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Review Article

Eosinophilic Gastrointestinal Diseases and their Impact on the Intestinal Microbiome

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Abstract

In the last decade, articles have been published regarding the increased incidence of primary eosinophilic digestive diseases linked to atopy. This has led to efforts to minimize their negative impact, due to repeated diagnostic errors caused by their rarity and the tendency to focus on other, more common pathologies. To highlight this pathology, we explore what occurs from the esophagus to the colon when affected by eosinophilic disorders.

Keywords: *Eosinophilic Esophagitis (EE); Eosinophilic Gastroenteritis (EGE); Eosinophilic Colitis (EC); Gut Microbiome (GM)*

Introduction

Eosinophils are a type of white blood cell crucial to the immune system, parasitic infections, and allergic reactions. They are part of the body's homeostasis, defense against viral and parasitic infections, cancer immunology, and the pathology of our current topic: gastrointestinal eosinophilic diseases. Questions remain to be answered regarding their biology. These microscopic particles can contribute to health or disease. Among the diseases associated with eosinophils are various gastrointestinal processes, such as eosinophilic esophagitis (EE), gastric eosinophilia (GE), duodenal eosinophilia (DE) or eosinophilic duodenitis, eosinophilic gastroenteritis (EGE), eosinophilic colitis (EC), and hypereosinophilic syndrome with gastrointestinal involvement. Currently, several procedures exist to diagnose these rare problems, such as endoscopy and histopathology, computed tomography, and biopsies. Treatment options include diets, corticosteroids, steroid-sparing agents, fecal microbiota transplantation, and surgery, including new biological therapies with interleukins [1].

Epidemiology: The incidence and prevalence of eosinophilic esophagitis (EE) in the United States have been reported to be higher than previously reported. Eosinophilic gastroenteritis (EGE) occurs in 5.1 per 100,000, and eosinophilic colitis (EC) in 2.1 per 100,000. EGE is more prevalent in children, while eosinophilic colitis is more common in adults. There is a higher prevalence in northern states, and in urban and suburban areas more than in rural areas. The prevalence is slightly higher in women [2].

Eosinophils in health and disease: They possess receptors for a variety of cytokines, chemokines, and adhesion molecules. They use these receptors in inflammation and homeostasis, in the adaptive immune system, and in pathogen identification. They can produce a

variety of granular proteins, including major basic proteins. They reside primarily in the lamina propria of the small intestine, protecting against parasites and bacteria, regulating the gut microbiome (GM), and participating in tissue homeostasis [3]. An overabundance of eosinophils is detrimental to health, as it is produced by pathogens or allergens, causing epithelial damage.

Pathophysiology: There are numerous causes of gastrointestinal eosinophilia, including food hypersensitivity, parasitic invasion, drug intolerances, and malignant tumors. All of these are more frequent than primary eosinophilic processes. The pathophysiology is not fully understood; it is considered an exaggerated Th2-type immune response to exogenous antigens (food). Up 5% of patients with treated allergic rhinitis develop eosinophilic gastrointestinal disease [4]. Gastrointestinal dysbiosis may play a role in the pathophysiology of these disorders.

Impact of eosinophilic gastrointestinal diseases on the microbiome: Eosinophilic gastrointestinal disorders are characterized by an excess of eosinophils in the mucosa, submucosa, or muscularis propria of the stomach, small intestine, or colon; their cause is often unknown. Eosinophilic gastrointestinal diseases significantly affect the microbiota, altering the balance of intestinal microorganisms, as well as increasing inflammation and tissue degeneration. Their presence in the lamina propria is the host's first line defense, protecting the function of the intestinal epithelial barrier. They maintain tissue homeostasis at the intestinal inter face. For example, in asthma, the manifestation of the disease does not depend on the number of eosinophils, but rather on the interaction between the microbiota and genetic predisposition [5]. Changes in the microbiota have been noted in allergies, but it is unknown whether they are a cause or a consequence of the disease. Therefore, the combination of genetic predisposition, dysbiosis and environment, creates the conditions for eosinophilic processes [6].

