

GUT BRAIN AXIS IN RELATION TO AYURVEDA - A CONCEPTUAL STUDY

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ABSTRACT: Background: The gut-brain axis is a bidirectional communication between the central and the enteric nervous system. It includes Central Nervous System, neuro endocrine, immune system, and autonomic nervous system with the enteric nervous system, and the vagus nerve and the gut microbiota. In *ayurveda* *vaata* is responsible for all the movements in the body and it is the motivating and regulating factor. From this we can say normal *vaata dosha* and vagal nerve maintain normal neural, respiratory, digestive homeostasis. Dysfunction of both causes mostly similar diseases.

Aim: To decode the understanding of gut brain axis in *ayurveda* and illuminate it in an intelligible way of presentation as well as to contribute new insight to the gut brain axis in different diseases.

Materials & methods: Data is collected from the different Ayurvedic texts and articles which is analysed and discussed.

Results: The discussion on gut brain axis and its relation in *ayurveda* is presented by showcasing the role of gut brain axis in different diseases by explaining the role of *vaata* in maintaining the homeostasis in the body. An attempt is made to establish the concept of gut brain in *ayurveda* through concept of *vaata* and the way through *virudhaahara* vitiated *dosha* spread from gastrointestinal tract causes *mano vaha-srotodushti* and causes *manovikara*.

Conclusion: The explanation of gut brain axis through *vaata* and similarities with vagus nerve and autonomic nervous system, makes it an exemplary path finder for the practitioners. It is the need of the hour to recognize the huge significance of gut brain axis and consider in day-to-day clinical practice.

Keywords: Gut brain axis, CNS (central nervous system), *vaata*, *manovaha-sroto dushti*, *manovikaara*

INTRODUCTION

Gut brain axis is a bidirectional neuro humoral communication network between enteric nervous system and central nervous system and is vital for maintaining metabolic homeostasis. It includes CNS, enteric nervous system (ENS), the autonomic nervous system (ANS) and its associated sympathetic and parasympathetic branches, neuroendocrine and immunological systems, hypothalamic pituitary axis (HPA axis) in addition to the gut microbiota. In human gastrointestinal tract around 60 tonnes of food along with an abundance of microorganisms pass in an average life span, which impose a huge threat on gut integrity.^[1]

The term microbiota refers to populations of microorganisms present in the body's various ecosystems. Gastrointestinal tract harbors about 10^{14} microorganisms, which means ~10 times more bacterial cells than the number of human cells. Some of the essential neuroactive molecules, such as acetylcholine, catecholamines, amino butyric acid, histamine, melatonin and serotonin are produced by gut flora, which are essential for regulating peristalsis and sensation in the gut. Change in the composition of the gut flora due to diet, drugs, or disease correlates with changes in the levels of circulating cytokines, some of which can affect brain function also. The gut flora also releases molecules that can directly activate vagus nerve, which transmits information about the state of the intestines to the brain including hormonal, neuronal and bacterial changes in the bowel.^{[2,] [3]} In the gut fermentation of carbohydrate results in the formation of short-chain fatty acids, which affects brain functions by entering the systemic circulation. The gut microbiota affects brain development and plasticity by secreting various neurotrophins and proteins, such as brain-derived neurotrophic factor (BDNF), synaptophysin and postsynaptic density (PSD)-95^[4].

In *ayurveda* the functions of basic survival and homeostasis are linked with *vaata*. *Vayu tantra yantra dhara*^[5] is the homeostasis function of *vaata dosha* and it controls all the movements so, it is called *praana* which connotes normalcy. Due to its properties like *daaruna*, *bahu-seeghra* and *anavastitvatva*^[6] it is responsible for all the movements and convey information from one to another part of the body. On the other hand, impaired *vaata dosha* is directly associated with serious neurological conditions such as *anavastitacitta* and *vishaada*^[7]. Survival and homeostasis are controlled by ANS which is involuntary and it regulates the function of cardiovascular, respiratory, gastrointestinal, excretory and reproductive system. Therefore, ayurvedic text provides a firm bases for physiological and functional link between *vaata dosha* and nervous system.

