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Review Article

# APPLIED ANATOMY OF *PRANVAHSROTAS* W.S.R TO CARDIOPULMONARY SYSTEM

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**ABSTRACT**

*Srotas* are the channel in the body through which various substances pass from one place to another. There are an infinite number of *Srotas* present in the body. All the physiological and pathological processes conducted in the body are dependent on *Srotas*. *Pranvahasrotas* are the most important *Srotas* in the body which is the pathway for *Pranswaropivayu* or we can say oxygen. *Pranvahasrotas* transport oxygen to all over the body and our life is dependent on oxygen. Like *Pranvahsrotas*, in contemporary science cardiopulmonary system transport oxygen. *Pranavaha Srotas* has its two *Moolsthan* from where it is regulated. Cardiopulmonary system is consists of two interdependent system. One is Respiratory System which is involved in transfer of oxygen to blood and make it oxygenated and cardiovascular system is responsible to carry it all over the body. Since heart and its entities and lungs are the principal organ of the cardiopulmonary system. Function, sign and symptoms of *Pranvahasrotas* and cardiopulmonary system has many similarities. Objective of the study is comprehensive study of anatomical feature of *Pranvahsrotasmool* in Ayurved to cardiopulmonary system in contemporary science.

**KEYWORDS:** *Pranvahsrotas, Hriday, Mahasrotas,* Cardiopulmonary system.

## INTRODUCTION

Ayurveda is ancient sciences, which explain that *Sharir* is made up of innumerable *Srotas*. *Srotas* are the structure present in the body which play important role in transportation of the essential elements. *Srotas* are the channel present in the body to convey body elements from one place to another place. *Srotas* is derived from Sanskrit root *"Srugatau" dhatu* means oozing, flowing, permeate etc *"Sravnatsrotansi".*[1] The structure through which *Sarana Karma* that is flowing, moving, oozing and permeation takes place those channels are known as *Srotas*. By these channels conduction of respective elements to their respective destination can be possible. *"Srotamsi Khalu Parinampadhyamananam Dhatunam Abhivahinibhavyantaya Ayanarthen".*[2] Those channels play an important role in carrying *Dhatus* which are undergoing transformation. These channels involve in the uninterrupted and unidirectional process in making successive *Dhatus*. *Srotas* are involved in many physiological and pathological processes in the body. Stagnation in *Srotas* leads to manifestation of diseases.

There are 11 pairs of *Yogvahisrotas* according to Acharya Sushrut[3] and according to Acharya Charak there are 13 pair of *Sthool Srotas*[4]. *Pranavaha srotas* is the main *Srotas* among all these *Srotas Pranavahasrotas* is a type of *Srotas* which carry *Pran* that's why it is called *Pranvahasrotas*. Vital air or vital energy is responsible for each and every activity of the living body. Cardiopulmonary system and *Pranvahasrotas* are similar in oxygen carrying function; they are also similar in many points of view. Most of the *Laxan* describe in *Dushti* of *Pranvahasrotas* are indirectly related to diseases of cardiopulmonary system. A person who is not able to do this *Swasan Kriya* naturally will be shifted on ventilator machine by which supportive artificial respiration given to patient to sustain life, this is the example how *Pranvahsrotas* is important in human body.

## MATERIAL AND METHOD

Available literature collected regarding *Pranavharotas* and its *Vikriti* from Ayurvedic classical books like *Charaksamhita*, *Sushrut Samhita*, *Astanghriday*, *Kashyapsamhita*, *Sharangdhar*, etc and other Ayurvedic text books also. Modern literature on cardiopulmonary system and its diseases collected from the textbook and practical manual of anatomy and other clinical textbooks. Anatomical position of organ studied from cadaver present in SGT dissection hall as well as from preserved organ present in department. Little information was collected from Pubmed, Google. Normal physiology and function of heart could be assessing by diagnostic method (ECHO), ECG etc.

