



Physiology of Respiration with Co-Relation of Ayurvedic Shwasan Kriya

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ABSTRACT

The Shvasankriya (respiration) comprises of two terms; Nishvas (inspiration) the act of breathing air within the body via nose and Uchvas (expiration), the act of breathing air outside the body through nose. The prana vayu is inspired by pranava srotas during inspiration. The inhaled prana vayu carries out the function like prinana, jivana and boosts jatharanala (activation of digestive fire, and oxidation process) (stimulation of digestive fire, and oxidation process). Respiratory system physiology is not clearly detailed in Brihattrayi (Charaka, Sushruta, Astanga Hridaya). The process of breathing, respiratory diseases has been mentioned in numerous Ayurvedic writings but its vivid depiction is not accessible as a complete. Description of diverse components of respiratory system organs and functions are found in description of pratyana sharir, srotas, kosthanga, prana vata, Udana vata, rakta dhatu, rasa dhatu and disorders of nasa, kantha, pranavaha srotas etc. In this article an effort has been made to grasp respiratory system functioning anatomy and physiology as it is presented in Ayurveda.

Keywords: Shwasan Kriya, Prana Vayu, Pranavaha Srotas, Nishvas, Uchvas.

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INTRODUCTION

Oxygen intake from the environment, transport to the tissues, and energy production by the cells in the tissues are all components of respiration. External respiration refers to the process of obtaining oxygen from the environment and delivering it to the body through the act of breathing. When it comes to Ayurveda's interpretation of the human condition, the process of breathing, or "inspiration" and "excretion," is seen as a key indicator of life. Prana vata and Udana vata are responsible for the physiological function of breathing, which is linked to Pranavaha srotas. In order to maintain life, external air (Prana vayu) must be brought into the body through the Pranavaha Srotas. Because it receives oxygen from the external environment via the respiratory tract, Pranavaha srota is considered a respiratory system in contrast to Sthula srota, which receives it through the digestive tract. It has been explained by Sharandhar that both exterior and internal respiration, i.e., ventilation and transportation of gases, take place. An organism's cells get energy at the cellular level via respiration, a metabolic process in which oxygen is combined. Respiratory physiology is described in Ayurvedic texts under Vata dosha, pathophysiology of Pranavahasrotas, Dhamani and Marma, and so on (1).

Shwasa prashwasprakriya:

According to Sharngadhara, the respiratory system's physiology is broken down as follows:

1. Oja and awareness reside in the heart, according to Sharngadhara. Nabhi (Umbilicus) is linked to arteries and veins that extend throughout the body and provide the tissues with oxygen (Sha. Pu. 5/47). The tissues' ability to transport and use oxygen is referred to here. It is probable that Sharandhar has taken this relationship into account of foetal circulation, since the foetus receives oxygen from its mother via the umbilical veins and arteries.
2. As soon as it touches the Hritakamalantar (heart-lung), Pranavayu comes out of the neck to receive Vishnupadamrita (oxygen) from the external environment, and after receiving Amberpiyush (oxygen) again, it returns to the body with speed (Sha. Pu. 5/48).
3. Ayu (life) is dependent on Vayu (air) and the body's ability to absorb and metabolise it, and the combination of Vayu and the body is crucial.

This explanation refers to description of internal respiration i.e., utilisation of oxygen by cells and release of energy to perform various cellular functions. To put it another way, this relates to how the lungs expel and take in oxygen and gas. (Sha.pu.5/48-49)

Pranavahasrotas have two primary organs: the heart and the intestines. In the case of *Pranavayu* being vitiated, it can manifest in various ways, such as an increase in the rate of expiration (*Atisrutham*), a decrease in the rate of expiration (*Atibaddham*), an increase and decrease in respiration rate (*kupitam Alpalpam*), and an increase and decrease in respiration depth (*kupitam Alpalpam*) (*Sashabda*). Physiological characteristics of respiration: Without the above-mentioned clinical signs, breathing is considered normal. According to the *Upanishad*, the precise number of typical human respirations may be found. Modern physiology likewise accepts the same 15-minute breathing rate (2).