Eosinophilic esophagitis and its impact on the microbiome: This condition is characterized by eosinophilia in the squamous mucosa, demonstrating an interaction between eosinophilic microorganisms, genetics, and allergens. Clinically, it presents with dysphagia, vomiting, food impaction, and abdominal pain, often accompanied by food allergies, atopic dermatitis, asthma, and allergic rhinitis. Recent studies present that the esophageal microbiota regulates these processes, with an increase in Haemophilus and a decrease in Firmicutes. Furthermore, microbiota penetration leads to the activation of epithelial cells and innate and adaptive immune cells, with the release of cytokines, resulting in inflammation and immune responses. The action of Toll-like receptors in EE supports the potential role of the microbiome in disease progression. *Neisseria* and *Corynebacterium* have been found in the esophageal mucosa of children with EE. In healthy children, *Streptococcus* and *Atopobium* are present [7].

Gastric eosinophilia or eosinophilic gastritis and its impact on the microbiome: This is an uncommon condition affecting the gastric mucosa or all the walls of the stomach. Its clinical manifestation is determined by the intensity and depth of eosinophilia and mast cells. Its incidence is unknown, as the vast majority of cases go unreported. Until 2003, 300 cases were reported worldwide, of which 51 were reported in Spain [8]. It may be associated with *Helicobacter pylori* infection. Non-steroidal anti-inflammatory drugs (NSAIDs) can trigger the process. There is evidence suggesting that genetic predisposition, diet, and excessive tobacco and alcohol use may influence the development of eosinophilic gastritis. Homeostatic eosinophils are selective in their response to parasites, allowing some to reside in the mucosa and thus regulate the microbiome [9].

Duodenal eosinophilia and its impact on the microbiome: This condition is linked to functional dyspepsia and is characterized by nonspecific gastrointestinal symptoms. Also known as eosinophilic duodenitis, it is characterized by nonspecific gastrointestinal symptoms and an increased number of duodenal eosinophils. Its transcriptome and pathological pathways have been defined, identifying 382 genes with differential expression. Among the duodenal histological features, eosinophils in the lamina propria were most strongly associated with transcriptomic changes [10].

Eosinophilic gastroenteritis and its impact on the microbiome: Eosinophilic gastroenteritis (EGE) is associated with drug allergies, asthma, rhinitis, dermatitis, sinusitis, eczema, and urticaria. It is characterized by eosinophilic infiltration of the stomach and small intestine and can have mucosal, muscular, and serous subtypes. It has been described in duodenal biopsies of patients with functional dyspepsia, particularly those with early satiety, although the number of eosinophils is lower than that observed in eosinophilic gastroenteritis [11]. Rates of EGE have increased, and plasma concentrations of thymic stromal lymphopoietin and IL-33 can be used as biomarkers.

Eosinophilic colitis and its impact on the microbiome: It is characterized by eosinophilic infiltration of the stomach and small intestine. It comprises mucosal, muscular, and serous subtypes. It is linked to colonic spirochetosis. It is associated with drug allergies, asthma, rhinitis, dermatitis, sinusitis, eczema, and urticaria. It may be linked to altered hypersensitivity, such as food allergies in infants, and T-cell-mediated hypersensitivity. Gastroenteritis dysbiosis is recognized as a significant factor in various forms of colitis. There is impaired barrier function, aberrant immune responses, and damage caused by bacterial metabolites [12].

Diagnosis: Endoscopic studies, including biopsies, with the choice of site being very significant, especially in esophagogastroduodenoscopy and Cholangiopancreatography. Biopsies should be taken from all regions, including any macroscopically evident lesions. It is recommended that four samples be taken from the first and second portions of the duodenum. If EG is suspected in children, esophageal, gastric body, antral mucosal, and duodenal biopsies are suggested. If lesions are not visible in ED, the same criteria as for inflammatory bowel disease (IBD) are used. Therefore, random biopsies will be obtained from the terminal ileum and each segment of the colon, placing the biopsies in separate containers. The diagnosis of EG requires ≥ 30 eosinophils per high-power field. ED requires approximately 2.22 eosinophils per four duodenal biopsies. EG and EC may be suspected on endoscopic examination, and imaging can be helpful in assessing the extent of the disease, but biopsies are needed to confirm the diagnosis. There may be eosinophilic infiltration of the liver, biliary tree, or pancreas, and it can even mimic malignant or inflammatory involvement [13,14]. The esophagus is radiologically significant in evaluating severity. Computed tomography or magnetic resonance enterography are also useful. The diagnosis is complex and is determined based on clinical presentation, imaging findings, and tissue eosinophilia [15].

