



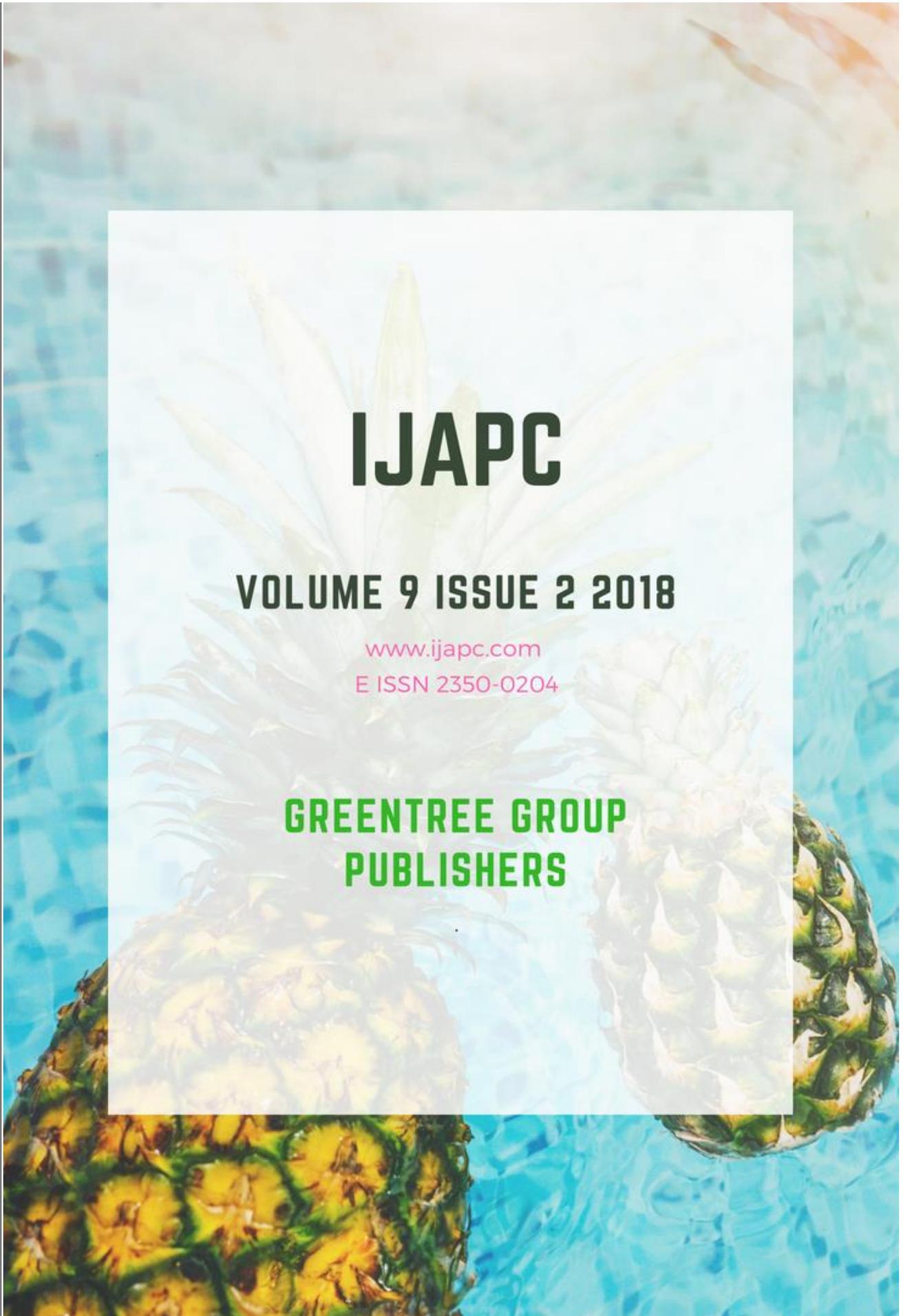
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A Critical Review of *Udanavayu* in the Modern Perspective