### *Pranvaha Srotas*

*Pranvahasrotas* is most important *Srotas* among all the *Srotas* because it carries *Pran* or *Pranvayu* which is important for life. In Ayurved *Dash Pranayatan* are where *Pran* resides, *Sankhau, Marmatrayam, (Hriday, Basti, Nabhi) Guda, Shukra, Oja, Rakta.*[5]

**Place of *Pranvata*:** *Sthan* of *Pran* are *Murdha* or *Sirhapradesh*, *Urah* (*Vakshasthal* place of heart and lungs), *Kantha*, *Jihvanasika* and spitting, sneezing, burping, *Swas* (respiration), intake of *Aahar* are function of *Pranvat*.[6]

**Importance of *Pranvat*:** According to Acharya Charak "*Vayustantrayantradhar*" means *Vayu* embraces soul, body and organ.[7] *Swaskriya* depend on *Pranvayu* or oxygen[8]. *Vayu* is strength of body, *Vayu* is life *Vayu* is health.[9]

### *Mool* of *Pranvaha Srotas*

According to Acharya Sushrut two Mool are *Hriday* and *Rasvahinidhamni.*[10] According to Acharya Charak, *Hriday* and *Mahasrotas* are two *Mool* of *Pranvah Srotas*.[11] First of all we have to understand *Moolsthan* of *Pranvahsrotas* because diseases developed due to vitiation of *Srotas* are expressed in the place of *Moolsthan*.

**Causes of *Pranvahasrotas* vitiation [12]**

*Dhatukshay*- depletion of tissue
*Sandharanat*- withholding of natural urges
*Roukshyat*- consumption of dry food
*Kshuditasya*- excessive exercise during starvation
*Vyayamat*- strenuous exercise

**Symptoms of *Pranvahasrotas* Injury[13]**

*Akrosh*- Screaming/anger
*Vinaman*- Bending of body
*Mohan* - Unconsciousness
*Bhram* - Dizziness
*Vepanan*- Palpitation
*Marnam* - Death

**Symptoms of *Pranvahasrotas* Vitiation[14]**

*Atishrustamswas* - too long breathing
*Atibaddhamswas* - obstructive breathing
*Kupitswas* - difficult breathing
*Alpaalpamswas* - Cheyne- stroke respiration
*Abheekshanamswas* - frequent breathing
*Sasabdswas*- breathing with abnormal sound
Sashoolaswas - painful breathing

**Treatment of *Pranvahsrotas*[15]**

Management of *Pranvahsrotas* vitiation is on the line of treatment of *Swasrog* (breathing disorder*), Hridayrog* (heart disease), and *Kas* (cough).

### *Hriday*

*Hriday* is one of the *Moolsthan* of *Pranvahsrotas* and it is the seat of Pran.[16] *Hriday* is the main place of *Pran* among all the *Pranayatan*. *Mahat* and *Arth* is synonyms of *Hriday*, ten major *Dhamni* are attached to it.[17] In *Bhelsamhita* chapter 20 explain *Artha* related to *Hriday* and number of *Dhamni* are ten.[18] Aacharya Charak consider *Hriday* as axial of wheel because *Dash Dhamni*, *Pran*, a *Apan*, *Buddhi* (intellect), *Chetana* (consciousness) and *Mahabhut* are oriented around *Hriday* like spokes of wheel.[19] At the time of development of embryo *Hriday* is developed from *Rakta* (blood )and portion of *Kapha sar*.[20] *Hriday* is situated between two Stan in thoracic region, injury to that place leads to death.[21] *Hriday* is like flower of lotus facing downward. At the time of awaken it is open and work fastly and at sleeping position it is closed and works slowly.[22] Dimension of *Hriday* is approximately size of fist.[23] *Hriday* is included in *Sadhyapranharmarma* and in *Siramarma*, *Marma* places are seat of *Pran* by nature.[24]

### *Hridrog* Causes and pathophysiology[25]

*Dukha* (grief), *Upwas* (starvation*), Vyayam* (exercise), *Ruksha- bhojan*, *Alpa bhojan* (consumption of food in small amounts), excessive alcohol intake and anger (emotional factor) are also causes of *Hridrog*. *Vat Dosha* increases, Due to above mentioned causes and then reached in heart and develop severe pain.

