

AN INSIGHT OF PHYSIOLOGY OF RESPIRATION IN AYURVEDA

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ABSTRACT

Respiration has been recognized as the symbol of life. It is as evident from the fact as the description of mechanism of respiration as told by Ayurvedic Scholars in ancient times clearly depicts the process of respiration in parlance with modern medical sciences. In Ayurveda the functions of *Prana Vayu* is held responsible for the process of respiration in human body. The channels or tracts (*Srotas*) in which *Pranavayu* flows are called *Pranavaha Srotas*. *Prana Vayu* is compared with the atmospheric oxygen which is necessary to carry out the vital functions of life.

Keywords: *Prana Vayu, Pranavaha Srotas, Swasa Kriya*

INTRODUCTION

Respiration is an important physiological process necessary for the existence of life. In *Ayurveda* the functions of *Prana Vayu* is held responsible for the process of respiration in human body. The channels or tracts (*Srotas*) in which *Pranavayu* flows are called *Pranavaha Srotas*. *Prana Vayu* is compared with the atmospheric oxygen which is necessary to carry out the vital functions of life. The facts as described by ayurvedic scholars much before depict a clear resemblance with the features mentioned in the process of respiration in modern medical studies.

AIMS & OBJECTIVES

1. Physiology of respiration as described by Ayurvedic Scholars in ancient times.
2. Possible correlation of process of Respiration as per Ayurvedic & Modern medical sciences

DISCUSSION

Functional anatomy of the Respiratory System:

The organs of the respiratory system include the nose, the nasal cavity, the pharynx, the larynx, the trachea, the bronchi & their smaller branches & the lungs which contain the terminal air sacs or alveoli. The places of *Prana Vayu* for respiration as described in *Ayurveda* were also same as *Murdha* (head), *nasik* (nose & nasal cavity), *Kantha* (trachea & larynx) & *Uras* (thorax)

Nose: The only externally visible part of the respiratory system, the nose lies in the middle of the cranium & mouth. Posterior it communicates with the pharynx. It is the sense organ of smell / olfactory receptors (*ghranendriya*).

Pharynx: Pharynx is a funnel shaped structure which connects the nasal cavity & mouth to the larynx & esophagus inferiorly. It is a common passage for air (through Pharynx & Trachea, the canal for air) & food (through oesophagus).

Larynx: Larynx is situated between Pharynx & trachea. It acts as a passage of air to the respiratory system & food to the oesophagus. Besides this, it plays a very important role in the production of voice. During swallowing its inlet is closed by epiglottis.

Trachea: It is 10-12 cm long. Trachea is the continuation of larynx and ends in getting divided into 2 principle bronchii in the mid thorax.

The bronchii: The trachea is divided into 2 parts – viz. left & right bronchi at about at the level of 5th vertebra of the thorax in the mediastinum. Both the primary bronchi enter each site of the lung; vary in shape according to the location of the lung. After entering the lung each primary bronchus divides into secondary, tertiary bronchi and bronchioles and terminal bronchioles.

The alveoli: The remote small ends of bronchioles are further subdivided into the minute cavities called alveoli which end again at alveolar sac in the lungs. This portion of the lung is directly responsible for exchange of inhaled gases.

Lungs: In Ayurveda, Acharya Sushruta describes the lungs to be produced from the foam of the blood, whereas in the modern medicine it is described as two lungs one lying on each side of the mid line of the thoracic cavity. They are cone shaped and described as having an apex, a base, costal surface and medial surface.

The pleura: the pleura is thin, double layered membrane which covers the lungs it produces pleural fluid, a lubricating serous secretion which remains between the two layers and the lungs easily glided at respiration.

Swarupa of Prana Vayu

The *Vata* from nature and the *Vata* from body are not visible or *Pratyakshagamy*. They are identified by their works. The *Prana Vayu* plays a vital role in the process of respiration.

