CONCEPT OF CARDIO VASCULAR SYSTEM IN AYURVEDA: A CONCISE REVIEW

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ABSTRACT

Though the references to the heart are available in the ancient Indian Literature including the Vedas and Puranas, the collection of facts and the presentation efforts have been made in the present context. The Ayurveda samhitas have described anatomical and physiological concepts of Srotas (channels) broadly. Srotas mainly regulates process of circulation in human body. Rasa (plasma, lymph) has its primary seat in Hridaya (heart). Due to the integrated function of Vyana vayu (biological functioning entity) the Rasa dhatu (tissue entity) is continuously circulating throughout the entire body. Srotas are describe as structural and functional unit of the body designed to carry all specific materials, hormones, enzymes, molecules, massages, impulses, emotions and thoughts. It is such a minute supply that is not seen but visible by their action or by functioning that occurs. As in texts Dharmi (artery) and Sira (vein) are more resembled with Srotas by functioning level as of transportation but these three are different from each other. Though they are innumerable but for convenience they are divided into several. Acharya Charakā, Sushrut and Astang Hridaya mentions Hridaya and the ten Dhāmanis as the Moola (Root/cardinal organs) of this Srotas. On comparison of both the aspects we find that heart and blood vessels are the major component of both cardio vascular system and Rasavah Srotas(channels circulating plasma, lymph). So, in this article an attempt was made to elaborate the concept of Rasavaha Srotas in detail and its resemblance with cardiovascular system, and was also tried to point out the physiological involvement of some other organs to the system.

Key words: Dharmi, Hridaya, Rasvah Srotas, Sira, Srotas, Srotomoola.

INTRODUCTION

Many Fundamental principles and concepts are explained in Ayurveda, Concept of Srotas is one of them. Srotas are the transporting channels including Dhatus like blood, and nutrients which are undergoing for a transformation. The Srotas not only perform various physiological functions but disturbance in Srotas may also impart some pathological manifestation, therefore it is very essential to understand physiological concepts of Srotas. Each Srotas is attached to a specific anatomical structure called Moolā (The Root)[1], Srotomoola is the most vital part of the Srotas, just like the root of the tree. The normal functioning of the particular group of channels (Srotas) is depends upon its moolasthān. But in reference to Srotas, they are the two cardinal organs, directly or indirectly related with scattered Srotas of the body. Any abnormalities in these peripheral Srotas ultimately can effect on the Moolā(Root/cardinal organ)[2]. Rasavaha srotas is one of the important among all the Srotas, which is related to Rasadhatu formation and transportation. It includes Hridaya (heart), Sira Jala (network of veins), Dhāmanī Jala (network of arteries), Rasayni Jala including the Lasika Granthi (network of capillaries and lymphatic)[3]. According to C. Dwarakanatha, lymphatic channels are termed as Rasavaha srotas. Therefore the concept of Rasavaha Srotas in Ayurveda may be correlated with functions of heart and blood vessels. It has become the need to study the fundamental and applied aspects of Ayurveda in depth with comparison to the science of today. This review highlights to make a concept about understanding the Rasavaha Srotas in present scenario.

SROTAS

It is derived from the Sanskrit root ‘sru srawane’ meaning to exudates, to ooze, to filter and to permeate[4]. The term Srotas means a channel through which poshak dhatu (unstable tissue) passes to form sthūyi dhatu (stable tissue). A Srotas is a physical and energetic pathway, through which water, food and air enter the body, while feces, urine and sweat leave the body similarly three Doshas (biological functioning entity) move within it. All the bodily substances cannot form or decay without Srotas, because they are capable of circulating the transformed Dhatus[5]. According to some authors the Srotas may be interpreted as micro-vascular carrier, which is specialized for exchange of the materials. The exchanges of materials between interstitial fluid and intra capillary substance move through highly specific pores. They are innumerable in number[6], which explains that every cell in the body is possibly a Srotas. Acharya Charak has described 13 Srotas in female there is one more i.e. Artvavaha Srotas in Garbha prakaran, where as Acharya Sushrut has told 11srotas, but they are paired. They resembles in color to its dhātu, are variable in size anu (small) or sthula (large) and also variable in shapes like vritta (circular), dirgha (long), pratana (branched)[7].