### *Laxsan* of *Hridayrog*[26]

The following are the *Laxsan* of *Hridayrog: Vepathu* (palpitation), *Veshtan*, *Stambh* (obstruction in heart rate), *Pramoh* (unconsciousness), *Shunyata* (lightheadedness), *Darh* (murmur sounds), *Trishna* (thirst or dry mouth), *Bhram* (dizziness), *Swed* (sweating).

### *Laxsan* of *Hridayaghat* [27]

*Kaas* (cough)*, Swas* (breathlessness), *Bal kshay* (fatigue), *Kanthashosh* (dryness in throat), *Klomakarshan* (pulling pressure on *Kloma*), *Mukhtalushosh* (dryness in mouth and palate) *Pralap (*irrelevant talk)*, Sangyanash* (unconsciousness).

### *Rasvahi Dhamni*

*Rasvahidhamni* are one of the *Mool* of *Pranvahsrotas* as considered by Acharya Sushruta. *Dhamni* which carry *Ras* is named as *Rasvahidhamni= Ras+dhamni. Ras* word is derived from *"Rasgatoudhatu*" continuously flowing element in body known as *Ras*.[28]

*Purush* are supposed to originated by *Ras* hence person should save *Ras* from vitiation with follow proper diet and *Aacharpalan* (code of conduct given in *Samhita*).[29] *Ras* converted in *Uttrotardhatu*.

According to Acharya charak "*Dhamnaddamniha"* he clearly mentioned that the channel carries related content with "*Dhamn*"(pulsation) has been named as *Dhamni*[30] *Dash dhamani* are situated in heart, *Mhat* is synonym of heart that's why named *Mahamoola.*

***Mahasrotas***

It is one of the *Moolsthan* of *Pranvahasrotas* according to Acharya Charak. *Mahasrotas* indicate a large structure or tube which is large in diameter. According to Acharya Charak *Mahasrotas* is synonym of *Kostha*, *Sharirmadhya*, *Mahanimna*, *Pakvashay*. According to Acharya Sushruta *Mashya*, *Agnyshya*, *Hriday*, *Unduka*, *Phupusa* are included in *Kostha*.[31] *Mahasrotas* can be a large structure.

***Phuppusa***

According to Acharya Sushrut "*Shonitphen prabhavphupusa" Phupusa* (lungs) originated from *fen* (foam) of *Shonhit* (blood). Foam has air in between bubble hence lungs look like cluster of bubble and *Phupusa* situated on the left side of *Hriday* and *Kloma* on the right side in *Vakshasthal* (thoracic cavity).[32]

***Phupusa Rog***

In Ayurveda as named *Phupusa Rog* is not described anywhere but there are many diseases where involvement of *Phupusa* or *Vakshasthala or Urah* (thoracic cavity) described in pathophysiology of *Pranvahsrotas* that is *Swas Rog* which is fatal, *Kas rog*, *Parshvshool*, *Rajayakshma*, *Kshatsheena*. All they are *Pranvahsrotas* disease, so we can consider those diseases as *Rog* of *Phupusa* because without involvement of *Phupusa* those disease would not occur.[33]

**In Modern**

Cardiopulmonary system consists of two systems one is cardiovascular system and other is pulmonary system. Cardiovascular system transport the blood to the whole body part and pulmonary system exchange gases between environment and body, intake of oxygen occurs and waste product carbon dioxide expelled out of the body. Both systems are interdependent because they help each other to transport oxygen throughout the body. Pathogenesis of one system leads to vitiation of another system.

**CARDIOVASCULAR SYSTEM**

Cardiovascular system is the transport system of the body. It transports blood which is the essential component of the human body. The cardiovascular system consists of heart, blood and blood vessels. Pulmonary circulation is also included in this system. The pulmonary circulation is a "loop" through the lungs where blood is oxygenated and the systemic circulation is a "loop" through heart providing oxygenated blood to the rest of the body.

**Heart**

The heart is a conical hollow muscular organ situated in the middle mediastinum. It is enclosed within pericardium. The pericardium is a fibroserous sac which encloses the heart and the route of the great vessels.