Pranavaha srotas focus on the heart and digestive system. Violations of *Pranavayu* can cause a wide range of symptoms, including an increased rate of expiration, a decreased rate of expiration, an increased rate of respiration, a decreased rate of respiration, a frequent change in the rate of respiration, painful respiration, and respiration with an extraneous sound (3).

FUNCTIONAL ANATOMY OF THE RESPIRATORY SYSTEM

System: A person's respiratory system consists of many organs, the most prominent of which are the nose, nasal cavity, pharynx, larynx, windpipe, trachea, bronchi, and minor branches, as well as the lungs, which house the alveoli, or terminal air sacs. *Murdha* (head), *Nasik* (nose & nasal cavity), *Kantha* (trachea & larynx) & *Uras* were the same sites for breathing as mentioned in *Ayurveda* (thorax)(4).

Nose: The only externally visible part of the respiratory system, the nose lies in the middle of the cranium & mouth. It communicates with the pharynx from the back. Olfactory receptors / olfactory sense organ (*Ghranendriya*).

Pharynx: One of the most important parts of the pharynx is the passageway that links the nasal cavity to the larynx. A common route for air and food (via the Pharynx and the Trachea, the air canals) (through oesophagus).

Larynx: Between the pharynx and trachea, the larynx is located. A conduit for air and food, it serves the respiratory system and the oesophagus. In addition, it plays a critical part in the development of voice. During swallowing, the epiglottis seals up its intake.

Trachea: It is 10-12 cm long. There are two primary bronchii (bronchial tubes) in the middle thorax: the larynx and the trachea.

The bronchii: At the level of the fifth vertebra of the thorax in the mediastinum, the trachea is separated into two portions, the left and right bronchi. The morphology of the principal bronchi varies depending on the location of the lung. Each primary bronchus splits into secondary, tertiary, and terminal bronchioles and bronchioles after entering the lung, respectively.

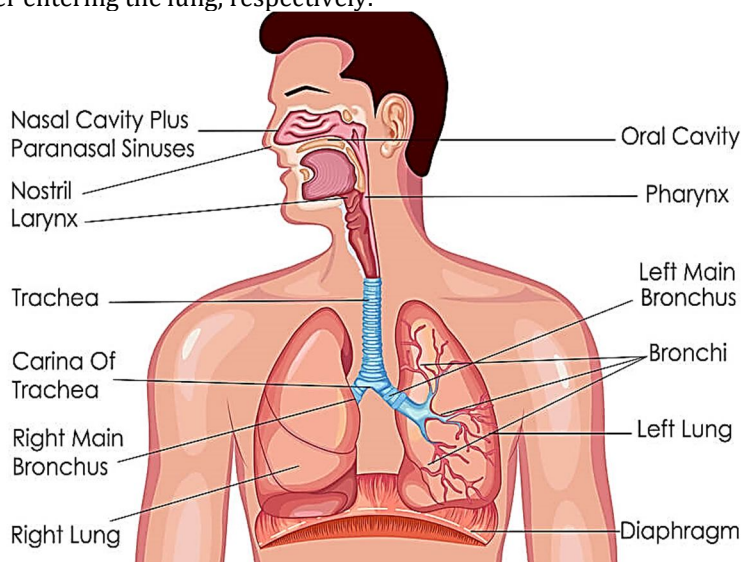


Fig: 1 Physiology of Respiration

The alveoli: The alveoli, which are the smallest of the bronchial cavities, are located in the alveolar sac in the lungs. Inhaled gases are exchanged directly in this part of the lung.

Lungs: Ayurveda defines the lungs as being formed from blood foam, but contemporary medicine sees them as two lungs on each side of the thoracic cavity's midline. In addition to the apex and base, the cones are characterised as having costal surfaces as well as the medial surface.

The pleura: Inhalation is made easier by pleural fluid, a lubricating secretion that lingers between the pleura's two layers and helps the lungs slide more smoothly during respiration. (5,6).