RASAVADA SROTAS

Acharya Charak and Vagbhat has mentioned Hridaya and Ten Dhāmanis[8], whereas Acharya Sushrut mentioned Hridaya and Rasvahi Dhamnies as moola of Rasavah srotas. So, exploring these references made by major three Acharya, these components may undergo with Cardio vascular System. To understand the concepts of cardio vascular system of body, we should first understand the concept of Hridaya, Srotas, sira and dhāmanis. After digestion and absorption, the food is converted into Ahara Rasa (juice extract) which carries the nutrients to all the tissues of the body. It passes from intestines into blood vessels and then to the heart by the action of saman vayu(biological functioning entity)[9]. From the heart, it is pumped out forcefully and circulated continuously all over the
body, through its main blood vessels, by the action of Vyan vayu into millions of capillaries. Charaka has emphasized that the cardiac muscles do not get tetanized ever throughout the mechanism of Rasa Rakta Samvahan (circulation) [10]. However this view gives a suggestion about characteristic feature of cardiac muscles having long Action Potential and plateau phase [11]. The circulation is controlled by autonomic nervous system i.e. by vyan vayu mainly and also by samana vayu [12]. From capillaries, rasa penetrates all the tissues and cells of the body, the fluid from the tissues is brought back to the heart by capillaries and veins. The organs and channels through which this Rasa Samvahan (circulation) takes place are collectively termed as Rasavaha srotas [13].

COMPONENTS OF RASVAHA SROTAS

HEART (Hridaya)

‘Hridaya’ is derived from three verbs (as per Satpath brahman and Brihad aranyak). ‘Hrun’ which means to abduct, ‘Dad’ which means to donate and ‘in Gatou’ self generated rhythmicity for contraction and relaxation [14]. The heart thus means an organ which draws fluid including blood from all over the body and then supplies it to all the parts of the body [15].

Embryology:

The heart originates from the essence of Shonitat (blood) and Kapha (biological functioning entity) and develops into a muscular organ [16]. Genetically, in the development of the heart maternal influence dominates. Hence in an individual with Hridroga (diseases related to heart), it is particularly important to inquire regarding Hridroga on the maternal side. Heart become more obvious by the 4th month of Garbha utpatti krama (stages of fetal development) [17]. According to Charak, it starts functioning in the third month of fetal life [18].

Anatomy and Physiology of Heart:

a. In the Vedas:

Rigveda- In Rigveda, the term Hridaya has used at several places. The term Hridaya appears to be derived from the word Hrid. In a sutra of Rigveda, the word Hridaya is mentioned along with the description of the various body parts and their diseases. The Hridaya is also described by the synonym like Guhya [19].

Atharva veda- The word Hridim, Pundarika, Devakosh, and Kosha have described for Hridaya. Terms like Hamsa and Sindhu have also been used as synonyms of Hridaya [20].

Vaidik mantra - It is said that the Hridaya lies in the thorax below the Kantha (neck) and above the Nabhi (umbilicus) simultaneously it is also said that Siru (head) and Hridaya are the two different structures in the body.

Samvida- As a part of Hridaya the word Virata is described and it is said that Virata-Purusa holds the earth with ten fingers [21].

Satapath Brahman- Words such as Hridayam, Puritata, Stombhaga and Aditya etc used for Heart. The word Hridayama originates from the root word Hrid. Hridaya is derived from three verbal roots i.e. Hri, Da and Ya having the meaning of receiving, giving and moving, respectively.

Kanthropnishad- Atma and Paramatma both reside within the Hridaya. Some terms have also been mentioned for Hridaya, like Guhya, Dehinin and a tree of Ashvattha.

Chandogya upnishad- The terms like Pundariro and Omkara has used for Hridaya. Hridaya has defined as synonyms to Atma, and it is believed that Hridaya is the seat of Brahma.

Mandukya Upnishada- Hridaya has been defined as a hollow structure having various cavities inside. It is mentioned that Guhyacara (great almighty) resides in the cavity of Hridaya.

Mahabharat- A very nice description regarding Hridaya, Nadis (vessels) and the seat of Atma and Prana, have been given in Shanti-parva [22].

Bhagavat Gita- It also showed a clear-cut difference between the heart and the brain, while emphasizing on the importance of concentration, Lord Krishna is quoted to have said Arjuna that Hridaya is the seat of God of all the human beings [23].

Padma Purana- Hridaya is said to be like a lotus and Nadis emerges out from this Hridaya. Rasa (circulating fluid) is propelled in these Nadis by Prana Vayu and all these Nadis filled with Rasas traverse all over and saturate the entire body. Further Ranjaka-Agni which is there in the Nadis, metabolizes the circulating Rasa and converts it into Rudhira or blood. Almost similar description is found in Skanda-Purana.

