteria, decreased IAP, and increased pathogenic bacteria, leading to mucosal barrier disruption. This favors pathogen-associated molecular pattern translocation and toll-like receptor 4 activation in the liver, promoting hepatic inflammation and the progression to metabolic dysfunction-associated steatotic liver disease (MASLD). Furthermore, MASLD itself can impair bile acid homeostasis and alter gut microbiota composition, thereby exacerbating intestinal permeability, inflammation, and dysbiosis, which may, in turn, predispose or contribute to the development of IBD. This vicious cycle underscores the reciprocal, amplifying relationship between intestinal and hepatic disorders, positioning the gut-liver axis as a critical therapeutic target in the co-management of IBD and MASLD. FXR: Farnesoid X receptor; IAP: Intestinal alkaline phosphatase; IBD: Inflammatory bowel disease; IL: Interleukin; MASLD: Metabolic dysfunction-associated steatotic liver disease; NF-κB: Nuclear factor-kappa B; PAMPs: Pathogen-associated molecular patterns; SCFA: Short-chain fatty acid; TGR5: Takeda G protein-coupled receptor 5; TLR4: Toll-like receptor 4; TNF-α: Tumor necrosis factor-alpha.

Moreover, butyrate functions as an epigenetic modulator by inhibiting histone deacetylase, thereby regulating the transcriptional programs involved in inflammation, oxidative stress, and immune homeostasis. It also promotes the differentiation of regulatory T cells, thereby enhancing mucosal immune tolerance, an essential mechanism disrupted in IBD. Additionally, butyrate mitigates intestinal inflammation by modulating the toll-like receptor 4 (TLR4) signaling pathway, reducing pro-inflammatory cytokine production, and limiting the translocation of PAMPs into the portal circulation, ultimately contributing to the attenuation of hepatic inflammation[69-71]. This direct immunomodulatory role of butyrate is further complemented by its ability to upregulate intestinal alkaline phosphatase (IAP), providing additional protection against microbe-associated inflammation.

Importantly, butyrate enhances IAP expression, an enzyme with critical barrier-protective and anti-inflammatory functions. IAP dephosphorylates LPS and other microbial components, reducing their immunogenicity and preventing excessive TLR4-mediated activation of hepatic immune cells[72]. In addition to LPS detoxification, IAP contributes to microbial homeostasis by favoring commensal species and suppressing pathobionts. Disrupting the butyrate-IAP axis, which is frequently observed in both IBD and MASLD[73,74], leads to increased intestinal permeability and systemic endotoxemia, exacerbating hepatic inflammation and advancing disease progression.

Gut dysbiosis disrupts the gut-liver axis in pathological contexts such as IBD and MASLD (Table 2). Both conditions are characterized by profound compositional shifts in the microbiota, resulting in reduced microbial diversity and a loss of balance between commensal and pathogenic bacteria. These alterations compromise the mucosal barrier function,

Table 2 Changes in gut microbiota and the risk of metabolic dysfunction-associated steatotic liver disease in patients with inflammatory bowel disease

Changes in gut microbiota	Evidence/commentary
Intestinal dysbiosis	Imbalance between beneficial and pathogenic microbiota can lead to liver inflammation and the development of MASLD
Decrease in <i>Firmicutes</i> and increase in <i>Bacteroidetes</i>	Common changes in patients with inflammatory bowel disease, associated with an increased risk of hepatic steatosis
Decrease in <i>Lactobacillus</i> and <i>Bifidobacterium</i>	Beneficial microorganisms that play a role in intestinal protection, the reduction of which can intensify liver inflammation
Increase in <i>Proteobacteria</i>	Species of the genus <i>Proteobacteria</i> associated with intestinal and hepatic inflammation, promoting the risk of MASLD
Increase in <i>E. coli</i>	The proliferation of <i>E. coli</i> associated with chronic inflammation can aggravate the risk of fat accumulation in the liver
Changes in the production of SCFAs	Dysbiosis leads to lower production of SCFAs, molecules that help regulate liver and intestinal function
Alteration of the intestine-liver axis	Altered microbiota may influence liver function <i>via</i> immune and nervous axes, exacerbating the risk of MASLD
Pro-inflammatory microbiota	The predominance of pro-inflammatory species, such as <i>Enterococcus</i> and <i>Streptococcus</i> , is associated with an increased risk of MASLD