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ABSTRACT

The purpose of *Ayurveda* science is to maintain the health of the healthy and cure disease of diseased. In *Ayurveda* a person is said to be healthy when *Dosha*, *Agni*, *Dhatu*, all the physiological process are in homeostatic state and soul, sense organ and mind are in a state of total wellbeing. *Vata dosha* acts as *yantratantradhara* which means in its normal state it maintains the function of organs and organ systems. Among five *vata dosha*, *udana vayu* is located in *urah* (thorax region), and travel across *nasa* (nasal passage), *nabhi* (umbilicus), and *gala* (throat region). It is responsible for the production of speech, effort, energy and maintenance of strength required for the purpose. It also helps in remembrance of vocabulary required to make the speech meaningful. That's why it is considered as *pavanottama*. It collaborates with *prana* and *vyana vayu* to perform most of its functions. All the functions of *udana vayu* can be compared with physiological functions of anatomical structure of contemporary modern medical science. Basically Broca's area, Wernicke's area, thymus gland, serotonin like happy hormone, motor area of cerebral cortex and other structures might be compared with the functions of *udana vayu*. Very few works have been accomplished on conceptual features of *vata*. In this article an attempt has been made to correlate the physiological activity of *udana vayu* with modern medical science. For this study, the basic materials have been collected from the *Ayurvedic* classics with the available commentaries, as well as Text books of contemporary modern medical science have been referred for better understanding of the concept and its comparison with contemporary science.

KEYWORDS

PranaVayu, *Udanavayu*, *Broca's area*, *Wernicke's area*, *Thymus gland*



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INTRODUCTION

Physiology of *Ayurveda*, is based on the basic theory of *tridosha* which is the root for all *Ayurvedic* concepts. These three *doshas* do their functions at various level such as cellular, single system and organization level. *Vata* among these three *doshas* administers all the movements in mind and body including *Pitta*, *Kapha*, *Mala* and *dhatu*. *Pitta*, *Kapha*, all *dhatu*s and *malas* are immobile like lame individuals. It becomes mobile when *vata* becomes active. The active *vata* carries them away from its location just like the clouds being carried away by the wind¹. It is the initiating and controlling factor of human body and responsible for all type of movements². *Vata* is considered as *Prana* for human beings. It is the initiator of all kinds of activities within the body, the controller and impellor of all mental functions, and the employer of all sensory faculties. It joins the body tissues and brings compactness to the body, promotes speech, origin of sound and touch sensation, it is the root cause of auditory and tactile sense faculties, it is the causative factor of pleasure and courage, stimulates the digestive fire, and helps in the absorption of the *dośhas* and ejection of the excretory products. *Vata* travels through all gross and subtle channels, gives the shape

of embryo and is the indicator of continuity of life³. *Vatadosha* has been divided into five types on the basis of location namely *prana*, *udana*, *saman*, *vyana* and *apana*. All these five *vata doshas* have their different site as well as different functions. Among the five types of *vata*, *Udana vayu* has various functions which act at different level. It also performs its function with the help of *prana* and *vyana vayu*. So there is need of proper coordination and cooperation of these three *vayu*. It cannot be represented by one structure at all the time. *Ayurveda* is the science based on the concept of functional understanding. Specific correlation of *udana vayu* is not mentioned in ancient literatures. It seems to be a problem found in student life, particularly first year of Bachelor of *Ayurvedic* Medicine and Surgery to understand about the concept of *udana vayu*. Increased demand of *Ayurveda* science in the present society is required to understand the depth of *Ayurvedic* principles on criterion of modern medical science in an easy mode. In this review we are trying to identify anatomical structures based on its physiological functions retrospectively described under the function of *udanavayu*.