Brahimpanishad the term Hridaya serves the very purpose of the physiological functions of the heart. The word Hridaya consists of three verbs i.e. Hri which means to bring back forcibly (venous return) Da to donate (pumping function of the heart) Ya means to move or to circulate.

b. In the Samhitas:

Charaka has accepted heart to be the seat of consciousness, which is primarily a function of brain. Even a small injury to the heart results in fainting and serious injury leads to death [24]. The heart is more active during the day. It provides Rasa, Rakta and Oja to entire Srotas of the body through Siras like that of the mountain ranges, which provide water, nutrition and life to the entire world through rivers [25].
Sushruta has observed that the heart is placed in the thoracic cavity in between nipples and extends up to the cardiac end of stomach, spleen and lungs on the left side of the heart, and its right side there is liver and gall bladder. He observed Hridaya like a red lotus having its apex downwards[26]. Further he represented that Hridaya is a place of consciousness and when it is enveloped by the illusive effects of Tuma (darkness), person goes to sleep [27]. Sushruta illustrated that circulation of Rasa occurs in such a manner, it propagates transversely as Shabd (sound), upwards as Archi (fire) and downwards like Jala (water)[28]. So its gives an indication about hemodynamics phenomenon of the heart and to observe relation of velocity against diameter of vessels and pressure gradient within it[29].

Astang Hridaya has represented heart, as a seat of mind where as the seat of Satva in another verse[30]. Arundatta in his commentary on Astang Hridaya depicted the heart as a fleshy muscular organ, resembling a red lotus bud and hangs with its apex downwards; from which vessels and capillaries spread all over the body[31]. In the Astang Samgraha, Sharira sthana detailed description of the heart has been mentioned. Size of the heart is Dvyangulum; located in thorax between two breasts, if it is injured, causes sudden death. It is like a lotus, hollow organ and special place of Chetana[32].

A very authentic description about autorhythmicity of heart has explained in Nadigyanam[33] gives a clue to interpret the electrophysiological properties of the heart i.e. autorhythmicity, excitability and conductivity. As per Bhela Samhita, Rasa gets ejected out of the heart and moves all over the body, after that returns to the heart through the blood vessels called Siras which originate at heart[34]. Sharangadhatra has also explained a synonymous view. The description of cardiovascular system as a closed circuit is the specific contribution of Bhela which was actually re-invented by William Harvey in 17th Century[35].

c. Circulation of Oja:

Oja (component of blood which provides immunity) gets circulated from the heart through blood vessels [36,37]. Hemadri has described different types of Ojas, among which the Rasatahaka Oja can be considered as substances of complement system, antibodies; Dhatutedorupi Oja can be considered as he tissue macrophages or all WBCs present in tissues; and Shonita rupi Oja as the WBCs in blood[38]. Blood is also called the ‘fluid of health’ because it protects body against diseases as it contains Oja (immunoglobulins, and WBCs,)[39].

BLOOD VESSELS

The Atharvaveda refers Dhamanis are, ducts with thick walls are like arteries; Siras are ducts with thin wall are equivalent to veins and still finer ducts are referred to as Snavas similar to capillaries. In Ardheshashmahamooliyadhayaya, Charakha has illustrated specific characteristic of Dhamni, Srotas and Siru i.e. ‘Dhamanadhimnya Sravanat Srotamis Saranatsirah’[40]. The order in above verse has an important significance; the first word is about Dhamani i.e. dhmanadhamanyah. It indicates that where the pulsation can be felt is called as Dhamani, It is that tract which produces sound and this can be felt or seen only in arteries, not anywhere else in the body. The second word is ‘Sravanat Srotamisi’ here Sravan means exudates, oozing; and the last word is, ‘Saranatsira’, the word Sarana means moving, flowing. The Sira are that which carry the Rakta from capillaries to heart, when we look into the references we find veins carry the deoxygenated blood with fewer nutrients in them. Some of Acharya mentioned that all these are same, but Sushruta has different opinion, as Dhamni, Srotas and Siru have different character, number and function so they are different[41]. On the basis of their function they can be assumed as Arteries, Capillaries or Veins.

a. Artery (Dhamani):

Sushruta has explained Nabhī is the site of origin of both Dhamani and Siru. But in another chapter he says that Dhamnies originates from Heart. Charaka has also mentioned that the Dhamanis arise from the Hridaya. Charakha said that 10 Dhamani arises from Hridaya[42], in another chapter Charaka has outlined that Dhamnies are 200 in number and says one should understand it by their own interpretation[43]. Sushruta has mentioned, among the Dhamani arising from the Nabhi, ten spread upward, ten downward and four in transverse directions. Bhavprakash and Astang Samgraha have same view[44].