Sites of Prana Vayu

Head & chest are two main sites. Head, throat, mouth, tongue, nose, heart, mind & intelligence are also included in sites of *Pranavayu*.^{1,2} *Pranas* of the living beings stay in umbilicus & umbilicus is dependent on *Pranas*. Umbilicus is surrounded by *Siras* in the same way as the nave of the wheel is surrounded by spokes.³

Pranah : It indicates that *Siras* are the basic seat of *Pranas* i.e. *Pranas* depends on *siras*, because through this *Siras* from heart the *Prana* is circulated to whole parts of the body and here the work *Prana* is done.

Functions of Prana Vayu

Movement, carrying sensation upwards, filling with food (ingestion), segregation and upholding characterized by these and divided into five accordingly *Vayu* sustains the body. Equilibrium, decrease and increase of *doshas*, *dhatu*s, *malas* etc. should be known by their natural characters and functions, hence in the content of equilibrium both these character should be taken into consideration *Prasandanam* - movements of the body, this is the function of *Vyana*. *Udvahanam*. - carrying sensation upwards, this is the function of *Udana*. *Puranam*- filling of stomach with food, this is the function of *Prana*; *Vivekah*. - Segregation of essence (*Rasa*) and excrement (urine and feces) this is the function of *Samanavayu*; *dharanam*. - upholding semen, urine etc. and during urge pushing them out, this is the function of *Apanavayu*; thus *Vayu* is divided

into five type - *Prana*, *Udana*, *Samana Vyana*, *Apana*. Others, however, take these functions of *Vayu* in general such as *Prasandanam* - respiratory movements, *Udavanam* - carrying *doshas*, *dhatu*s and *malas* here and there, *puranam*. -filing the respective viscera with *ahara* – *Rasa* etc., *vivekah*.- segregation of essence (*rasa*) and excrement (urine and feces), *dharanam*. Maintenance of the mechanism of the body.^{4,5} *Agni* is flamed and preserved in all ways by three types of *Vayu* - *Prana*, *Apana*, *Samana*, staying in their respective positions.⁶ To maintain the proper and smooth activity of *Buddhi* (intelligence), heart, mind and sense organs, mental functions like *dhi* (selection of good and bad), *dhriti* (courage) and *smriti* (memory).⁷ To perceive the sensation and to decide which functions of sensory and motor organs are, Inspiration and deglutition are most important functions of *Prana*. Pure air and food (external *Prana*) are taken in the direction and *Prana* activity is from nature to body (external to internal). If these inwards movements get obstructed problems like asthma begins. Spitting, sneezing and belching are comparatively less important functions.

The *Pranavayu* is circulated through *Pranavaha Srotas* and along with the important needed *Pranashakti* is also provided by *Pranavaha Srotas*. The *Pranavaha Srotas* is first *Srotas* among other *Srotas*. Among the internal opening *Srotas* the first description is of *Pranavaha Srotas*. The physiological importance of *Pranavaha Srotas* is much higher than other *Srotas* so it is described first. *Prana* is very important for living body and this *Prana* is carried by *Pranavaha Srotas*. The external air which is

inspired through nose is called as *Prana* and the body is alive with this *Prana*. If there is disturbance or break in this *Vayu*, man will be died. So it is called *Prana Vayu*.

Pranavaha Srotas & Swasana Samsthana (Respiratory System)

Srotas are the channel or structure through which *Sravanam Karma* i.e. flowing, moving, oozing & permeation of different constituents & nutrients of body takes places. *Pranavaha Srotas* is obviously the transport system of *Prana* which has been narrated as vital air (vital breath) inhaled & also be the vital energy of the body responsible for each & every activity of living being. Therefore the concept of *Pranavaha Srotas* also is understood in the light of these facts. Among the five types of *Vayu*, there is one named “*Prana*” which is commonly used & appear to be appropriate. This *Prana Vayu* signifies the atmospheric air which is essential for respiration & vitality of life

Mulasthan (origi) of Pranavaha Srotas:

There has been diverse of opinion, even among the authentic texts of *Charak* & *Susruta Samhita*. Based on the description of the texts, the commentators express their own views in their own line of thinking.