MATERIALS & METHODS

The information available in the classical ayurvedic texts and latest advancement in the information on gut biota are used for discussion and conclusion here.

VAGUS NERVE AND VAATA DOSHA ROLE IN GUT- BRAIN LINK

Both vagus nerve, correlated to *vaata dosha* is responsible for gut homeostasis. (A comparison is given in the Table No.1). It is the vagus nerve branches which link gut- brain⁸. Thus, signals about appetite, stress, food intake and food composition are carried by gastric

and hepatic vagal afferent branches via the ‘gut-brain’ link to the brain. Vagal efferent branches directly or indirectly send signal from brain to different target organs by triggering release of certain enteric hormones. Therefore, through vagal signalling via the ‘Gutbrain’ link gut homeostasis, regulation of gut inflammation and certain functions of the immune system are maintained^{[9],[10]}.

Tridosha represents the various homeostatic functions at various levels in body. To maintain health the ‘*doshas*’ should be in state of equilibrium. In general, *tridosha* i.e., ‘*vaata*’, ‘*pitta*’ and ‘*kapha*’ represent neural, endocrine and immune mechanisms respectively. Due to its properties like initiating and controlling factor, *vaata* is considered as prime among *tridoshas*. During ‘*katu-avasthaa-paaka*’ (last stage of digestion) main site for *vaata dosha* production is *pakvaasaya*. Therefore, *vaata* functions originate within the gut (*koshtha*) is known as *koshthastha-vaata* and this *koshthastha-vaata* influences *apaana-vaayu*, which functions at the level of *pakvaasaya*. *Apana-vaata* then interacts with *samaana-vaata*, since both of them are active at different levels of *koshtha*. At *koshtha aahaara-rasa* is converted to *rasa-dhaatu* which is carried to *hrdaya*, and then transported to different body parts by *vyaana vaata*^[11] For these reasons, integrity of *koshtha* and *pakvaasaya* determines the gut homeostasis and overall nutrient status^[12]

Sareeravaata is of five types and is responsible for all the basic functions of the body^[13]. The functions which are controlled by *vaata*, vagus and autonomic nervous system show similarity to some extent. (Table no. 1)

TABLE NO. 1 - TYPES OF VAATA AND THEIR FUNCTION

Type of Vaata	Functions	Functions controlled by vagus	Functions of autonomic system
1. <i>Praana vata</i> ^[13]	<ul style="list-style-type: none"> • <i>Shtheevana</i> (salivation) • <i>Budhi-dhaarana</i> (sensory knowledge and memory) • <i>Chitta dhaarana</i> (functions of mana) • <i>Kshavathu</i> (sneezing) • <i>Udgaara</i>(hiccups) • <i>Prachvaasa</i> (expiration) • <i>Uchvaasa</i>(inspiration) • <i>Hrdya-dhaarana</i> (functions of heart) • <i>Dhamani-dhaarana</i>(circulation) 	Swallowing Sneezing Vomiting Respiration Heart rate	Pupil response Sneezing Swallowing Vomiting Respiration Heart rate

