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Concept of Vata Vs Nervous System

Review article

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Abstract

Increased awareness about *Ayurveda* and the need of *Ayurveda* in the present society demands to understand and emphasize the depth of *Ayurvedic* principles in an easy and more transparent mode.

Even though the contemporary science is developing very fast with so many new research works in the field of medicine, it will not be an exaggeration to say about *Ayurveda* - that it has already established its unique identity and it has been continuing its onward march with added illumination.

Every concept of *Ayurveda* is postulated and explained on the basis of *panchamahabhuta*, *Dosha*s represent the existence of *pancha maha bhuta* in our body, and everything is *panchabhutika* in the universe. Whatever may be the development in Contemporary science the ultimate treatment depends on management of *panchamahabhutas* for which the approach of *Ayurveda* is crucial.

Vata one among the three basic humors plays a major role in both health and disease condition. Most of the *vata* disorders discussed in *Ayurveda* are being diagnosed under neurological disorders in modern medicine. Hence an attempt has been made to understand the physiological activities of *vata* with special reference to neurophysiology.

Key words: *Ayurveda*, Nervous system, *vata*, Humors, Panchamahabhutas.

Introduction:

In its holistic approach, *Ayurveda* is based on three fold management known as *tridosha* theory consisting of *vata*, *pitta* and *kapha dosha*s, which form the base for all the *Ayurvedic* concepts concerned with physiology, pathology, diagnosis, prognosis, medicine, therapeutics. Each *dosha* is represented by different physical and physiological characteristics.

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Vata is responsible for psychological activities such as enthusiasm, concentration etc. , and exhibits several kinetic and physiological activities like respiration, circulation, voluntary action etc. (1)

Intelligence, clear conception, digestion, assimilation, heat production, hormones, enzymes and metabolism can be attributed to *pitta*. (Though *pitta* is responsible for the hormonal activity, their production and target organ release is controlled by *vata* hence hormonal problems are manifested as vata disorders also.) (1)

Courage, tissue building, body strength, immunity, resistance, anabolic activities etc. can be attributed to *kapha*. (1)

Basically *vata, pitta, kapha* constitute three regulatory systems respectively controlling input/ output, turn over and storage making them universal properties of all living systems. Among such important *tridoshas* the supremacy of *vata* is explained by all our *Acharyas*. For example it is said " *pittam phangu kapham phangu phangavo mala dhatavah Vayuna yatra niyante tatra gacchati meghavat* " (2) . *Vata* is the only principle having predominance of *Vayu mahabhuta* and its main lakshana is *gati* (movement) and gandhana (knowledge perception) (3) which are generally attributed to nervous system of contemporary science exhibiting the same functional properties. However an attempt has been made to compare the physiological functions of nervous system to that of *vata* and to ascertain that the principles of *Ayurveda* are everlasting and applicable at any instance or any point of time.

Very few works have been carried out on conceptual features of *vata* and its divisions such as *Apana, Udana and prana vata*. Its functions are compared with acetylcholine and a study of concept of *vata* in other traditional medicines was done. So this study is done to understand and re-establish the relation between physiological functions of all the five divisions of *vata* with nervous system.

Aims and objectives:

To ascertain and re-establish the up-to-date knowledge regarding physiological functions *of vata* and its role in nervous system basing on *Ayurvedic* principles

Plan of study:

Materials & methods:

For this study, the basic and conceptual materials have been collected from the *Āyurvedic* classics viz. *Brihattrayee* and *Laghutrayee* mainly the *Suśruta Samhitā, Caraka Samhitā* and other classics with the available commentaries, as well as various reference books to be reviewed. Various Publications, Text books of contemporary science, Research papers, and proceedings of seminars have been referred for better understanding of the concept and its comparison with contemporary science. The discussions with the seniors and renowned academicians have paved the way to achieve some fruitful conclusions.

Conceptual study:

Physiological functions of *vata* (4)

Sl. no	***Caraka***	***Vagbhata***	***Susruta***
1	*Utsaha*	*Utsaha*	*Praspandana-movement*
2.	*Ucchvasa*	*Ucchvasa*	*Udvahana*
3.	*Nihswasa*	*Nihswasa*	*Purana*
4.	*Chesta*	*Praspandana*	*Viveka*
5.	*Samahatu gati* (proper metabolism)	*Indriya patutva*	*Dharana*
6.	*Sama moksha* (proper elimination of wastes)	*Vega pravartanadibhih*	

Though *vata* is all pervading and responsible for all activities in our body, basing on the names, site and functions *sareera vata* is divided into 5 categories **(5)** which undertake almost all the functions of *vata* explained separately in *Vata kalakaliya* chapter of *Charaka samhita*.