Prana Vayu

The five motions or functions of prana, or life energy, are known as the *prana vayus*. *Vayu*, or "wind," is a direct translation of the Sanskrit word. "*Pranavayu*," "*Apanavayu*," "*Samandavayu*," and "*Vyanavyana*" are the five *prana vayus*, respectively. A distinct part of the body is ruled by each. The body and mind benefit from their harmony, and we are able to reach our maximum potential when they are in perfect harmony. *Prana vayus* balance is achieved by the practise of *yoga asanas* (postures), *pranayamas* (breath control), and *shat kriyas*.

Swarupa of Prana Vayu:

Nature's *Vata* and the body's *Vata* are imperceptible, or *Pratyakshagamy*. Their creative output serves as a defining characteristic of their personas. *Prana Vayu* is critical to breathing.

Sites of Prana Vayu:

Both the upper and lower body are important. Sites of *Pranavayu* include the head, throat, mouth, tongue, nose, heart, mind, and intellect (7,8). *Pranas* of living creatures are stored in the umbilicus, and the umbilicus relies on *Pranas* to function. Similar to how the nave of a wheel is ringed by spokes, the umbilicus is surrounded with *Siras* (9). *Siras* are the primary seat of *Pranas*, which means that *Pranas* are dependent on *Siras*, as *Siras* circulate the *Prana* from the heart to the rest of the body and do the task of *Prana*.

Functions of Prana Vayu:

Vayu is defined by movement, transporting feeling upwards, filling the body with food (ingestion), segregation, and upholding. *Vayu* supports the body in this way. The inherent characteristics and functions of *doshas*, *dhatu*s, *malas*, and other *ayurvedic* substances, such as these, should be studied in order to determine balance, decrease, and increase. *Vyana's* role is to do *Praspananam*, or bodily motions. *Udvahanam* - *Udana's* role is to convey sensation up, and this is what he does. *Prana's* role is to fill the stomach with food; *Vivekah* is the opposite of *Puranam*. *Vayu* is classified into five types: *Prana*, *Udana*, *Samana Vyana*, and *Apana*. The other hand views *Vayu's* duties such as *Praspananam* - motions of breathing - and *Udvahanam* - moving *doshas*, *dhatu*s, and *malas* about - *puranam* - as universal. File the viscera with *Ahara* (*Rhasa*, etc.) and look at it. *Rasa* and faeces (urine and faces) are separated, *dharanam*. Maintenance of the body's internal systems (10,11).

Prana, *Apana*, and *Samana*, the three *Vayu* kinds, all remain in their rightful locations to keep *Agni* flaming and stable. Mental processes such as *dhi* (selection of good and evil), *dhriti* (courage) and *smriti* (introspection) are necessary to sustain the appropriate functioning of *Buddhi* (intelligence), heart, mind, and sensory organs (memory). Inspiration and deglutition are two of the most significant activities of *Prana* in determining which sensory and motor functions are. External *Prana* (air and food) and *Prana* activity (external to internal) flow in the same direction (12).

Asthma may develop if these inward motions are impeded. The functions of spitting, sneezing, and belching are less significant. It is via *Pranavaha Srotas* that *Pranavayu* is circulated and *Pranashakti* is also delivered through *Pranava Srotas*. In the order of precedence, the *Pranavahas* are first in the list of *Srotas*. *Pranavaha Srotas* are the first of the interior opening *Srotas* described. *Pranavaha Srotas* have a greater physiological significance than other *Srotas*, hence they are detailed first. The *Pranavaha Srotas* are responsible for transporting the vital life force known as *Prana*. *Prana* is the external air that is inhaled via the nose, and it animates the body. Man will perish if this *Vayu* is disturbed or broken. That's why *Prana Vayu* was coined (13).

Mechanism of shvas kriya in ayurvedic science:

In *Ayurvedic* and *Sanskrit* Literature, descriptions of respiration's physiology are present. When stated in the *Yajurveda*, air is referred to in the form of both *Prana* and *Apane* as it enters the *Naasika*. *Udana* has been referred to as *Apana* on occasion.

Prana (PRA) + Apana (ANA) - going in Udana (UDA) + Apana (ANA) -going out.