<p>2. <i>Udaana vaata</i>^[14]</p>	<ul style="list-style-type: none"> • <i>Vaak-pravr̥tti-</i> (speech) • <i>Prayatna</i> (motivation) • <i>Oorjaa</i>(tolerance) • <i>Bala kara</i> • <i>Vaṛṇa kara</i> • <i>Smṛti-kaaraka</i>(sensory adaptation) 	<p>Blood Pressure</p>	<p>Blood Pressure</p>
<p>3. <i>Samaana vaata</i>^[15]</p>	<ul style="list-style-type: none"> • <i>Annam vivecana</i> (digestion, absorption and discrimination of essence and waste) • <i>Anna grahaṇa</i> (receiving and withholding of food) • <i>Anna pacana</i> (proper digestion by secreting digestive juices and responsible for transferring of contents to next stage) • <i>Anna mocana</i>(passing away of contents) 	<p>Gastric secretions and motility Blood Sugar</p>	<p>Digestion</p>
<p>4. <i>Vyaana vayu</i>^[16]</p>	<ul style="list-style-type: none"> • <i>Gati</i> (movements of muscles) • <i>Samvahana</i> (circulation of rasa) • <i>Sweda asrik sraavaṇa</i> (outflow of sweat and blood) • <i>Srotoviśodhana</i> (cleansing of channels) 	<p>Respiration Heart rate Blood Pressure</p>	<p>Respiration Heart rate Blood Pressure</p>
<p>5. <i>Apaana</i>^[17]</p>	<ul style="list-style-type: none"> • <i>Mootra nishkraamaṇa</i>(bladder emptying) • <i>Śakṛt nishkraamaṇa</i>(bowel evacuation) • <i>Śukra nishkraamaṇa</i>(ejection of semen) • <i>Aarttava nishkraamaṇa</i>(menstrual flow) • <i>Garbha nishkraamaṇa</i>(bearing down the foetus) 	<p>Kidney function Fertility Sexual activity</p>	<p>Urination Defecation Sexual drive</p>

Thus, it can be concluded that all five types of *vaata* require support and nourishment of *koshthastha-vaata* as mentioned '*pancaatmake vaayu koshthe praadurbhavati*'^[18]. Accordingly, prolonged abnormality of *koshthastha-vaata* can hamper functions of all sub-types of *vaata*. Gut homeostasis is maintained by regulating electrical signalling through afferent-efferent vagal fibres in the 'gut-brain' link and in the same way *koshtha* and *pakvaasaya* ensure normalcy of *apaana vaata* and *samaana-vaata*, which in turn maintain gut homeostasis and support all sub-types of *vaata*^[19]. On the other hand to maintain gut homeostasis enteric hormone release and gut microbiome interactions are needed. This shows that the normal activity of both *vaata* and vagus nerve comparable in maintaining the homeostasis in nervous system and any abnormal functioning of either *vaata* or vagus nerve causes disorders of nervous system.

Gut microbiota disturbances and diseases

Gut microbiota maintains host wellness but it can be disrupted by external factors such as antibiotics and dietary components. Host factors that induce dysbiosis in gut microbiome also have a role. This dysbiosis disrupts the normal functioning of gut microbiota in maintaining host wellness and potentially induces certain microbiota members including pathobionts. This leads to dysregulated production of microbial derived products or metabolites which might be harmful to the host. These cause diverse range of diseases on local, systemic or remote areas. For example, several mood disorders such as anxiety, depression link to functional GI (Gastro intestinal) disruptions, whereas GI disease (e.g., irritable bowel syndrome, irritable bowel disease) often involve psychological problems. Gut microbiota play a potential role in modulating psychological stress via the vagus nerve according to Yarandi et al. (2016) The vagus nerve forms a direct connection between the brain and stomach. Hormonal, neuronal and bacterial changes in the bowel are transmitted to the brain via the vagus nerve explain a system in which gut microbiota is stimulating the "stress response and the activity of the corticosterone pathway governed by the HPA-axis"^[20]. It can be understood as any leakage of "bacteria or metabolic products" through intestinal barrier due to an increase in gut permeability triggers an inflammatory response. Stress activation can also cause the release of cortisol which can stimulate the release cytokines, resulting in a permeable gut^[21].