According to *Charak*, the *Hridaya* & the *Mahasrotas* are at the *Mula* (Root) of “*Pranavaha Srotas*”. The symptomatology described by *Charak*, regarding *Pranavaha Srotas* when it gets deranged, appear to be supportive of Respiratory System of the body.⁸ The organs described in *Pranavaha Srotas* according to *Gangadhar Tikka* are *Hridaya* & *Vaksha* . (*Phusphusa* i.e. lungs).⁹

Chakrapani says the passage through which “*Vayu*” in terms of “*Pra-*

navaha” passes through the body is known as *Pranavaha Srotas*. It is particular sorts of “Prana” having specific passage of “Vayu”. *Pransadnyakvat* means inspiration of *Prana Vayu* & Expiration of *Udan Vayu* which are the functions of *Pranavaha Srotas*. *Pranavayu* is circulated through the body by *Hridaya* with the help of *Vyan Vayu*. *Sadhak Pitta* which is in the heart (*hridaya*) with the help of *Vyan Vayu Avalambaka Kapha* is secreted by micro respiratory tubules & alveoli (*Vayu Kostha*) in *Phuphusa*. *Avalambaka Kapha* is present between *Hridayavaran* (Pericardium) & *Phuphusavaran* (pleural cavity). *Avalambaka kapha* helps in the functions of *Hridaya* & *Phuphusa*. *Sleshaka Kapha* present in *Pranavaha Srotas* helps in the *sandhan* of all the *peshis*. It also helps in the movement of respiration by *Snehana Karma*.¹⁰

In *Susruta Samhita*, the description of *Pranavaha Srotas*, its number, origin & location are somehow different than the description available in the *Charak Samhita*. According to *Susruta*, there are two *Pranavaha Srotas* originating from *Hrdaya* (heart) & *Rasavahinis dhamanis* (Arteries carrying nutritional fluid). In connection with *Rasavahinis dhamanis*, there is difference of text, where we find *Pranavahi Dhamanis* in its place. Considering this *Pranavahi Dhamanis*, the great scholar Dr. BG Ghanekar states that there are just “SVASAVAHINIS” representing the bronchi of respiratory tract¹¹. In this view these are the *Pranavaha Srotas* in to which *Pranavayu* gets in. He has rightly supported this view from the quotation of *Sharangadhar Samhita* which clearly represents the entire process of respiration & the link between the

Vayu of *Pranavaha Srotas* & atmospheric air.

Functions of Pranavaha Srotas

Prana is most important in our body. The actions like movement of body circulation of *dhatu*s contraction and relaxation, pulsation are done by *Prana* and the strength of *Prana* is holding by *Pranavaha srotas*. The bodies functions are depend on normal functioning of *Pranavaha Srotas*. The loss during different types of *Sharira Kriya* is replace by *Panchabhautik Ahara* and along with the *Ambarpiyusha* is also accepted by *Pranavaha Srotas*. For the acceptance of *ambarpiyusha* contraction and Relaxation of *mahaprachira peshi*, *phupphusa* and other related muscles are important. This stimulation is given by *Abhyantara prana*. If there is controversy in energy created by food and energy lost during different body actions, result increasing in contraction and relaxation of *Pranavaha Srotas* and hence it is responsible for disturbance in *Pranavaha Srotas*. In the process of accepting *ambarpiyusha* if the (*pranashakti*) power of *Prana* is less than it also causes disturbance in *Pranavaha Srotas*.

The nutrition of remaining *Vayu* is done by *Prana Vayu* , If there is contamination in nutritive *Vayu* or less in amount or disturbance in its pathway. Then the functions of other *Vayu* are also disturbed. Due to this the functions of *Dhatu* and *mala* are also disturbs resulting diseases in body. The *Vayu* produces in the form of *mala Vayu* during the digestion of food is *Niyanta - praneta* of *sharir* and *mana*. And the final nutritive products are given by *Pranashakti* so when we totally think about *Pranavaha*

Srotas and organs in *Pranavaha Srotas* and also about their strength.