Respiration, or *Shwasa Kriya*, is a continuous process that begins at conception and ends at death. There are two stages to this process: *Nishwasa* (Inspiration) and *Uchawasa* (Expiration). Alveoli are filled with *Prana Vayu* (atmospheric air) once it enters via nasal passageways and is driven out of the body through the same *Srotas* that brought it in. *Prana Vayu* for *Nishwasa* and *Udana Vayu* for *Uchawasa* play a major role in this procedure. *Sleshmika kala* (mucous membrane) is lined from the nose to the *Vayu koshas* and secretes a modest quantity of *Kapha* (thick fluid) at all times. One of *Kapha's* best attributes, *Awalambaka*

Kapha, assists in retaining *Aadra* (moisture) and also confers *Bala* (strength) (strength). Airborne contaminants are kept at bay by the material's ability to trap them (14).

It is via the *Purvakhanda* that *Acharya Sharangdhar* explains in detail the physiological process of normal breathing, which he defines as the whole process of normal breathing from organ transfer all the way to cell transport. It is his belief that the *Prana Vayu* (life force) is located in the *Nabhi Pradesha* (centre of the body) and that it comes out of the neck, touches the lotus-like heart, and then enters back violently. (Sha. pu 5/89-99).

According to this, *nabhi* (the umbilical area) is where this breathing begins, and abdominal muscles aid in the process. Breathing relies on the diaphragm, which plays a vital part in the process. When the diaphragm moves up and down, it causes the exhalation and inhalation processes of breathing to occur. Air that is inhaled enters the trachea and goes to the lungs, where gas exchange occurs. *Hrdaya* and *Phupphusa* (the heart and lungs) are constantly pumping blood out of your body (Lungs). The *ambarpiyush* (O₂) contained in the air is absorbed by this blood, and the CO₂ it produces is breathed out (15).

Prof. *Ghanekar* agrees with *Acharya Sharangdhar* interpretation of the word "*Pranvahadve*," which refers to the two lungs on each side of the chest. "*Mulam Hridayam*" refers to the pulmonary arteries that originate in the heart and go into the lungs. It's also worth noting that both the bronchi and bronchioles have their own branches. As a result, deoxygenated blood from the heart is returned to the lungs through the pulmonary veins, where it is oxygenated by "*Pranavayu*" delivered in by the lungs' bronchioles. According to this definition, most of the "*Pranavayu*" is taken up and carried via the lungs and its accompanying pathways (16).

Steps of Respiration

The Respiration includes four major steps: Ventilation, Transport of gases, Pulmonary diffusion and Tissue respiration.

Ventilation: It is the flow of air via these conduits between the atmosphere and the lungs that constitutes breathing. In order to move air, the diaphragm and thoracic muscles contract, resulting in pressure gradients. Breathing is a popular term for pulmonary ventilation. During inspiration (inhalation), air enters the lungs, and during expiration, air exits the lungs (exhalation). There is a difference in air pressure between outside the lungs and within. Other gases move in the same way: from a place with a lot of pressure to a lower-pressure zone. Ventilation is a consequence of pressure changes caused by muscular breathing and elastic tissue rebound (17). Pulmonary ventilation involves three different pressures:

- Atmospheric pressure
- Intraalveolar (intrapulmonary) pressure
- Intrapleural pressure

It is the external pressure of air that exerts a force on the human body, which is called atmospheric pressure. The pressure in the alveoli of the lungs is known as intraalveolar pressure. The pressure inside the pleural cavity is known as intrapleural pressure. Pulmonary ventilation is dependent on these three pressures (18).