Table 1 Site and Function of Udanavata by Different Acharya-

	Charak Samhita ⁴	Sushrut Samhita ⁵	Astanga Hridaya ⁶	Astanga Sangraha ⁷
Sthan (Location)	umbilicus, thorax and trachea	<i>Vata Dosha</i> which leads upwards is <i>Udana Vayu</i>	<i>Uras</i> and traverses from <i>nasa</i> (nasal passage) to <i>nabhi</i> (umbilical region) through <i>gala</i> (throat)	thorax moves in the region of throat, nose and umbilicus,
Karma (Function)	vocalization, drive, energy, strength, complexion	exhalation, speech, singing,	<i>Vak pravritti</i> (speech), <i>prayatna</i> (enthusiasm), <i>urja</i> (energy), <i>bala</i> (strength), <i>varna</i> (production of alphabets) <i>smriti</i> (memory)	Production of speech, activities(physical movements, actions), valour, strength, nourishing the tissue pores, (by providing them nutrition), discrimination, courage, memory, awakening of the mind

- *Acharya Arunadutta* and *Hemadri* has described the chief location of *Udana Vayu* as *Uras* (thorax region), and it acts from thoracic area to nasal area⁸.
- *Acharya Sarngadhara* has mentioned lungs as the chief organ of *Udana vayu*⁹.
- *Acharya Chakrapani*, commentator of *Charak Samhita* agrees with similar locations and areas of functions of *prana* and *udana vayu*. He states their location may be same but functions are different. He simplifies his statement by giving an example. If round shaped earthen pots are kept one on the top of the other, their location in relation to house is similar yet each pot has different existence and different functions. This is the relation between *Prana* and *Udana vayu* in terms of their location and functions¹⁰.

- *Acharya dalhana* in his commentary mentioned the *uchvasana* karma of *udana vayu*¹¹.
- Due to aggravation of *Udana vayu* diseases above shoulder level are observed. All Ear, Nose and Throat diseases and *shiro roga* are included under this category. If *kapha* covers and block *dhamani* that convey words a person is unable to speak properly. Depending upon area of blockade various defects of speech are observed.

ROLE OF PRANA AND VYANAVAYU IN THE FUNCTIONS OF UDANAVAYU:

Prana vayu, the chief among all *Vata* is located in *Murdha* and traverses through *uras* (thorax), and *kantha* (throat), it maintains the proper functioning of *budhhi* (intelligence/judgement), *hridaya* (cardiovascular functions), *chitta* (mind). It also performs functions such as *sthivana*

(spitting), *ksavathu* (sneezing), *udgara*(belching), *nisvasa* (respiration), *annapravesha* (deglutination)¹². Major site of *Udanavayu* is thorax region. The function of *Udana vayu* is *Smriti* which means *Sanskarjanyagyana*. After the *artha graham* (through special senses) by *Prana vayu*, the information is reached and stored in the brain. This stored information is protected by *Srota prinana karma* of *Udana vayu*. It also maintains intelligence (*dhi*), mental endurance (*dhriti*), by supplying stored knowledge to the mind. So with the help of *pranavayu*, *udanavayu* performs its functions like *varnasmriti*, *vakpravriti*, *prayatna* and *urja*. *Vyanavayu* is located in heart. It always ejects the *rasa dhatu* from the heart simultaneously continuously and forcefully throughout the body so it is responsible for all actions of body¹³. *Srota prinana* means the *prinana* of *srotamsi* means nutrition to the channels through which all the essence of *aahara* moves. *Moolasthan* of *Rasa dhatu* is *hridaya*. *Mulasthan* of *udana* is *Urah*. The function *Rasa sambahan* starts from *hridaya*. All *Srotoprinana* is under the control of *Vyanavayu*. With the help of *vyanavayu*, *udanavayu* helps in nutrition of channels. The major difference between *Prana* and *Udana* is in their functions. Functions of *Prana vayu* indicates its direction is from outside towards inside as well as from

inside towards outside of the body but *Udana vayu* indicates its direction from inside to outside. It can directly act on *Annapraveshanadi karma* which is towards inside as well as on *Shteevana*, *Udgaara* which is towards outside. *Udana vayu* helps in exhalation, speech, singing, etc: in which the *Vayu* moves outside.