Treatment: Given that these are chronic, progressive, and immune-mediated conditions affecting children and adults, and not limited to any specific gastrointestinal anatomical area, their management has been standardized and consists of: diet, corticosteroids, steroid-sparing agents, fecal microbiota transplantation, and surgery. Diet and its modifications, as well as nutritional support and stress management, are significant. Proton pump inhibitors, topical steroids, and biologic drugs are more effective than placebos. The diet is based on the exclusion of gluten, soy, eggs, nuts/peanuts, and fish/shellfish [16]. Corticosteroids can be used in eosinophilic esophagitis EE and EC. Oral prednisone 20 - 40 µg/day for 2 weeks has been shown to induce clinical remission in most patients, although some reports recommend higher doses (0.5 - 1 mg/kg). Direct oral administration of viscous budesonide produces better histological results than swallowed budesonide. High-dose fluticasone (880 µg twice daily) produces greater cure rates. It is important to remember that steroid resistance exists in up to 40% of patients. EGE and colitis are treated differently from hypereosinophilic syndrome, which is usually managed with corticosteroids and tyrosine kinase inhibitors. For strongyloides infection, the antiparasitic agent ivermectin is recommended.

Steroid-sparing agents: To reduce the negative impact of steroids, mesalazine or 5-aminosalicylic acid, azathioprine, and anti-TNF agents such as infliximab and adalimumab have been used. Other novel biological therapies exist, such as interleukin (IL)-5, the IL-5 receptor, or IL-4/IL-13 [17].

Fecal microbiota transplantation (FMT): The review and clinical applications of FMT have continued, with varying results, although good outcomes have emerged, encouraging further research into this new procedure, which has become established in the management

of *Clostridioides difficile*. It has shown good results in inflammatory bowel disease and severe eosinophilic gastroenteritis. In the latter, it is used in conjunction with prednisone [18]. FMT has been analyzed in patients colonized with antibiotic-resistant bacteria, and high efficacy has been observed. Furthermore, steroid-resistant graft-versus-host disease has improved [19]. Núñez PF and colleagues report increased interest in FMT for treating dysbiosis-associated conditions [20]. While good results have been reported with FMT, further research is needed for the procedure to be included in the therapeutic arsenal for gastrointestinal diseases with dysbiosis. It is important to remember that this process can alter the course of the disease, and we only know that we are administering bacteria, as the other microorganisms remain largely unknown [21].

Surgery: Patients with eosinophilic gastrointestinal diseases may develop complications and require surgical procedures to correct perforations or strictures. It should be noted that this morbidity may respond to steroids. Strictures often respond to endoscopic dilation, even if the inflammation does not resolve [22].

Conclusion and Future Directions

- Long-read metagenomics for strain tracking after FMT offers new hope [23].
- The key study in eosinophilic gastroenteritis is the histological examination of gastric and duodenal samples to detect eosinophilic infiltration (>20 eosinophils per high-resolution field) [24].
- New eosinophilic intestinal diseases are emerging, such as duodenal eosinophilia in functional dyspepsia and colonic spirochetosis [25].
- A simplified algorithm for personalized medicine is emerging.
- Non-invasive baseline phenotype assessments and determinations will be performed [26].

Conflicts of Interest

The authors declare that do not have affiliation or participation in organizations with financial interests.

Ethical Approval

This report does not contain any study with human or animal subjects carried out by the authors.

Informed Consent

The authors obtained informed written consent from the patients, in order to develop this article.

Declaration on the Use of Artificial Intelligence

The authors declare that no generative artificial intelligence was used in the writing of this manuscript.

Bibliography

1. Eechsler ME., *et al*. "Eosinophils in health and disease: a state-of-the-art review". *Mayo Clinic Proceedings* 96.10 (2021): 2694-2707.

2. Thel HL., *et al*. "Prevalence and costs of eosinophilic esophagitis in the United States". *Clinical Gastroenterology and Hepatology* 23.2 (2025): 272-280.e8.

3. Walker MM., *et al*. "Eosinophilic gastroenteritis and other eosinophilic gut diseases distal to the oesophagus". *Lancet Gastroenterology and Hepatology* 3.4 (2018): 271-280.