E. coli: *Escherichia coli*; MASLD: Metabolic dysfunction-associated steatotic liver disease; SCFAs: Short-chain fatty acids.

facilitating the translocation of microbial products, including LPS, peptidoglycans, and bacterial DNA, into the portal circulation. These microbial components act as PAMPs, engaging pattern recognition receptors, such as TLR4, which is expressed on hepatocytes, Kupffer cells, and hepatic stellate cells. TLR4 activation initiates nuclear factor-kappa B (NF- κ B) signaling cascades, culminating in the release of pro-inflammatory cytokines, including TNF- α , IL-1 β , and IL-6, which contribute to hepatic inflammation, fibrogenesis, and the progression of steatosis[74-78].

Bile acids, synthesized in the liver from cholesterol and modified by gut microbiota, are not only essential for lipid emulsification but also act as signaling molecules. By activating nuclear receptors (*e.g.*, FXR) and membrane-bound receptors (*e.g.*, TGR5), they regulate intestinal inflammation, epithelial integrity, immune tolerance, and antimicrobial peptide production. In MASLD and IBD, the dysregulation of bile acid signaling, particularly with the accumulation of toxic bile acids such as lithocholic acid and reduced FXR/TGR5 activity, can worsen epithelial dysfunction and promote dysbiosis [79-83].

Transcriptomic and metabolomic analyses in patients with IBD and MASLD have begun to reveal distinct microbial and molecular signatures, suggesting that specific pathways—such as TLR4–NF- κ B activation, impaired FXR signaling, and SCFA depletion—may underpin the co-manifestation of these diseases. These insights pave the way for identifying biomarkers and precision-targeted interventions[84,85].

IBD exacerbates MASLD by sustaining intestinal inflammation[5] and dysbiosis, promoting microbial translocation and hepatic immune activation[55,56,86-88]. Conversely, MASLD may influence the course of IBD. Chronic hepatic inflammation and insulin resistance can alter the composition of gut microbiota and bile acid metabolism, which are essential for maintaining intestinal immune regulation and preventing bacterial overgrowth.

From a therapeutic perspective, agents that modulate gut microbiota composition (*e.g.*, targeted prebiotics, postbiotics, or microbial consortia), enhance bile acid receptor signaling or restore mucosal immune tolerance are being explored as strategies to address both intestinal and hepatic inflammation. The ability to influence both ends of the gut–liver axis through a unified approach offers a promising frontier in managing these interconnected disorders[89-91].

As understanding deepens, the gut–liver axis emerges not as a mechanistic bridge but as a therapeutic target in itself—highlighting the need for translational studies that integrate microbiome science, hepatology, and immunology to improve outcomes in patients with IBD and MASLD.

CONCLUSION

The interplay between IBD and MASLD reflects the convergence of chronic intestinal inflammation, metabolic dysfunction, and gut microbiota alterations, all interconnected through a dysregulated gut–liver axis. Rather than viewing these conditions in isolation, clinicians and researchers should approach them as interdependent components of a systemic pathophysiological process.

Recognizing the key mechanisms shared by IBD and MASLD, including impaired intestinal barrier function, microbial dysbiosis, altered bile acid metabolism, and immune dysregulation, can guide the early identification of at-risk patients and inform integrated clinical strategies. Clinicians should be encouraged to adopt routine liver assessment in IBD management, particularly in patients with metabolic risk factors or ongoing inflammation.

Future research should prioritize the development of non-invasive biomarkers for early detection, the characterization of patient subgroups at higher risk, and the evaluation of therapies targeting the gut–liver axis. These efforts may include interventions focused on modulating the microbiota, activating bile acid receptors, and restoring mucosal tolerance. Ultimately, adopting a systems-based approach centered on the gut–liver axis may enhance the prevention of disease progression, reduce comorbidities, and improve individualized care for patients affected by IBD and MASLD.

FOOTNOTES

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