MODERN ASPECTS:

Vakpravriti and Varnasmriti:

The most important function of *Udana vayu* is *vakpravriti* which means production of speech. It also helps in singing which is also a type of *vakpravriti*. The mechanism of singing and speech are alike. The term *Varna* should not be alienated with *Smriti*. It is not *Varna* and *Smriti*. It is *Varnasmriti* which refers to the process of recall of vocabulary. Recalling the vocabulary is required to frame a meaningful sentence during *Vakpravriti*. *Varna* means vocabulary. Repeation of vocabulary potentiates the *Smriti* or memory power. So *Smriti* comes under the function of *Udanavayu* as it regulates the function of speech.

Language is meant for communicating one's thought through spoken words or in writings and is also the medium for all delicate interpersonal transactions. There are four main areas in the brain that play important role in processing of language and speech. These four areas are

collectively known as language zone that are present around the sylvian fissure. Two are called receptive area and the other two are called executive area. Receptive area is also called sensory speech area. They are Wernicke's area that perform the perception of spoken language and the angular gyrus that subserve the perception of written language. Area 41 and 42 are also included in receptive areas that take part in processing spoken language. Wernicke's area is located behind the primary auditory cortex in the posterior part of the superior gyrus of temporal lobe. This is major association area for processing sensory information from the somatic sensory, visual and auditory cortices. It is essential for the comprehension, recognition, and construction of words and language. It is the most important part of the whole brain for higher intellectual function because almost all intellectual functions are language based. Angular gyrus is second receptive area which is present in the inferior parietal lobule anterior to the visual receptive area. This subserves the perception of written language. The executive area initiates the production of speech. These are Broca's area (area 44, area 45) and writing area. Broca's area is concerned with motor aspect of speech which is located in the prefrontal association cortex, adjacent to the motor

cortex. Broca's area regulates the function of muscles of lip, tongue, pharynx and larynx. Exner writing area is located in the posterior part of the frontal lobe. This area helps in writing after visual perception of word. The sensory and motor areas are connected with each other. A rich network of nerve fiber, the arcuate fasciculus which passes through the isthmus of temporal lobe and posterior end of sylvian fissure connects Wernicke's area and Broca's area. This fasciculus coordinates the understanding and execution of speech and the language skills.

Angular gyrus receives visual and auditory inputs and makes preliminary processing of this information. Angular gyrus projects to Wernicke's area, which is concerned with the comprehension of visual and auditory information. Wernicke's area projects to Broca's area through arcuate fasciculus, which further processes information received from Wernicke's area into elaborate process of vocalization. Broca's area projects to motor complex that brings about the motor activities of speech apparatus, which finally produces speech¹⁴.

Bala:

Here *bala* refers to strength or immunity which is provided by the help of *udana vayu*. Immunity is the ability to resist

almost all types of organisms that injure the tissues and organs. Acquired immunity develops after the body is first attacked by a bacterium, virus, or toxin. It needs weeks or months to develop the immune response. Acquired immunity is achieved by immune system which forms antibodies or activated lymphocytes. These lymphocytes attack and obliterate the specific invading organism. Acquired immunity is of two types. The body develops globulin molecules in the blood plasma that are capable of attacking the invading agent. This type of immunity is also called humoral or B-cell immunity. The second type of acquired immunity is achieved during the formation of large numbers of activated T lymphocytes. These are specifically activated in the lymph nodes to destroy the foreign particles. This type of immunity is called cell-mediated immunity or T-cell immunity. Lymphocytes are mainly responsible for acquired Immunity. The lymphocytes are located mostly in the lymph nodes. They are also found in the spleen, sub mucosal areas of the gastrointestinal tract, thymus, and bone marrow. The lymphoid tissue helps to intercept invading pathogens before they spread too widely in the body. The invading agent first pierces the tissue fluids and then is carried by way of lymph vessels to the lymph node or other lymphoid tissue. The

