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Review Article

How Gut Microbes Influence the Human Brain?

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Abstract

We all get initial dose of microbes from mother; they multiply and the grown-up human body contain in a range of 30 to 40 trillion in numbers. During their life cycle they produces many chemicals some are beneficial to the host and others are harmful. Once the gut-brain axis is established, the microbial products in the gut start influencing the brain. Hundreds of neuro-chemicals produced by the gut microbes regulate basic physiological processes as well as mental processes such as learning, memory and mood. Dysbiosis and inflammation of the gut are responsible for anxiety and depression which are prevalent in society today. In addition to these, recently faecal microbiota was used as therapeutic agents for neurological disorders.

Keywords: Gut-brain link; gutmicrobiome; dysbiosis; human neurological diseases

Summary

Gut microbes unconsciously regulate human host behaviour depending on the composition of the type and number of microbes and become part of the system [1].

Nervous system that regulates our gut is often called the body's “second brain”, capable of taking part in neurochemistry but not in wisdom as brain is involved. This efficient and vigilantism extensive network of “second brain” uses the same machinery (same chemicals and cells) as the brain to help in digestion and also send massages to alert the brain when something is wrong [2]. Gut microbes produce hundreds of neuro-chemicals which human brain utilizes in regulating physiological functions and functions related to learning, memory and mood. [3]. For example, serotonin, the most important neurotransmitter, about 90 % is produced by gut bacteria that regulates both mood and gastro-intestinal (GI) activity. Convincing evidence are available for a close association between the microorganisms present in the digestive system and diseases of the GI as well as other systems. In connection with several mental illnesses, such as anxiety and depression, dysbiosis and inflammation of the gut proves to be the major causal factor [4].

Together with gut microbiota, brain axis influences the cognitive function, social interaction and stress management [5] which are mainly brain functions. The bidirectional interactions between the gut and the enthral nervous system is influenced as well as regulated by neuro-endocrine systems associated with stress response, anxiety and memory function. This unique capability indicates that gut microbes are indispensible for neurochemistry to carry out its function [6].

Microbes are also capable of producing hormones and neurotransmitters identical to that are produced by neuro-endocrine system. Bacteria present in the gut stimulate directly neurons of the enteric nervous system (ENS) which send signals via vagus nerve to the brain [7]. In turn, bacterial posses' receptors for these hormones which influence their own growth as well as virulence [8]. Short-chain fatty acids of bacterial origin which are identified to have beneficial effect and may exert neurotoxicity. Bacterial components such as lipopolysaccharides act as a low-grade tonic to stimulate the innate immune system [9].

Either bacterial dysbiosis or bacterial overgrowth in the small intestine, and/or increased intestinal permeability may turn out to be the contributory factor for systemic and/or central nervous system inflammation [10]. Dysfunctional responses of the adaptive immune system result when human antigens may cross-react with bacterial proteins [11].

The gut microbes are responsible for lying the blue print for the action of sleep and stress reactivity of the hypothalamic-pituitary-adrenal axis. This function proves to be a vital knowledge during the treatment for a range of disorders, including alcoholism, chronic fatigue syndrome, fibromyalgia, and restless legs syndrome, multiple sclerosis and the neurologic manifestations of celiac disease; and therefore, simply by changing the population of gut microbiota by changing the diet, probiotics, and prebiotics is an efficient management tool [12,13] to handle above mentioned diseases.

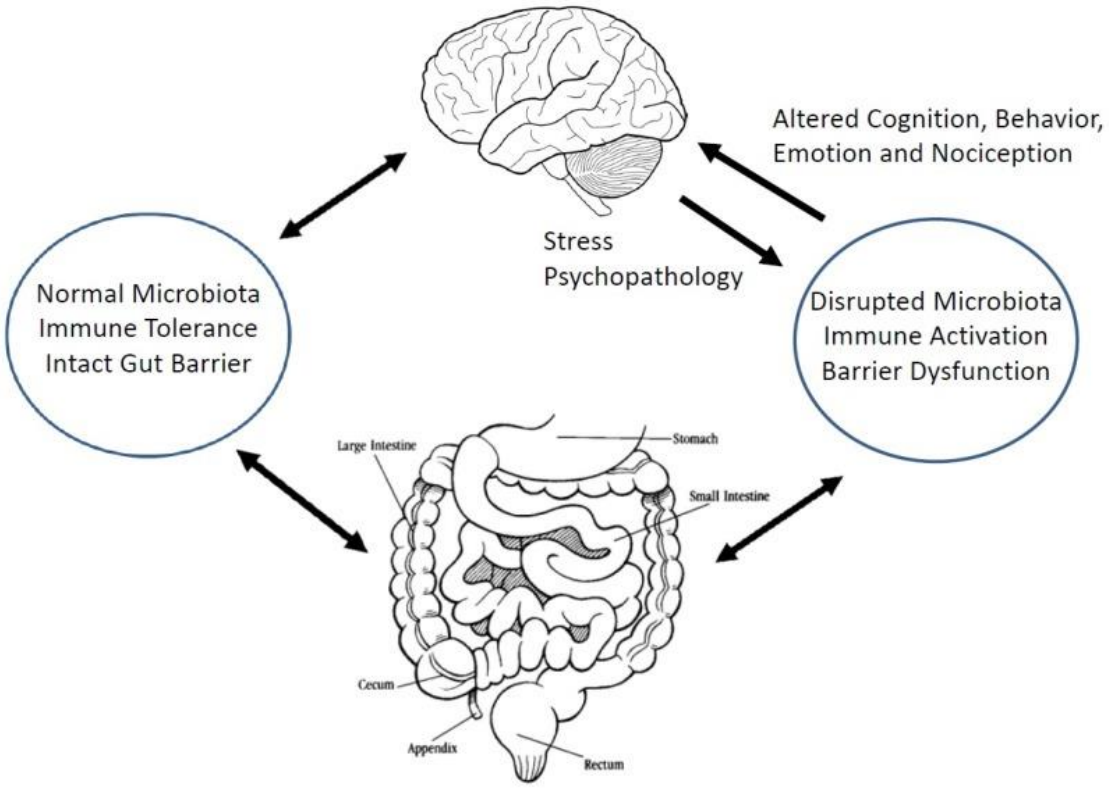

Figure 1. A schematic representation of the microbiota-gut-brain axis. Microbiota associated with a disrupted gut barrier, activates the mucosal immune system resulting in release of inflammatory mediators and other neuro-active molecules. They reach the brain and promote changes in cognition and behaviour.