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Functions of *Prana vata* (6) :

Types of *vata*	Functions	Anatomical relation with nervous system	Physiological functions
Prana vata	1. ***Buddhi dharana***-a) *mano buddhi (tattva gnana, dharana, grhana) , indriya buddhi (*sensory knowledge) . b) *smriti* (memory) , *anubhava* (knowledge through direct perception, inference, analogy, verbal testimony)	PFA (pre frontal area) Hippocampus, cerebral cortex, Wernicke's area, physical cortex, anterior thalamic group	site of working memory helps in complex intellectual activities like judgement, decision making. Helpful in retention and recollection of recent and past experiences.
	2. ***Chitta dharana***: holds functions of *mana* (*indriabhigraha*- initiates and withdraws *indriyas* (*gnana*-intellectual, *karma*-motor) from perceiving their objectives and sends information to *atma* (intellectual, motor, emotional) . *swasya nigraha* (self-control)	Heschl's gyrus, post central gyrus, insural cortex, pre pyriform cortex, amygdala, cerebellum, hypothalamus dorsomedial aspect of thalamus associating with prefrontal gyrus, primary motor area, pre motor area, basal ganglion.	Intellectual, emotional, motor activities
	3. ***Hridaya dharana***: holds functions of *hridaya* (heart)	Neurons lie in dorsal motor nucleus of the vagus nerve in reticular formation of medulla, caudal hypothalamus, vasomotor centre in medulla	Cardio inhibitory
	4. ***Swasa*** (respiration)	Respiratory centres located in the reticular formation of brain stem, dorsal group of respiratory neurons of medulla, pneumotaxic centre and apneustic centre of pons	
	5. ***Anna pravesana*** (mastication, salivation, deglutition)	Nuclei of trigeminal, facial, glossopharyngeal, vagus, hypoglossal, located in pons, medulla, other parts of brain.	salivation and deglutition, chewing.
	6. ***Kshavadhu*** (sneezing)	Sneezing centre of CNS stimulated by impulses through trigeminal nerve from nasal mucosa.	Sneezing
	7. ***Nishteeva*** (spitting)	Nucleus of facial nerve located in caudal portion of pons.	Spitting

	8. ***Udgara*** (belching)	Medulla (a poly synaptic visceral reflex)	Holding of breath, contraction of diaphragm and abdominal muscles, relaxation of sphincters, initiation of reverse peristalsis.

Functions of Udana *vata* (7) :

Type of *vata*	**Functions**	**Anatomical relation with nervous system**	**Physiological function**
Udana vata	1. ***Vakpravritti***- (speech) , 2. ***Prayatna*** (motivation) , 3. ***Urja***, 4. ***Balakara,*** 5. ***Varnakara,*** ***6. Smritikaraka*** ***(***sensory adaptation)	Motor fibres of the cranial nerves- facial, glossopharyngeal, vagus, and accessory, hypoglossal as a whole can be compared to cervical plexus as it is formed by these along with nerves arising from vertebrae C_1-C_4	Speech, swallowing, respiration etc. All other functions can be included in it as speech is an integrated outcome of motivation, emotion, sensory adaptation in terms of performance of an individual.

Functions of *Vyana vata* (8) :

Type of *vata*	**Functions**	**Anatomical relation with nervous system**	**Physiological function**
Vyana vata	1. ***Gati*** – voluntary movements of muscles, *Prasarana* (extension) , *akunchana/akshepana* (flexion/ withdrawal) , *vinamana* (bending) , *unnamana* (upward movement) *tiryaggamana* (lateral movement)	CNS	All these movements are nothing but the functions of motor neurons regulated by the CNS based on the sensory information received.
	2. ***Rasa samvahana*** (circulation of rasa) - circulation of rasa along with other dhatus like rakta (according to Gayadasa) to nourish all the dhatus.	Motor nerve supply to the cardiac muscle.	The circulation is effected by the force of regular contractions of cardiac muscles.
	3. ***Sweda asrik sravana*** (effecting the outflow of blood and sweat) – this depends on effective contraction of heart and calibre of vasculature.	Thoraco lumbar sympathetic division and Vasomotor centre of ANS and parasympathetic	Simultaneous and continuous functioning of the muscles of heart and vasculature.