Urdhva Dhamanis spreading upward, receiving sensation of sound, touch, sight, taste and smell; inspiration, expiration, laughing, yawning, sneezing, talking, shouting and such other functions[45]. Adhogami Dhamanis spreading downward procure flatus, faces, semen, and menstrual blood etc. downward. It serve throughout the body and nourish the body supplying nutrient materials to the Dhamani spreading in upward and transverse direction, and separate urine, faces and sweat[46]. Each one of the four Tiryagga Dhamani spreading transversely divide into hundred and thousand of branches further and so becomes innumerable; by these, the entire body appears to be full of aperture; The sensation of touch both comfortable and uncomfortable, are perceived by these only. All 24 Dhamnies perform their functions throughout life[47].

b. Capillary (micro Srotas):

Sushruta has described Srotas have pores on their walls, through which they supply rasa to all parts of the body, very much like the minute passages present in a lotus stem. Likewise, Vagbhata has compared Srotas to the extremely fine passages and pores present in the lotus stem[48]. It is also said that variability of the substances occurs due to Srotasas itself. Exchange of substances can take place at the capillary level only, which also helps in fluctuating status of the substances in the body. Due to this reason the capillaries can be connected to Srotas[49]. Ayurveda has also appreciated this observation and mentions ‘asankhya paramanu’ and ‘Srotomaya sharir’. Each cell has a specific structure to its need and each performs a different function but basic requirements are same i.e. each cell requires the supply of nutrition and removal of their waste products for maintenance of life. The channels which perform these two functions are micro channels that are blood capillaries, lymph capillaries and cell membrane. These micro channels are highlighted as Srotas in Ayurveda[50].
c. Vein (Sira):

Total 700 Sira are present in the body, can constrict and relax. Embryological development of Sira is from Pitra (paternal) element in fetus, so somewhat it is a hard structure [51]. Sira is formed as a byproduct of Rakta dhatu and nourished from it [52] “Saran” is a main function of Sira, in which secretion and exudation is not expected from its walls. This structure is made to hold the fluid in such a way that it will not exude or ooze out. Main Siras are 40 in number and are grouped into four categories [53]. They are Vatavahini, Pittavahini, Kaphavahini and Raktavahini, they all divide and re-divide in to total 175 branches. For example-Raktavahini Sira grows towards locations of Raksthaan i.e. liver and spleen and divide in to 175 branches.

In nutshell, we see the nutrient portion of properly digested food after being absorbed from the intestines by lacteals gets divided into two portions, one portion reaching Hridaya [54] the other portion being conveyed to the Yakrit (liver) where it is acted upon by Ranjaka Pitta, gets converted into Rakta and reaches the Hridaya later on to join the Rasa [55]. So Rasa and Rakta Dhatu are always found to be circulating together, the Rasa portion being watery carries with it the Rakta which is slightly thicker. In modern parlance, the fluid portion of blood i.e. plasma is comparable to Rasa Dhatu and the formed element portion of blood to Rakta Dhatu. So, this Rasa cum Rakta has the nutritive elements required for all the Dhatus of the body and supplies them during its circulation.

DISCUSSION AND CONCLUSION

The Rasavaha Srotas is the main Srotas or called as First Srotas that supply Nutrients to all parts of the body through blood circulation. Here we see blood circulation include both Rasa and Rakta Samvahan (circulation). Rasavaha Srotas mainly give Poshana (nutrition) to Rasa Dhatu as well as Rakta Dhatu. Liver and spleen are considered as root of Rakta Srotas [56], because synthesis of blood cells occurs in liver and spleen during third to fifth month of intrauterine life (hepatic phase of haemopoiesis) and both the organs act as blood reservoir. Along with liver and spleen, Raktavaha Dhamani (blood vessels) has also been considered as root of Raktavaha Srotas. It means that Raktavaha Srotas includes both haemopoietic system and a part of cardiovascular system i.e. Raktavahi Dhamani (blood vessels). Liver synthesizes haem, clotting factors and proteins of plasma and some nutrients (Vitamin B12 and folic acid) are stored in liver also, most among these enhance haemopoiesis. Due to some diseased condition if red bone marrow fails to take part in haemopoiesis, then even liver and spleen start haemopoiesis in adults, called extramedulary haemopoiesis [57]. Thus it shows some organs like liver and spleen also play an accessory role in cardio vascular physiology. These descriptions show that a very detailed physiology of blood (Rasa along with Rakta) circulation and its applied aspect have been discussed by the ancient Ayurvedic scholars, and the scientific explanations in this article may be helpful in its understanding.

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