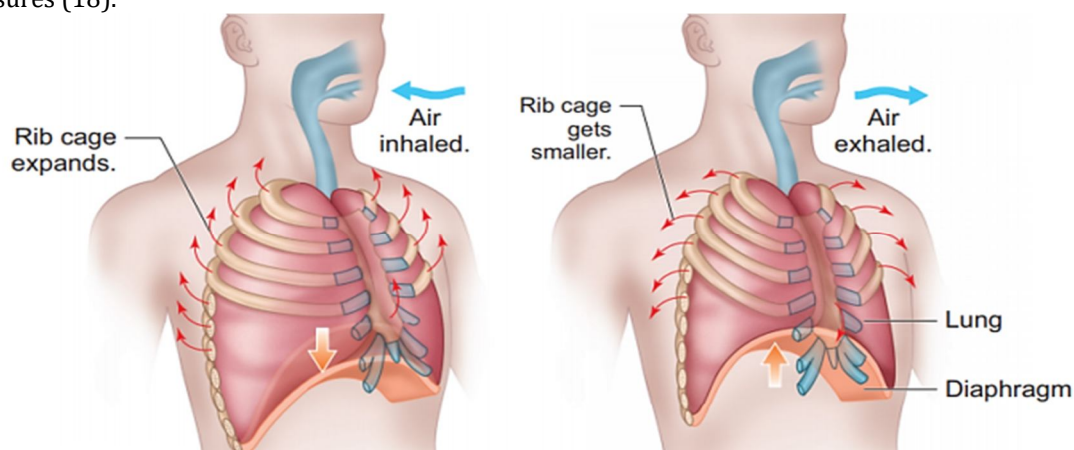


Fig: 2 Mechanics of Ventilation

Inspiration

According to this, *Pranavayu's* umbilicus is located there. *Sharangdhara* emphasises *Pranavayu's* position in the heart when defining the five varieties of vatadosha. "*Amber*" means the sky, whereas "*piyusa*"

means honey or milk in the dictionary. A human may survive on nectar or milk. "*Ambarpiyusha*" means "nectar coming from the sky." In this context, "*ambarpiyusha* (oxygen derived from the environment)" makes sense (19).

The umbilicus is *Nabhi*. Through this umbilical cord that connects the umbilical artery to the placenta, a baby's blood supply is supplied with nourishment and oxygen by the mother's blood. According to *Ayurveda*, the umbilicus is the point of genesis for all vessels conveying various substances. *Prana* is only one of many issues. Diaphragm and abdominal muscles have a role in ventilation via the use of the term *Nabhi* (umbilicus).

There are both thoracic and abdominal motions that may be seen via the movement of the umbilicus. The umbilicus may be referenced for this purpose as well. Besides *Hrutkamalantaram*, the diaphragm plays an essential part in the respiratory process (Between lungs and heart). It is a sign of alveolar gas exchange. Air that is inhaled enters the trachea and goes to the lungs, where gas exchange occurs. He or she is pumping a particular quantity of blood out of *Hrdaya* (the heart) and *Phupphusa* (the arteries) (Lungs). The *ambarpiyush* (oxygen) contained in the air is absorbed by this blood, which then exhales out its waste (carbon dioxide) (20).

Expiration

According to the Ayurveda tradition, Ayurveda scholars noted the upward movement of exhalation from the moving umbilicus toward the neck (pharynx and nose) and termed it as *Pranavayu* enduring umbilicus, which reaches the inside of the heart and exits via the neck (pharynx). As a result, it returns to the body with a burst of energy known as "*ambarpiusa*." A healthy digestive system and a fresh physique are the results of ingesting this "*ambarpiyusa*" (body freshener). The conventional interpretation is that this passage speaks of the end and the beginning of a new life. Compendia are better understood by their commenters. The Sharangdhar samhita's words come closer to the *Yoga* philosophy after reading the commentary on these passages (21).

Transportation of gases:

The phrase '*Spristvahritakamalantaram*' refers to the gaseous exchange between the alveoli and the kanta, after which the unclean air is expelled (throat, nasopharynx). As the *Amberpiyush* term for oxygen is employed here, the word '*Hritakamalantar*' might be considered a synonym for lungs. *Vayu* travels throughout the body. Blood is the conduit for the movement of gases. Gases are taken into the bloodstream at the umbilical level and then circulated throughout the body through arteries, where they combine with all of the tissues (22).