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		divisions in turn are regulated by CNS. Hypothalamus	Sweat production is stimulated when hypothalamus is triggered due to the heat produced as a result of increased blood flow to the musculature in conditions like exercise, fight etc.
	4. ***Yonow sukra pratipadana*** (deposition of semen inside the vaginal cavity) - here only the act of intercourse can be considered as the actual ejection of semen is the function of *Apana vata*.	Sympathetic flow arising from inferior horn cells of the spinal cord regulated by the CNS.	Movement of the skeletal muscles
	5. ***Sroto vishodhana*** (clearing the channels)	Sympathetic division and Vasomotor centre of ANS	Increased circulation to muscle helps in better supply of oxygen and removes the waste products.

Almost all the functions of *Vyana vata* are motor in nature related to ANS which are performed by the command send by the CNS after analysing the sensory input.

Functions of *Samana vata* (9) :

Type of *vata*	**Functions**	**Anatomical relation with nervous system**	**Physiological function**
Samana vata	1. ***Annam grihnati*** (receiving and withholding it in annavaha srotas)	Vagal, glosso pharyngeal supply of the GIT (gastro intestinal tract) , ENT (enteric nervous system)	Vagal, glosso pharyngeal reflexes facilitate the entry of the food into stomach through oesophagus and storage of food is monitored by duodenal gastric reflex of vagus and by prevention of the reverse peristalsis by ENS
	2. ***Annam Pachati*** (helps in proper digestion by regulating production of digestive juices, movement of parts of digestive system for proper mixing and transferring the contents to next stage of digestion.	Sympathetic, para sympathetic supply of glands of digestive system, myo-enteric plexus.	Secretion of the digestive juices through vago- vagal reflex, sympathetic stimulation. Movement of digested food into duodenum, towards iliocaecal valve for absorption is initiated by the myo enteric plexus.

	3. ***Annam Vivechayati*** (discrimination of essence and waste products of digested food by the absorption of essence, water etc and forming solid wastes)	Myo- enteric plexus, vagus nerve innervation	The retention of chyme in ileum for more absorption is facilitated by relaxation of iliocaecal sphincter by vagus stimulation initiated by gastrin feedback. Absorption of water, electrolytes in colon is by Haustrations controlled by myo enteric plexus.
	4. ***Munchati*** (passing away the contents)	Parasympathetic innervation of colon, myo- enteric plexus	The movement of the remnants from colon to rectum and anus is by gastro colic, duodeno colic reflexes transmitted by myo-enteric plexus by initiation of Para sympathetic nerves stimulated by over distension of colon.

Functions of *Apana vata* (10):

Type of *vata*	**Functions**	**Anatomical relation with nervous system**	**Physiological function**
Apana vata	1. ***Mutra nishkramana*** (emptying of bladder) the urine formed by *Samana vata* is excreted out by the coordinative function of the *Apana-Prana-Vyana vata*s.	sensory fibres of the pelvic nerves, motor branches of the pudendal nerve (Central control is by the centres in cortical, pontine, spinal regions which can be considered as indriya dharana of prana) .	Micturition reflex is through sensory fibres of pelvis, pudendal nerve, voluntary control of micturition is by sacral reflex
	2. ***Sakrit nishkramana*** (bowel evacuation/ defecation) A process of evacuation of solid wastes from guda by coordinative function of the *Apana-Prana-Vyana vata*s.	Pudendal nerve, nervi erigentes which inturn are under the control of CNS.	The process of defecation is through Mass peristalsis, intrinsic reflex, defecation reflex
	3. ***Sukra nishkramana***	Parasympathetic supply, nervi	CNS analyses Sensory, psychic stimulus, initiates parasympathetic

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	(Ejection of semen) the movement of sukra from vrishana to sishnendriya and its ejection.	erigentes, sympathetic supply in L1-L2 level, pudendal nerve	supply through nervi erigentes results in erection, simultaneously initiates sympathetic supply in L1-L2 level resulting in contraction of epididymis, vas deference, seminal vesicles, and prostate causing expulsion of semen into the urethra, urethra then elicits signals to pudendal nerve which inhibits micturition and facilitates ejaculation by rhythmic contraction.
	4. ***Artava nishkramana*** **(**menstrual flow) artava is described both as menstrual blood and ovum, hence here menstruation, ovulation both can be considered under this heading.	HPO axis	Ovulation and menstruation both are due to the interplay of hormones through HPO axis
	5. ***Garbha nishkramana*** **(**bearing down the foetus during labour)	Nerve supply to the muscles of uterus and abdomen, hypothalamus	The expulsion of the foetus is by coordinative rhythmic contractions of uterine and abdominal muscles explained by optimal distension theory and ferguson reflex mechanism (weak uterine contractions of uterus caused due to over stretching of cervix-neurogenic reflex to hypothalamus-oxytocin- intensifies the contractions- neurogenic reflex to hypothalamus- oxytocin production- , it is a positive feedback mechanism which continues till the delivery of the baby.