**Position and Size of Heart**

The heart is located in the chest between the lungs behind the sternum and above the diaphragm it is located in thoracic compartment called the mediastinum. Mediastinum most important content is the heart enclosed in the pericardium in the middle part of the inferior mediastinum on the middle mediastinum. Heart is approximately size of the men's fist. Weighing about 230 to 250gm and its shape like an inverted cone, it is about 12cm long 9cm broad and about 6cm thick. Its weight varies from 280 to 340g (average 300g) in males and from 230 to 280g (average 250g) in females. Cardiac weight is 0.45% of bodyweight in males and 0.40% in females. The heart reaches 50% of its adult dimensions at birth, 75% by 5 years and 90% by 12 years.[34]

**External feature of the Heart**[35]

**Apex:** The heart has an Apex directed downward forward and to the end is overlapped by the anterior border of the left lung it is situated in the left 5$^{th}$ intercostal space, 9cm lateral to the midsternal line just medial to the midclavicular line.

**Base:** It is formed mainly by the left Atrium and by a small part of right Atrium. Opening of the four pulmonary veins into the left Atrium and the superior and inferior Vena cava open into the right Atrium.

**Border of the Heart:** It has 4 borders, Upper border, Right border, Inferior border and Left border.

**Surface of the Heart:** The anterior or sternocostal surface is formed mainly by right Atrium and right ventricle and partially by left ventricle and left auricle. The inferior surface rests on the diaphragm. Heart has four chambers they are right atrium, right ventricle, left atrium, left ventricle.

**Valves and Artery**

Atrio ventricular valves are approximately 2.5cm in diameter. It is surrounded by a fibrous ring. They are 2 in number, as named Tricuspid valve on right and Bicuspid valve on left. The aortic and pulmonary valves are called semilunar valves because their cusps are semilunar in shape both valves are similar to each other. The heart is supplied by two coronary arteries. They arise from two of the three sinuses at the root of the ascending aorta. Both arteries run in the coronary sulcus.[36]

**Blood vessel**[37]

Arteries, veins and capillaries are the blood vessels which carry blood and nutrients, oxygen, hormones etc. in the human body. Arteries are the blood vessel that delivers oxygen rich blood from the heart to the tissue of the body and vein carry deoxygenated blood from all the body part to the heart except Pulmonary vein. Each artery is a muscular tube lined by smooth tissue and has three layers. That is Intima, Tunica media, Adventitia

**Blood**[38]

It is a specialized body fluid. It has four main components are Plasma, Red blood cells (RBC), White blood cells (WBC), and Platelets. Plasma is Straw coloured liquid part of blood which carry the remarkable solution containing an immense number of ions and organic molecules like nutrients, antibodies, protein, water, salt and other essential components.

**Disease of Cardiovascular System**

Heart disease may be develop due to infection or congenital or structural deformity lead to profound reduction of oxygen supply due to acute circulatory failure, low cardiac output leads to clinical symptom like Chest pain, Orthopnea, Fatigue, Syncope, Palpitation and Sign Anaemia, Pyrexia, Clubbing, Oedema, Raised Jugular venous pressure, Blood pressure, Murmurs, Rhythm disorder are present in cardiac disease like left heart failure, Pericarditis, Myocardial infarction, Angina pectoris, Mitral Stenosis, Congestive heart failure, Atherosclerosis.[39]

**Respiratory System**

The lungs are a pair of respiratory organs situated in the thoracic cavity. Each lung invaginate the corresponding pleural cavity. The right and left lung are separated by the mediastinum. The lungs occupying major portion of the thoracic cavity leave little space for the heart. The two lungs hold the heart tight between them. The right lung weighs about 700gram it is about 50 to 100 gram heavier than the left lung. Each lung is conical in shape. It has an Apex at the upper end and a base resting on the diaphragm. Lungs have three borders and two surfaces, posterior border extend from C7 spine to T10 spine. Lungs contain 300 to 500 million alveoli and this respiratory tract is long as they branched and convert into microscopic structure together lung contain approx 2400km of airways. In lung diseases various sign and symptom seen like Pyrexia, Dyspnoea, Tachypnea, Cyanosis, abnormal breath sound, sign of heart failure.[40]

**DISCUSSION**

*Hriday* is located in the *Vakshasthala* between *Klom* and *Phupusa*, like heart which is present between lungs. Its shape is like flower of lotus facing downward and size of heart is approximately *Swapanital* means approx the size of fist as described in modern and located in mediastinal region between two lungs. Acharya Shusrut has mentioned in chapter 4 that it is open in awaken stage and closed during sleep like flower of lotus, it shows that contraction and relaxation process of heart. With the help of contraction and relaxation process heart pump the blood throughout the body via arteries.