Formation of Pranavaha Srotas

When we think about the formation of *Pranavaha Srotas* it is essential to think about the elements responsible for the formation of organs including in *Pranavaha Srotas* which is produced by *Rakta dhatu*. *Rakta* is one of the *dhatu* from *saptadhatu* and it is also one of the *Prana* from *Dashapranayatana*. There is main role of *Rakta* in formation of every organ of body so it is creator of few important organs of the body.^{12, 13}

Rasa dhatu is colourless and consist of nutrients of seven *dhatu* liquid while colored *Rasa* when enters into *Raktavaha Srotas* liver and spleen gets red colour due to action of *Ranjaka pitta*. *Raktadhatu* conducts *Prana* to every *dhatu*, every cell of body. The air inhaled (*Ambarpiyusha*) during the process of respiration becomes vital *Prana* for human body. This *Prana* along with *Rakta dhatu* is supplied to every organ, tissue and cell to perform physiological activity.

Prana is energy without which body will not functioning. Body cannot survive without *Prana*. *Prana* and *Rakta dhatu* is a medium for the conduction of *Prana* hence life depends on *Raktadhatu*. Therefore hemorrhage or obstruction to blood flow can affect life so it is called *Jivana*.

Hridaya is formed during the fourth month of fetal life which is main site of *Pranavaha Srotas*. It is also main site of *Rasavaha* and *Pranavaha Srotas*. In circulation of *Rakta* and *Shvasana* the *Hridaya* is functioning mainly and over it also effect of *Pranavayu* and *Vyanvayu*. The organ *Hri-*

daya is made up of *Rasa, Rakta, Mamsa, Meda, Shukra* etc. *dhatu*s.

Shwasa Kriya: Mechanism of Respiration

The clear physiology of respiration is available in Ayurvedic and Sanskrit literature. In *Yajurveda*, it is mentioned that air (*vata*) in the form of *Prana* and *Apana* enters in the *nasika*. (“*Vatam pranena apanenasike*”: *YAJ* 15/12) . It shows that *Prana & Apana* are the words used to indicate inspiration & expiration.

Shwasa Kriya (Respiration) is a process which takes place from first minute of birth to last minute of death. This process involves two phases as *Nishwasa* (Inspiration) & *Uchawasa* (Expiration) going on alternatively. The *Prana Vayu* (atmospheric air) which enters through the nasal passages, along the course of *Swasanalika* (Trachea, Bronchi) & fills up the *kostha* (alveoli) Thereby it is allowed for a short period & is forced out through the same *Srotas* This whole process depends mainly on *Prana Vayu* for *Nishwasa* & *Udana Vayu* for *Uchawasa* From *nasa* to the *Vayu koshas* there is interior *sleshmika kala* (mucous memberane) is lined & which secretes a small amount of *Kapha* (thick fluid) always. This *Kapha* Known as *Awalambaka Kapha* helps the part by keeping *Aadra* (moist) & also conferring *Bala* (strength). It helps to hold any foreign matter coming along with the air.

Acharya Sharangdhar has described in *Purvakhanda* the physiological process of normal breathing as the total process of normal breathing to far transportation of organ to the tissue & the cells. He stands with the view that it is the *Prana Vayu* situated at *Nabhi Pradesha* (center of the body) comes

out of the neck, touching the lotus like heart & after getting saturated with *Vishnu Padamrata* (O_2) from atmospheric air again enters back forcefully. (sha.pu 5/89-99). It states that this respiration starts from *nabhi*, which may be considered as umbilical region i.e abdominal muscles helps for respiration. Diaphragm is also having an important role of respiratory process. The upward & downward movement of diaphragm produces expiratory & inspiratory process of respiration where it touches to *Hrut kamalantaram*. Inhaled air travels through trachea reaches to the lungs where gaseous exchange takes place. A certain amount of blood is continuously being pumped out by *hrdaya* (heart) & *Phupphusa* (Lungs). This blood absorbs the *ambarpiyush* (O_2) from the air present inside & leaves off its waste CO_2 which is exhaled out.