Discussion:

From the above data of *Prana vata* in a broad sense *it* can be compared to the CNS anatomically and physiologically as its main seat is *murdha* and controls almost all the physical and physiological functions by generating motor impulses after the integration of the sensory impulses from all over the body.

Major groups of muscles that take part in speech and respiration are located in the mouth and throat and the nerve fibres supplying these areas can be correlated with *Udana vata*. The

development of speech is associated with neuro-physiological phenomenon of learning which occurs as an integrated outcome of motivation, emotion, and sensory adaptation in terms of performance of an individual. Apart from this *Ayurveda* opines that this physiological phenomenon acts through *mana* and *buddhi*. So a stimulus may reach higher centres in *mastishka* from the *kanta, uras, nabhi sthana* through *Udana* because of its nature (moving upward) and as said earlier integration of stimulus is done through *Prana vata* and a motor impulse may be sent to muscles of the above said *sthana* where the movement of muscles occur due to *Vyana vata*. Hence it is clear that *Udana vata* performs its functions through the combined functioning of *Prana* and *Vyana vata*s.

All these functions are directly or indirectly due to voluntary and involuntary movements of the muscles caused by their contraction and relaxation all over the body which can be understood by poly synaptic reflex arc with a single stimulus i. e *sarva vyapta* of *Vyana*, as said earlier one endeavours to speak or act in accordance with the guidance and incitement of *manas and buddhi* (*Prana vata*) . In a broad sense motor pathways can be considered as *Vyana vata* as it is responsible for the movement of muscles at different parts of the body to achieve actions such as glandular secretion, movement of body parts, peristaltic movements to facilitate proper physiological functions of local *vata* i. e. *Samana*, *Udana*, *Apana*.

Based on the functions *Samana vata* can be correlated to the ENS which governs the entire GI tract. In real sense it is the sensory stimulus of ENS (*Samana vata*) that is sent to CNS and resulting in vagal stimulation and gastrin feedback mechanism (*Prana vata*) leading to the muscular movements, secretion of gastric juices (*Vyana vata*) for digestion , absorption and discrimination.

The primitive micturition reflex brought about by the central integrating centre in the sacral spinal cord can be considered as *Apana vata* action, while the influence of higher centre on micturition can be considered under *Prana vata karma- indriya dharana* and the voluntary movements of muscles in contraction, relaxation can be considered as *Vyana vata karyas*.

In the action of defecation the initiation of reflex can be described as action of *Apana vata*, the control of the CNS over the sphincters can be considered as *indriya dharana karma of Prana vata,* the contraction and relaxation of the muscles of the sphincters can be considered as the action of *Vyana vata*.

Here the body movements in sexual act can be attributed to *Vyana vata* as it is responsible for any *cheshta vyapara,* the *utsaha* by *smarana, keertana* and *sankalpa* like *mano vyapara, utthana* of *upasthendriya* can be considered due to *Prana vata* as it controls the manas, indriyas and the movement of sukra from *vrishana to sishnendriya* and its ejaculation is under the control of *Apana vata*. Hence *sukra nishkramana* is by the coordination of the three types of *vata- Prana, Vyana and Apana*.

In a broad view the anatomical spread and functional aspects of Lumbo sacral plexus appear similar to that of the *Apana vata*. There are scientific evidences showing the surgical removal of the sacral plexus or any injury resulting in loss of sensation over anterior abdomen and thighs, loss of erection, loss of bladder and bowel control, sciatica, paraplegia of both lower limbs, hence *Apana vata* can be partly correlated to lumbosacral plexus.

As a whole all functions of the five divisions of *vata - Prana, Vyana, Udana, Samana and Apana* are facilitated by coordination of *Prana* and *Vyana* with each other. Hence these can be correlated to three basic functions of nervous system:

- Sending Sensory information- from all five divisions from their sthanas to the site of *prana vata.*
- Integration of sensory information and generation of motor output – from the site of *Prana vata*
- Sending Motor impulses to the respective effector sites- through *Vyana vata*.

Conclusion:

It can be concluded that the functional field of *vata* cannot be limited by simply comparing it with nervous system or any other system alone, as the involvement of *vata* is inevitable in any systemic activity. So, functions of *vata* can be partially correlated with the functions of nervous system. As well as there is a need of further research to evaluate in detail the *kshaya* (decrease) , *vriddhi* (increase) , *samatva (*normalcy) and *avarana* - phases of *vata* in both physiological and pathological aspects for the betterment of mankind.

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