A network of vessels and conduits connecting the umbilicus to the rest of the body pushes gases throughout the body. Blood in a living human circulates with oxygenated blood, which is responsible for the strength, colour, and happiness of the body (23). These allusions imply that gas is being forced throughout the body's vessels. Ancient compendia do not have this information.

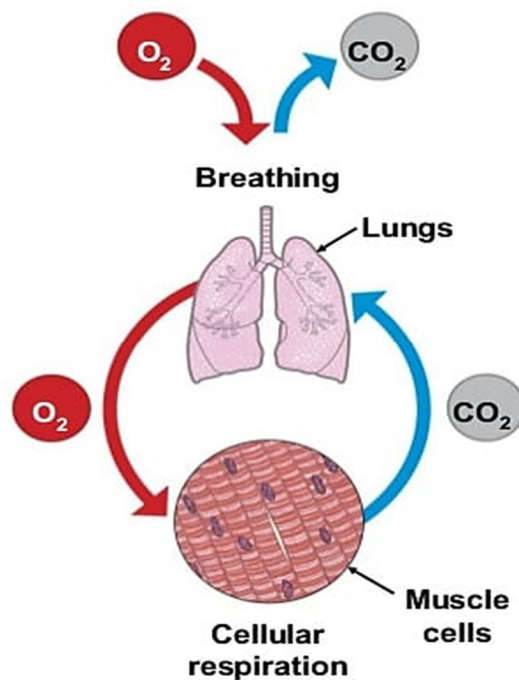


Fig:3 Exchange of gases

Pulmonary diffusion:

The principal locations of gas exchange in the body are the alveoli. The exchange of gases between blood and tissues is another occurrence. These locations primarily use pressure/concentration gradients to exchange O_2 and CO_2 . Additionally, the solubility as well as the thickness of the membranes engaged in diffusion might have an impact on the rate of diffusion. In a combination of gases, the pressure that each individual gas contributes is known as partial pressure (pO_2 for oxygen and pCO_2 for carbon dioxide) (24).

In the opposite way, from tissues to blood and from blood to alveoli, there is a gradient of CO_2 . When compared to O_2 , which has a solubility 20-25 times lower than CO_2 , substantially more CO_2 is capable of diffusing across a diffusion membrane per unit variation in partial pressure. Alveolar capillaries have an endothelium made up of single layer endothelial cells and a thin foundation membrane that supports the squamous epithelium. The basement membrane also surrounds the single layer endothelial cells of the alveolar capillaries. Its entire thickness, on the other hand, is much less than a millimetre. In other words, everything in our body is set up so that oxygen (O_2) and carbon dioxide (CO_2) may easily go from alveoli to tissues and back again (25).

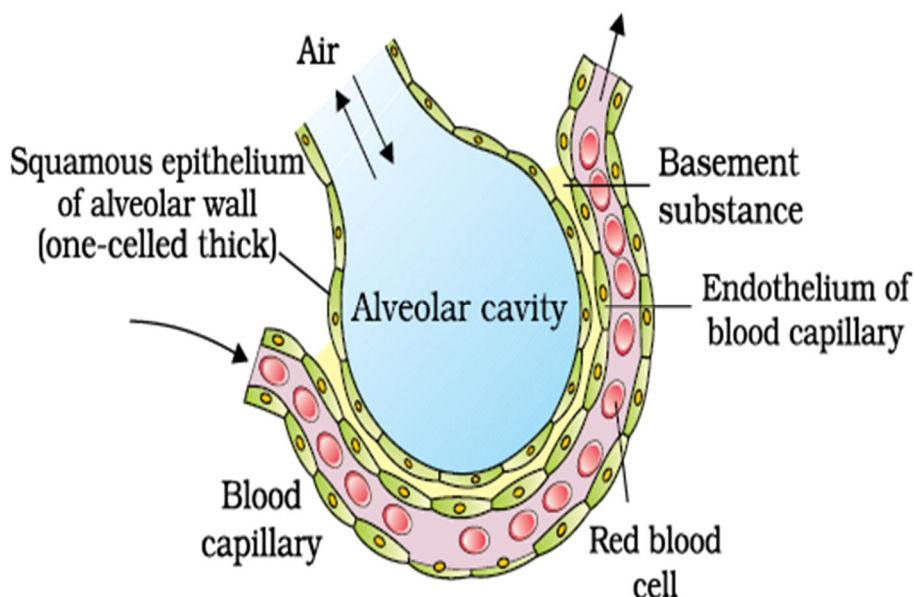


Fig:4 A Diagram of a section of an alveolus with a pulmonary capillary.