4. Kinoshita Y., *et al*. "Eosinophilic gastrointestinal diseases: The pathogenesis, diagnosis, and treatment". *Internal Medicine* 62.1 (2023): 1-10.

5. Gurtner A., *et al*. "Intestinal eosinophils, homeostasis and response to bacterial intrusion". *Seminars in Immunopathology* 43.3 (2021): 295-306.

6. Qian G., *et al*. "Exploring the etiology of colitis: insights from gut microbiota research". *Gut Microbes* 17.1 (2025): 2512010.

7. Zhang X., *et al*. "Eosinophilic esophagitis and esophageal microbiota". *Frontiers in Cellular and Infection Microbiology* 13 (2023): 1206343.

8. Rabassa-Pérez R., *et al*. *Archivo Médico Camagüey* 26 (2022): e8843.

9. Dellon ES., *et al*. "Determination of biopsy yield that optimally detects eosinophilic gastritis and/or duodenitis in a randomized trial of lirentelimab". *Clinical Gastroenterology and Hepatology* 20.3 (2022): 535-545.e15.

10. Tetsuo Shoda., *et al*. "Molecular analysis of duodenal eosinophilia". *Journal of Allergy and Clinical Immunology* 151.4 (2023): 1027-1039.

11. Kinoshita Y and Ishihara S. "Eosinophilic gastroenteritis: epidemiology, diagnosis, and treatment". *Current Opinion in Allergy and Clinical Immunology* 20.3 (2020): 311-315.

12. Qian G., *et al*. "Exploring the etiology of colitis: insights from gut microbiota research". *Gut Microbes* 17.1 (2025): 2512010.

13. Soni M., *et al*. "Eosinophilic gastrointestinal disease". *Journal of the American Medical Association* 331.16 (2024): 1407-1408.

14. Kinoshita Y., *et al*. "Eosinophilic gastrointestinal diseases: The pathogenesis, diagnosis, and treatment". *Internal Medicine* 62.1 (2023): 1-10.

15. Yalon M., *et al*. "Eosinophilic disorders of the gastrointestinal tract and associated abdominal viscera: imaging findings and diagnosis". *RadioGraphic* 42.4 (2022): 1081-1102.

16. Zalewski A., *et al*. "Long-term outcomes of the six-food elimination diet and food reintroduction in a large cohort of adults with eosinophilic esophagitis". *The American Journal of Gastroenterology* 117.12 (2022): 1963-1970.

17. Molina-Infante J and Lucendo AJ. "Update on topical steroid therapy for eosinophilic esophagitis". *Gastroenterology and Hepatology* 38.6 (2015): 388-397.

18. Dai YX., *et al*. "Fecal microbiota transplantation and prednisone for severe eosinophilic gastroenteritis". *World Journal of Gastroenterology* 20.43 (2014): 16368-16371.

19. Jasiński M., *et al*. "Eosinophilic gastroenteritis and graft-versus-host disease induced by transmission of norovirus with fecal microbiota transplant-2". *Journal of Inflammatory Bowel Diseases and Disorders* 6.3 (2021): e13386.

20. Núñez PF., *et al*. "Fecal microbiota transplant, its usefulness beyond *Clostridioides difficile* in gastrointestinal diseases". *Gastroenterology and Hepatology* 45.3 (2022): 223-230.

21. Hou S., *et al*. "Advances in fecal microbiota transplantation for gut dysbiosis-related diseases". *Advances Science* 12.13 (2025): e2413197.

22. Nguyen MT., *et al*. "Eosinophilic gastrointestinal disorders (EGIDs) treatment and management". Medscape (2025).

23. Fan Y., *et al*. "Long-read metagenomics for strain tracking after faecal microbiota transplant". *Nature Microbiology* (2025).

24. Sunkara T., *et al*. "Eosinophilic gastroenteritis: diagnosis and clinical perspectives". *Clinical and Experimental Gastroenterology* 12 (2019): 239-253.

25. Shah A., *et al*. "Duodenal eosinophils and mast cells in functional dyspepsia: a systematic review and meta-analysis of case-control studies". *Clinical Gastroenterology and Hepatology* 20.10 (2022): 2229-2242.e29.

26. Dikerson A., *et al*. "Future of therapy and monitoring for eosinophilic esophagitis and eosinophilic gastrointestinal diseases". *Annals of Allergy, Asthma and Immunology* 135.2 (2025): 143-154.

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