lymphoid tissue of the spleen, thymus, and bone marrow plays an important role of obstructing antigenic agents. The T lymphocyte is responsible for forming the activated lymphocytes which helps to provide “cell-mediated” immunity. Almost all of the lymphocytes end up in the lymphoid tissue, but before these actions they are further differentiated or “pre processed” in the following ways. The lymphocytes that are designed to form activated T lymphocytes first are pre processed in the thymus gland. Thus they are called “*T*” lymphocytes because of the role of the thymus. They are responsible for cell-mediated immunity¹⁵.

The role of thymus in lymphopoiesis is significant. Stem cells from bone marrow divide repeatedly to form smaller lymphocytes. During mitosis, DNA of lymphocytes undergoes random mutations as a result of which different lymphocytes acquire the ability to recognize a very large number of proteins and to react to them. All lymphocytes that would react against the body’s own proteins are destroyed. Because 90% of lymphocytes formed in the thymus are destroyed within 3-4 days. The remaining lymphocytes that react only against proteins foreign to body are thrown into the circulation as circulating immunologically competent T lymphocytes. Within the thymus, the

lymphocytes are not allowed to come into contact with foreign antigens because of the presence of the blood-thymic barrier. Hormones produced by the thymus may also influence lymphopoiesis in peripheral lymphoid organs. This influence appears to be especially important in early life, as lymphoid tissue do not develop normally if thymus is removed¹⁶.

Udanavayu is located in *urah* region. It's one of the function is to maintain strength in our body. White blood cells (WBCs) provide the baseline defense mechanism against pathogens. Thymus a lymphoid structure is located in chest region which provide cellular immunity by the activation of T lymphocytes. These lymphocytes provide the defense against the invading pathogens. So if immunity is good then *balawill* be best.

Oorja:

It means enthusiasm and drive to do something. We get energy for our activities with the help of normal *Udanavayu*. It is a physical as well as mental component. There are some hormones and neurotransmitters in our body which makes us happy and initiate to do our work.

- **Serotonin:** Serotonin is called the happiness hormone. Serotonin regulates the mood, prevent depression and makes us happy

- **Endorphins:** Endorphins make us feel good. It helps in reduce anxiety and sensitivity to pain.

- **Dopamine:** Dopamine accelerates mentally activity.

- **Phenylethylamine:**It is the brain's best known love chemical. It helps in the feelings we get in the early stages of a relationship.

- **Ghrelin:** Ghrelin is a hormone that reduces stress and can help to become more relaxed.

- **Oxytocin:**Oxytocin is the "love" hormone. It is released by physical contact. During Intercourse and childbirth. Oxytocin provides feelings of love and trust.

- **Acetylcholine:** It facilitates appetite control, release of growth hormone, memory, sexual performance, alertness.

- **Enkephalins:**it helps to control transmission of pain, reduce craving, reduce depression.

- **Melatonin:**It acts as "Rest and recovery" and "anti-aging" hormone. It normalize body clock.

- **Norepinephrine:**It helps in excitatory function, feel happy, alert, motivated. Anti-depressant, appetite control, energy, sexual arousal¹⁷.

Prayatna:

It can be the physical and mental effort to do something. *Udanavayu* initiates a person to do work. To achieve a result from any type of work there should be an effort and for this effort there should be an initiation. This initiation to perform minor or gross motor activities there are three areas present in motor cortex. Those are (1) the *primary motor cortex*, (2) the *premotor area*, and (3) the *supplementary motor area*. These areas of brain motor cortex help to initiate motor activity of skeletal muscles of our body. Primary motor cortex lies in the frontal lobes anterior to the central sulcus. This area generates mostly discrete pattern of movement. More than one half of the entire motor cortex is concerned with controlling the muscle of hand and the muscle of speech. Premotor area lies 1-3 cm anterior to the primary cortex. Nerve signals generated in the Premotor area cause much more complex patterns of movement. The most anterior part of Premotor area first develops a motor image of total muscle movement which is to be performed. This image excites each successive pattern of muscle activity in the posterior Premotor cortex. This posterior part of Premotor cortex sends its signals either direct to primary cortex or through basal ganglia and thalamus and then back to primary cortex to excite specific muscles. Motor cortex, putamen, globus pallidus, substantia nigra,