Tissue respiration:

An organism's cells perform cellular respiration, a collection of metabolic activities and processes that transform chemical energy from oxygen molecules into ATP, and subsequently release the waste products. Oxygen and other high-energy bonds are replaced by stronger bonds in the products of catabolic processes, which break big molecules into smaller ones and release energy. Cellular respiration is a major source of chemical energy for cellular processes. A sequence of redox reactions take place as part of the overall process. Even while cellular respiration is essentially a combustion process, its gradual, regulated release of energy in a live cell makes it distinct from one (26).

In oxidative metabolism, cells use the oxygen they get from capillary blood; at the same time, they release carbon dioxide back into the capillary blood. While many biochemistry textbooks describe "tissue respiration" as the breakdown of nutrients with the help of molecular oxygen, here "tissue respiration" is used in a wider meaning. In order to better understand these responses, we will focus on concerns about the supply of oxygen to the tissues, rather than CO_2 removal(27).

(a) In body tissue

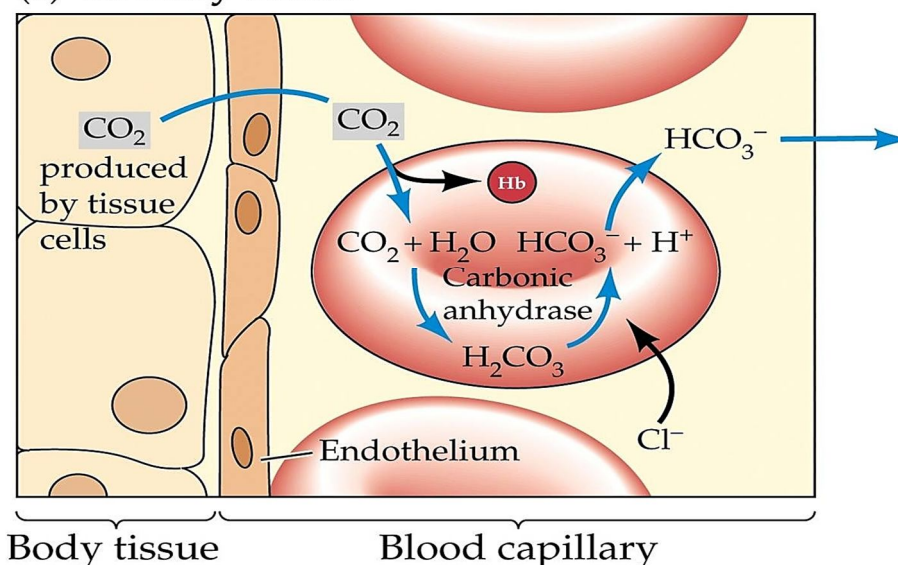


Fig:5 Tissue respiration

CONCLUSION

Pranavyu has *asharya* of *panchmahabhoota*, which sets it apart from other pranas. As it merely specifies the placenta's involvement in the foetal circulation, the *brahamarandra* (the centre of the brain) is located at the nabhi (umbilicus), supported by 24 spokes of the wheel. *Trupti* and *Geetadi*, the higher mental activities, are supported by the brain's *brahamarandra* (cognitive centre). the relationship between respiration and its anatomical location in the heart and lungs was identified. O₂ is absorbed by the brahamarandra, the brain's centre of intelligence, and the fluid provides food to brain cells. It is apparent that the respiration process requires the dissolution of a component. Two distinct terms are used to describe the relationship between the root (*brahamar*) and the *avayava* (*pachakagni* and *jeevana*). Secondary mitochondrial respiration or cellular respiration is what the *deh anilakarma* has adopted for respiration.

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