Supporting *Acharya Sharangdhar* view the term “*Pranvahadve*” Prof. Ghanekar says that both the lungs situated on either side in the thorax, should be regarded. In this view the term “*Mulam Hrdayam*” signifies the pulmonary arteries originating from the heart & transverse towards the lungs. He also accounts the bronchioles branching out from both the bronchi. Thus the deoxygenated blood, brought by pulmonary arteries gets spread over the surface of the lungs & after getting oxygenated with the “*Pranavayu*” carried in by bronchioles the blood goes back into the heart through the pulmonary veins. This description concludes that the take up & carry of the “*Pranavayu*” are mainly conducted by lungs & its accessory channels.¹⁴

Rate of Respiration

Ayurvedic literature generally does not discuss the rate of respiration but other ancient literature provides a scientific calculation on the topic. *Pran* and *Pranayam* have been the topic of interest of the Upanishad, as the control of respiration may lead to the control of *manas*.

‘*Swasanamana*’ refers to a number of respirations per day. *Yoga Chudamani* counts twenty one thousand six hundred respirations (21600) per day. Converting this to hours & minutes, it becomes fifteen respirations per minute (15/ min). Although no particular range of volume is provided but *Yoga Sciences* describes measures of complete *Pranayam* as 12 *anguli*. Hence it is logical to take this as measure of depth of respiration considered in those days. *Shatpatha Brahmana* also describes the same as 15 respirations per minute.¹⁵

Regulation of Respiration

The basic control of breathing is governed by the activities of neurons of medulla & pons. The respiratory centers in the Medulla & Pons are sensitive to both excitatory & inhibitory stimuli. The Pneumotaxic center influences the activity of medullary inspiratory centre. The *Prana Vayu* stated at *murdha* (head) or brain control *swasa* (respiration) & other modification of it for eg *Ksavathu* (sneezing) etc activities. According to *Charaka Samhita* the increased & decreases number of *Swasana* (respiration) is found in the internal covering (*avarana*) of *Vayu Dosa*. Thus the *Prana Vayu* seated at *murdha* (brain) controls the *swasana karma* in life.

Health (*Swasthya*) belongs to the haemostatic interrelationship (*Dhatusamya*) in all the systems of the body. *Prana Vayu*

plays very important role in its maintenance. The word *Swasana* is derived from the root verb *swasjvane* with *ghanj* suffix meaning the life of air activity or business (activity). In fact the *swasana* is a well-known carrier of *Prana Vayu* (*Nabhista prana pawanah*) which is the key point of life & without the proper supply of air the O₂ cannot be absorbed by the blood.¹⁶

CONCLUSION

According to *Chandogyopanishad*, one of the most ancient *Upanishads*, a human being can survive without eyes, ears, legs etc. but he cannot do so without breathing and without food, for life derives on these two elements and completely depends on them. This is the vital energy (*prana*) or vital force within them. Lungs are the organs that help in this exchange of gases. The respiratory system is the channel that carries the gases along with the vital life force, known as the *Prana*. The ancient Ayurvedic scholars had clearly depicted the process of respiration in parlance of modern medical sciences. Maintenance of the respiratory tract is therefore very important. Problems in the respiratory tract can arise due to improper diet, seasonal changes, polluted air and lack of exercise. Respiratory health can be improved through controlled diet. Avoid fried food and, having light breakfast and dinner are the best ways to be followed. Drinking luke warm water helps to break chest congestion. Herbs like *pippali, guduchi, shati, pushkarmoola* etc are few of the lung supporting herbs. Warming the body through exercise is another way for maintaining respiratory health. Yoga, meditation and *pranayama*, in specific, cleanse

the respiratory tract; strengthen the lungs and supports healthy lung function.^{17, 18}

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Source of support: Nil
Conflict of interest: None Declared