sub thalamus, ventro anterior and ventro lateral nuclei of the thalamus is involved in subconscious execution of learned pattern of movement through Putamen Circuit. Caudate Circuit is involved in cognitive planning of sequential and parallel motor patterns to achieve specific conscious goal. Supplementary motor area lies in the longitudinal fissure. Stimulation of this area helps in bilateral movement rather than unilateral for example bilateral grasping movement¹⁸.

DISCUSSION

Basically *Vata*, *Pitta*, *Kapha* constitute three regulatory systems i.e. nervous, endocrine and immune system respectively of all living systems. Among such important *tridoshas* the supremacy of *Vata* is explained by all our *Acharyas*. *Vata* is the natural pacemaker from where all the activities are initiated and continuing. It is the basic humoral element which controls all the function of the body. *Udanavayu* which is termed as *pavanottama* by *Acharya Sushrut* performs different functions like *vakpravritti*, *bala*, *varnasmriti*. It executes its functions with the help of *Prana and Vyanavayu*. *Dhriti* (power of retention of information), *Smriti* (power of reproduction of information) and *Mano*

bodhana(stimulation of mind) are higher mental activities and are governed by the brain and other parts of the nervous system which are located in *Sira* (cranial cavity). *Sira* is not been considered as the site of *UdanavayubyAcharyas*.

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. Major groups of muscles that take part in speech and respiration are located in the mouth and throat. Apart from this *Ayurveda* opines that major physiological functions occur through higher centre of brain. So a stimulus may reach higher centers in *mastishka* from the *nabhi, uras, kantha sthana* through *udana* because of its nature (moving upward). Integration of stimulus is done through *Pranavata* and a motor impulse may be sent to muscles of the above said sthana where the movements of skeletal muscles occur due to *Vyanavata*. Hence it is clear that *Udanavata* performs its functions through the combined functioning of *Prana and Vyanavata*.

From the above details as per the functions of *Udanavayu*, it can be compared with many structures like Broca's area, Wernicke's area, Motor cortex, Serotonin like happy hormones, Thymus gland. The

function *Vakpravritti* may be compared with Broca's area, *Varna and smriti* may be compared with Wernicke's area. *Oorja* may be compared with neurotransmitters like serotonin, dopamine like happy hormone with helps in enthusiasm. *Praytna* may be compared with the initiative functions of motor cortex which helps in initiation to do effort. *Bala* may be compared with the physiological functions of thymus gland which provides cellular immunity by the activation of T lymphocyte. Some of the physiological functions of *UdanaVayu* explained by *Acharyas* are found in relation with the location of anatomical structures. Some physiological functions like *vakpravritti, prayatna, smriti* are not related with function of anatomical structures explained by *Acharyas* under *Udana vayu*. As per modern medical science *vakpravritti, praytna* and *smriti* is the physiological function under the control of cerebral cortex i.e. higher center of brain. Brain is not included under anatomical structures explained in the location of *Udanavayu* but its physiological function is explained.

CONCLUSION

Function of *Udanavayu* varies by different *Acharya* and it is not limited to any particular part or system. It is primarily

responsible for *Vakutpatti* and its functions can be interrelated with different structures at cellular level to organism level as *Vatadosha* is involved in all type of systemic activity. It can be partially correlated with Broca's area, Wernicke's area, motor part of nervous system, thymus gland, serotonin like happy hormones. There is a need of further research to evaluate in detail of all other *Vatadosha* for the betterment of mankind.

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