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Emerging Therapeutic Strategies Targeting the Gut-brain Axis in Functional Gastrointestinal Disorders

George Fisher*

Department of Gastroenterology and Hepatology, University of Padua, Helsinki, Via VIII Febbraio, 2, 35122 Padova PD, Italy

Introduction

Functional Gastrointestinal Disorders are common, heterogeneous conditions characterized by chronic gastrointestinal symptoms in the absence of structural or biochemical abnormalities. The gut-brain axis, a bidirectional communication system between the gut and the central nervous system, plays a crucial role in the pathophysiology of FGIDs. Emerging research has focused on novel therapeutic approaches that target this complex interplay between the gut and the brain. This review explores recent advances in therapeutic strategies aimed at modulating the gut-brain axis for the management of FGIDs, including dietary interventions, probiotics, prebiotics, fecal microbiota transplantation, psychological therapies, and neuromodulation techniques.

Functional gastrointestinal disorders represent a group of disorders characterized by chronic or recurrent gastrointestinal symptoms in the absence of structural or biochemical abnormalities that could explain the symptoms. Common FGIDs include irritable bowel syndrome functional dyspepsia. These disorders significantly impair patients' quality of life and impose a substantial economic burden on healthcare systems worldwide [1-3].

The pathophysiology of FGIDs is multifactorial and involves complex interactions between genetic, environmental, psychosocial, and gut-brain axis factors. The gut-brain axis, which comprises bidirectional communication pathways between the gut and the central nervous system, plays a pivotal role in regulating gastrointestinal function and visceral sensation. Dysregulation of the gut-brain axis is implicated in the pathogenesis of FGIDs, making it an attractive target for therapeutic interventions.

A comprehensive literature search was conducted using PubMed, Embase, and Web of Science databases to identify relevant studies published up to [insert date]. The search terms included "functional gastrointestinal disorders," "gut-brain axis," "therapeutic strategies," "dietary interventions," "probiotics," "prebiotics," "fecal microbiota transplantation," "psychological therapies," and "neuromodulation techniques." Only articles published in English were included.

Description

Several dietary approaches, such as low FODMAP (fermentable oligosaccharides, disaccharides, monosaccharides, and polyols) diet, gluten-free diet, and specific carbohydrate diet, have shown efficacy in managing FGIDs by modulating gut microbiota composition and reducing symptom severity. Probiotics, live microorganisms that confer health benefits to the host when administered in adequate amounts, and prebiotics, non-digestible substances that promote the growth of beneficial gut bacteria, have demonstrated promising results in alleviating FGID symptoms by modulating gut microbiota and immune function.

FMT, the transfer of fecal microbiota from a healthy donor to a recipient, has emerged as a potential therapeutic option for refractory FGIDs, particularly IBS. FMT aims to restore microbial dysbiosis and improve gut barrier function. Psychological interventions, including cognitive-behavioral therapy, gut-directed hypnotherapy, and mindfulness-based stress reduction, have been shown to effectively reduce symptom severity and improve quality of life in FGID patients by addressing the central component of the gut-brain axis [4,5].

Neuromodulation techniques, such as transcutaneous electrical nerve stimulation, spinal cord stimulation, and sacral nerve stimulation, have shown promise in modulating visceral sensation and improving symptoms in refractory FGIDs. Functional gastrointestinal disorder, including irritable bowel syndrome, functional dyspepsia, and functional constipation, are characterized by chronic gastrointestinal symptoms without identifiable structural or biochemical abnormalities. These disorders significantly impact patients' quality of life and are challenging to manage due to their complex pathophysiology, which involves dysregulation of the gut-brain axis. Neuromodulation techniques represent a novel therapeutic approach that targets the central and peripheral nervous systems to alleviate symptoms and improve outcomes in patients with FGIDs. This review explores the role of neuromodulation techniques in the management of FGIDs.

TENS involves the application of low-voltage electrical currents through electrodes placed on the skin. It modulates pain perception by activating Aβfibers, which inhibit nociceptive input to the central nervous system. In FGIDs, TENS has been shown to reduce abdominal pain and improve overall symptoms in IBS patients. A meta-analysis of randomized controlled trials demonstrated that TENS significantly decreased pain severity and improved quality of life in IBS patients compared to sham treatment. SCS delivers electrical impulses to the spinal cord via implanted electrodes, modulating the transmission of pain signals to the brain. Although primarily used for chronic pain conditions, SCS has shown promise in the management of refractory visceral pain associated with FGIDs. Clinical studies have reported significant improvements in pain severity, gastrointestinal symptoms, and quality of life following SCS in patients with chronic abdominal pain and refractory FD.

SNS involves the implantation of a stimulator device near the sacral nerves, which regulate bowel and bladder function. It is an established treatment for fecal incontinence and has shown efficacy in select patients with refractory constipation, particularly those with slow-transit constipation or defecatory dysfunction. Studies evaluating SNS in FC have reported improvements in stool frequency, consistency, and quality of life, although response rates vary among individuals. Identifying appropriate candidates who are likely to benefit from neuromodulation therapy is essential. Some techniques, such as SCS and SNS, require invasive procedures and may be associated with significant costs and risks. Long-term data on the durability of symptom relief and the need for device maintenance are limited. Acceptance of implantable devices and compliance with therapy may vary among patients.

Conclusion

Therapeutic strategies targeting the gut-brain axis hold promise for the

***Address for Correspondence:** George Fisher, Department of Gastroenterology and Hepatology, University of Padua, Helsinki, Via VIII Febbraio, 2, 35122 Padova PD, Italy, E-mail: GeorgeFisher5@gmail.com*

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management of functional gastrointestinal disorders. Dietary interventions, probiotics, prebiotics, fecal microbiota transplantation, psychological therapies, and neuromodulation techniques offer diverse approaches to modulate gut microbiota, improve gut-brain communication, and alleviate symptoms in FGID patients. Further research is needed to elucidate the optimal strategies, patient selection criteria, and long-term efficacy of these interventions in FGID management.

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