AN INSIGHT OF PHYSIOLOGY OF RESPIRATION IN AYURVEDA
Aparna Sing1, OP Dadhich2

1PhD Scholar, Dept of Kriya Sharira, Faculty of Ayurveda, IMS, BHU
2Dean & HOD, PG Deptt of Sharira Kriya, 1,2National Institute of Ayurveda, Jaipur, India

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 5\(^{th}\) vertebra of the thorax in the mediastinam. 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 Pratyakshagamya. 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, dhatus, 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 Praspadanam - movements of the body, this is the function of Vyana. Udyahanam. - 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 Praspadanam - respiratory movements, Udavahanam - carrying doshas, dhatus and malas here and there, puranam. -filing the respective viscers with ahara – Rasa etc., vivekah.- segregation of essence (rasa) and excrement (urine and faces), dharanam. Maintenance of the mechanism of the body.

Agni is flamed and preserved in all ways by three types of Vayu - Prana, Apana, Samana, staying in their respective positions. 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). 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

Mulasthana (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 Hrdaya & 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. The organs described in Pranavaha Srotas according to Gangadhar Tikka are Hridaya & Vaksha . (Phusphusa i.e. lungs).

Chakrapani says the passage through which “Vayu” in terms of “Pran-
“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 Srotasas originating from Hridaya (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 “SVASAHAVINIS” 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* 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 mahaprabhina 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 a main role of Rakta in the formation of every organ of the body so it is creator of few important organs of the body.1, 2

*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 Hridaya is made up of Rasa, Rakta, Mamsa, Meda, Shukra etc. dhatus.

**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 kotha (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 membrane) 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 Pa
damrata (O2) 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 (O2) from the air present inside & leaves off its waste CO2 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.\textsuperscript{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.\textsuperscript{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 stationed 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 (Nabhistha 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 pip-pali, 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

REFERENCES

18. http://www.ayurvedaacademy.com/blogs/respiratory-health#sthash.33lzCb60.dpuf

CORRESPONDING AUTHOR
Dr. Aparna Sing
PhD Scholar, Dept of Kriya Sharira, Faculty of Ayurveda, IMS, BHU
National Institute of Ayurveda, Jaipur, India
Email: appisingh23@gmail.com

Source of support: Nil
Conflict of interest: None Declared