Crosstalk Between the Gut Microbiota and the Brain: An Update on Neuroimaging Findings.

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Abstract

An increasing amount of evidence suggests that bidirectional communication between the gut microbiome and the central nervous system (CNS), which is also known as the microbiota-gut-brain axis, plays a key role in the development and function of the brain. For example, alterations or perturbations of the gut microbiota (GM) are associated with neurodevelopmental, neurodegenerative, and psychiatric disorders and modulation of the microbiota-gut-brain axis by probiotics, pre-biotics, and/or diet induces preventative and therapeutic effects.

The current interpretation of the mechanisms underlying this relationship are mainly based on, but not limited to, parallel CNS, endocrine, and immune-related molecular pathways that interact with each other. Although many studies have revealed the peripheral aspects of this axis, there is a paucity of data on how structural and functional changes in the brain correspond with gut microbiotic states in vivo.

However, modern neuroimaging techniques and other imaging modalities have been increasingly applied to study the structure, function, and molecular aspects of brain activity in living healthy human and patient populations, which has resulted in an increased understanding of the microbiota-gut-brain axis. The present review focuses on recent studies of healthy individuals and patients with diverse neurological disorders that employed a combination of advanced neuroimaging techniques and gut microbiome analyses.

First, the technical information of these imaging modalities will be briefly described and then the included studies will provide primary evidence showing that the human GM profile is significantly associated with brain microstructure, intrinsic activities, and functional connectivity (FC) as well as cognitive function and mood.