In turn, disbiosis of the gut is possible by central stimuli, such as stress which can disrupt mucosal immunity, the gut microbiota and gut barrier function [14]. Evidence demonstrating the influence of gut dysbiosis on mental and neurological disorders has been reviewed earlier [15].

Diet and lifestyle factors such as poor sleep quality, alcohol consumption and inactivity can disturb gut bacteria [16]. Lifestyle characterized by regular physical activity, low stress and consuming a variety of whole foods is the best way to ensure healthy gut. More so by eating fresh fruits without added sugars and other additives and including whole grains and legumes in the diet which are rich in fibre will add enough healthy bacteria in the gut [17]. By including probiotic-rich foods such as plain yogurt in the daily diet also promote healthy bacteria in the gut [18]. These are some suggestions for a healthier gut and in turn will improve mood.

Taking advantage of this relationship gut microbiota from healthy individual were used as therapeutic agents for many neurological disorders, such as Alzheimer's [19], Huntington's [20] disease, Parkinson's [21] disease and Autism spectrum [22] and other neurological disorders through faecal microbiota transfer to the patient by restoring the right quantity and type microbiota.

References

1. Dinan T.G, *et al.* (2015). Collective unconscious: how gut microbes shape human behavior. J Psychiatr Res. 63:1-9.
2. Rao, M., Gershon, M. (2016). The bowel and beyond: the enteric nervous system in neurological disorders. Nat Rev Gastroenterol Hepatol 13, 517-528.
3. Dicks, L.M.T. (2022), Gut Bacteria and Neurotransmitters. Microorganisms 10, 1838
4. Nagao-Kitamoto H, *et al.* (2016). Pathogenic role of the gut microbiota in gastrointestinal diseases. Intest Res. 14(2):127-138.
5. Carabotti M, *et al.* (2015). The gut-brain axis: interactions between enteric microbiota, central and enteric nervous systems. Ann Gastroenterol. 28(2):203-209.
6. Ma, Q., *et al.* (2019). Impact of microbiota on central nervous system and neurological diseases: the gut-brain axis. J Neuroinflammation 16, 53.
7. Sigrid Breit *et al.* (2018). Vagus Nerve as Modulator of the Brain–Gut Axis in Psychiatric and Inflammatory Disorders Front. Psychiatry (Sec. Psychological Therapy and Psychosomatics) Volume 9
8. Abedi E, Hashemi SMB. (2020). Lactic acid production - producing microorganisms and substrates sources-state of art. Heliyon. 12;6(10):04974
9. Ygor Parladore Silva *et al. (*2020). The Role of Short-Chain Fatty Acids from Gut Microbiota in Gut-Brain Communication, Front. Endocrinol., Sec. Neuroendocrine Science
10. Stephen M. *et al.* (2009). The Relationship Between Intestinal Microbiota and the Central Nervous System in Normal Gastrointestinal Function and Disease GASTROENTEROLOGY; 136:2003-2014
11. Zheng, D., *et al.* (2020). Interaction between microbiota and immunity in health and disease. Cell Res 30, 492-506.
12. Galland L. (2014). The gut microbiome and the brain. J Med Food. 17(12):1261-72
13. Conlon MA, Bird AR. (2014). The impact of diet and lifestyle on gut microbiota and human health. Nutrients. 24;7(1):17-44.
14. Eamonn M.M. Quigley 2018 The Gut-Brain Axis and the Microbiome: Clues to Pathophysiology and Opportunities for Novel Management Strategies in Irritable Bowel Syndrome (IBS). Clin. Med., 7(1), 6
15. Naufel, M.F. et al., (2023). The brain-gut-microbiota axis in the treatmentof neurologic and psychiatric disorders. Arq. Neurostimulator. ; 81:670-684.

16. https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=https%3A%2F%2Fwww.gicare.com%2Fgi-health-resources%2Fhigh-fiber-diet%2F&btnG=
17. https://www.webmd.com/dige
18. https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Ways+to+Improve+Your+Gut+Bacteria%2C+Based+on+Science%2C+https%3A%2F%2Fwww.healthline.com%C2%A0%E2%80%BA+...+%E2%80%BA+Nutrition&btnG=
19. Pushkala, K. (2023).Faecal transplant technology in therapeutics of Alzheimer's. *J. Cell Tissue Res.*23:20:73-7325.
20. Pushkala, K. and Gupta, P.D. Management of by Faecal Microbiota Transplant (FMT) Technology in Huntington's disease, J Infect Dise Treat. 2023. 1(1): 1-3.
21. Pushkala, K and Gupta, P.D. (2023). Faecal microbiota transplantation (FMT): An effective therapeutic agent for Parkinson's disease. J New Medical Innovations and Research, 4(4);
22. Pushkala, K and Gupta, P.D. (2023). Faecal microbiota therapy: A romising therapeutic tool for autism spectrum disorder. J. Brain and Neurological Disorders, 6(6).