If any impairment of conduction occurs, it leads to ventricular fibrillation which causes impairment of contraction and relaxation process of heart leads to cardiac failure and death of a person occurs. Acharya Charak has mentioned in chapter 13 synonyms of heart is *Mahat* and *Arth*, due to this alignment of blood vessel to heart hence known as *Mahamool*, Vessel are ten in number those are, superior vena cava, Inferior vena cava, 4 pulmonary veins, 2 Pulmonary artery, 2 Coronary artery. All vessels and *Pranvahsrotas* are aligned with heart like spokes of wheel. Acharya Charak included it in *Dash Pranayatan* and *Hriday* is the main place where *Prana* is situated. Heart diseases like cardiac failure, coronary artery disease etc shows their sign and symptom like *Hridrog* and it is fatal if untreated. *Hriday* is one of the 10 *Pranayatan* where life resides by nature.

*Rasvahdhamni* are one of the *Mool* of *Pranvahsrotas* and blood vessels are one of the components of the cardiovascular system. These blood vessels carry blood to and from the heart. Acharya Charak mentioned in *Sutrasthan* that channel which carries *Dhatu* with *Dhamn* means pulsation, has been named as *Dhamni*. Sushrut stated that *Rakta* is life; one should save blood with all the efforts. A famous slogan is “save blood save life”. *Ras* undergoes the uninterrupted process in making successive *Dhatu* one by one. Oxygen cannot be transported without RBC which is present in blood. Heart has to make more effort in anaemic patients to compensate for lack of oxygen as there is a deficiency of Haemoglobin in the blood. *Rakta* is the main *Poshakdhatu* which nourishes all the body tissue. *Hriday* is the *Sthan* of *Das Dhamni* which carries blood, oxygen, *Oja* throughout the body and nourish all the tissues. So we can say *Rasvahdhamni* in context of *Pranvahsrotas* is *Raktavahdhamni* which carry oxygen.

*Mahasrotas* means a large path, many commentators have their own line of thinking but we can consider lungs as *Mahasrotas* in view of Acharya

Charak. As together lungs contain approx 2,400km of airways and 300 to 500 million of alveoli Respiratory system include lungs it is started from nose, mouth, pharynx, larynx, trachea, bronchus it is divided further into bronchioles to alveoli which is air filled sac responsible for gaseous exchange in *Vakshsthal*. In Ayurveda, *Phupusa* is "*Shonitphenprabhav*" originated from foam of blood and in contemporary science lungs is spongy in texture. We cannot imagine respiration without lungs.

*Sharangdhar* explain *Swaskriya Pranpavan* situated in *Nabhi* touched *Hritkamlantar*, comes out through trachea takes oxygen and goes inside with force and mixes with blood and nourish all the body tissue. Same explanation found in contemporary science, oxygen enters in lungs via nose, mouth, trachea and bronchi to the alveolar sac and diffusion of gases occur via alveolar membrane present in lungs. Then transport of gases by the blood occurs and then diffusion of oxygen and carbon dioxide take place between blood and tissue after that oxygen utilized by the cell for catabolic reaction and resulting release of carbon dioxide and then carried by blood to the heart via veins.

**Disease of Cardiopulmonary System and Disease of *Pranvahsrotas***

*Swas Rog* can be correlated with bronchial asthma. Bronchial asthma is an inflammatory disease of the small airways characterized by episode of reversible bronchial obstruction due to inflammation of airways. Inspiratory wheeze heard in severe broncho constriction.