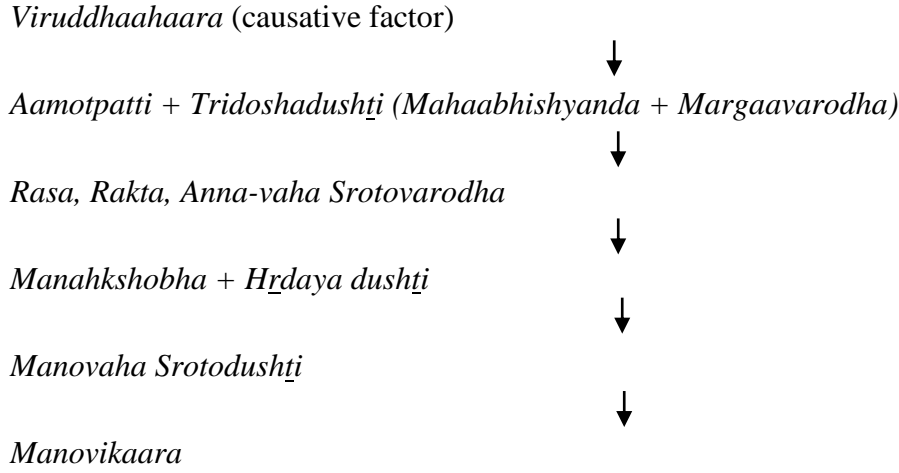
In *ayurveda* *dosha* and *gunas* play an important role in mental illness. Mind is always being affected by three *gunas* i.e. *satva*, *rajas* and *tamas*^[22]. *Mano- vikrti* is a current state of psychological imbalance which deviates from one's 'normal' functioning.^[23] Moreover, in

ayurveda depression can be understood as once that if an imbalance has occurred in the body through physical means diet, lifestyle, stress, relationships, one's response to challenges and repressed emotions^[24]. If psychological state is improper then it has a bidirectional effect on body and in particularly the homeostasis of *agni*. If this *agni* is compromised, there will be overflow of *dosha* into blood stream that leads to formation of *aama* (inflammatory waste), which in turn causes a range of psycho-physiological responses that can occur. *Vishama*, *manda* and *teekshna*, these three are physiological expressions of *agni*. Thus, due to improper functioning of *agni*, *aama* is produced and a range of psycho-physiological responses can occur ranging from nausea to osteoporosis. This digestive system is governed by *agni*, it is associated with digestion and assimilation. *Mandagni* referred to as irregular metabolism, it includes symptoms like poor appetite, slow metabolism and depression^[25]. Even if *mano bhaava* is left to accumulate over time, they can also give rise to imbalance and cause mental disturbances such as anxiety, depression etc.

DISCUSSION

A bidirectional communication between the gut and brain is crucial in health and illness. Afferent efferent vagal fibres maintain gut homeostasis by electrical signalling, releasing enteric and gut- microbiome interaction. Likewise, *ayurveda* it is *vaata* which is responsible for all the movements in the body. Main site of *vaata* is *pakvaasaya* and if *koshtha* or *pakvaasaya* integrity is maintained, then only *apaana* and *samaana vaayu* will remain normal and do maintain gut homeostasis.

Similarly, status of gut brain is also linked to depression. There are some striking resemblances between this biomedical understanding of the gut homeostasis and the ayurvedic perspective of depression. Where the former identifies bacteria leaking through an impaired intestinal wall into the blood stream and spreading throughout the body as a clinical cause of depression^[26]. This is known as “**impaired intestinal permeability**” and is usually caused by microbial dysbiosis. *Ayurveda* defines a potential cause as the spreading of vitiated *dosha* from the digestive system to particular tissue sites. The aetiology responsible for this gastrointestinal dysbiosis is primarily associated with an improper diet, stress and lifestyle choices^[27]. *Acaarya* Charaka has mentioned that contaminated and incompatible food is the one of the causes of *manoabhighaata* (mental trauma)^[28].



Therefore, we can conclude that abnormalities of vagus nerve and *vaata dosha* are associated with gastric and brain disorders.

CONCLUSION

From the above data, it can be concluded that there is a parallelism between the way in which *ayurveda* and modern understands the concept of gut brain axis. These functions which are performed by *vaata* show similarity with the functions of vagus and autonomic nervous system to some extent.

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