*Kaas rog* can correlated with Cough, it is a reflex act of forceful expiration against the closed glottis that help in clearing the airways including foreign body independently it is a disease of lungs but as a symptoms it can seen in cardiac asthma, and in many other pulmonary diseases (Bronchial asthma bronchiectasis pneumonia etc).

*Rajayakshma* can be correlated with Tuberculosis. It is a pulmonary and systemic disease caused by mycobacterium tuberculi characterized by fever, fretfulness, anorexia, cough and wheeze. Depletion of tissue or *Kshay* and weight loss are common signs.

*Hrishool* Pain in heart due to any causes is known as *Hrishool*. It is seen in Angina pectoris. Pain in Myocardial infarction is similar to angina it is of a spontaneous origin but lasting for more than 30 minutes but intensity is very serious it is not relieved by rest patient become restless.

*Hriday Rog* Descriptive study of *Hriday rog* is not found in Ayurveda but in *Charak Sutra Sthan 17*, *Chikitsa Sthan* 26 and *Siddhi Sthan* 9 we can find descriptions of the *Hriday rog*. *Hriday rog* (heart) and *Pranvahsrotas* rog has Common symptoms:-

***Vepathu***- Palpitations are found in aortic regurgitation, patent ductus arteriosus, Atrial fibrillation, ventricular fibrillation, Mitral stenosis.

***Stambh***- Obstruction in heart rate or heart failure are found in Congestive heart failure, Left ventricle hypertrophy.

***Pramoh-*** Altered sensorium is found in status asthmaticus, Cardiogenic pulmonary edema.

***Shunyata-*** lightheadedness is found in Myocardial infarction.

***Darh-*** Murmur sounds are found in Atrial septal disease, ventricular septal disease, Patent ductus arteriosus, Aortic stenosis.

***Vevarnya-*** Cyanosis is found in Tetralogy of fallot, pulmonary arteriovenous fistula, Asthma.

***Bhram-*** Dizziness is found in congestive heart failure, Myocardial infarction, pulmonary hypertension.

***Swed-*** Sweating is found in Myocardial infarction, Cardiac Asthma.

***Murcha-*** fainting/syncope is found in Myocardial infarction, Adams attack Tetralogy of fallot, aortic stenosis.

***Jwar-*** Fever is found in pericarditis, Endocarditis.

***Swas-*** Dyspnoea are found in Congenital heart disease, acquired valvular disease, coronary heart disease, hypertensive heart disease, cardio myopathies, left heart failure.

**RESULT AND CONCLUSION**

*Srotas* are the transport system of human body in micro and macro level. After studying about *Srotas* and blood vessel I have found similarities in function of transportation, despite what they are carrying. *Pranavaha Srotas* are the main *Srotas* that carry oxygen which is necessary to sustain life. To follow the line of observation we found that transportation of oxygen cannot occur without cardiopulmonary system. *Pranavaha Srotas* and its *Moola* are related to cardiopulmonary system (Heart, Lungs and blood vessel) and its component in location point of view, in function point of view and in structural point of view. *Hriday* is one of the *Mool* of *Pranvahsrotas* its location, symptom of vitiation and *Vidhvalakshan* of *Hriday* are similar with causes, sign and symptoms of heart disease *Rasvahdhamni* is another *Mool* of *Pranvahsrotas*, which carry blood and oxygen in the human body. After study of arteries and blood function especially how blood facilitated transportation of oxygen we can consider it *Raktvahdhamni*. Respiratory system is a part of cardiopulmonary system. Lungs are an organ of the respiratory system. According to observation its structure and function and its diseases, and signs and

symptoms show similarities with *Pranvahsrotas* and its *Vidhva* and *Dushti Laxan*. And how lungs are related to *Pran* means oxygen. So we can consider it as one of the *Mool* of *Pranavahasrotas*.

After observing *Pranvahsrotas* and its *Mool*, its causes of vitiation, *Dushti Lakshan* and *Vidhva Lakshan* are similar to Sign and symptoms of diseases of cardiopulmonary system. So on this basis *Pranvahsrotas* can be considered cardiopulmonary system.

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