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## The Concept of Srotas in Ayurveda with special reference to Blood Capillaries

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### ABSTRACT

The anatomical, physiological as well as pathological concepts about *srotas* are broadly mentioned in *Ayurveda samhitas*. According to various *acharyas* *srotas* are channels of nourishment with the particular functional entity in the body. It is structurally related to as various organs with due consideration of the physiological needs. *Charaka* has described many facts about *srotas* in meaning the structure through which the *sravanam kriya* takes place. *Sushruta* has described very well about the number, kinds and functions of *srotas* in context of *srotoviddha laxanas* (symptoms of injury). The *srotas*, in the broad term, refers to the channels of circulation present in human body. Anatomically and physiologically, channels of circulation have great importance. Present day scholars of *Ayurveda* are not unanimous in identifying *srotas* in its structure and function. This is so because of difference in description present in *Sushruta samhita*, *Charaka samhita*, *Ashtanga samgraha*, *Ashtanga hrudaya* and their commentaries. Modern scholars like Gananath sen, B.G. Ghanekar, C. Dwarakanath and others have interpreted their own way and a satisfactory conclusion has not been arrived at. The main aim of this article is to study the concept of *srotas* from various *Ayurvedic* classics and it correlates with modern anatomy.

### KEYWORDS

*Srotas, Hrudaya, Dhatu, Sira, Capillary, Sravana*



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## INTRODUCTION

*Srotas* is a unique doctrine of *Ayurveda*, explaining the circulation and transportation of *poshak dhatu* to *poshya dhatu* of the body. *Srotas* are defined as channels of circulation which carry tissues, fluids from place to the other<sup>1</sup>. They are the minute channels which are scattered in the whole body of an individual. Structurally, these are the hollow channels originating from the root space, spread in the whole body to act as a transport system for the fulfilment of nutritional needs of organisms and to get rid of the end results of metabolism from their body<sup>2</sup>. This is the internal transport system of the body and it has the fundamental importance in both health and disease. Like as *sira*, *dhamani* they also perform various physiological functions and biochemical mechanisms are maintained through them. *Ayurveda* has emphasised the role of *srotas* both in the physiological and pathological state, therefore study of *srotovigyana* is essential for understanding the basic systemic & functional anatomy of the body.

## MATERIALS AND METHODS

The literary material related to *srotas* has been collected from different *sthanas* (parts) of *Ayurveda samhitas* and modern anatomy books like Chaurasia general anatomy,

Gray's anatomy etc. critically reviewed and correlated with modern terms.

### Review of literature

#### A. Derivation of *srotas*

The term *srotas* means channel, it is derived from the *Sanskrit* root “*sru sravanae*” meaning to exudates, to ooze, to filter and to permeate<sup>3</sup>. *Acharya Charaka* has described the exact nature of the functions performed by *srotas*.

#### B. Definition of *srotas*

*Acharya Charaka* has defined *srotas* as “*sravanat srotamsi*” meaning the structure through which the *sravanam* takes place. Further *Charaka* has defined *srotas* as transporting passage of *dhatu*s undergoing the transformation. *Charaka* observes *srotamsi* serves as *ayan mukhas* to both the *malakhya* and *rasasdakhya dhatu*s<sup>4</sup>. They nourish the different species of *sthayi dhatu*s and requisite quantities of appropriate nutrition. The several interpretations have been given about *srotas*, they are as under:

1. The *sravana kriya* is that; by which *poshaka rasa* is taken to the *poshya dhatu*<sup>5</sup>.
2. A transporting passage through which oozing, permeation or transportation takes place<sup>3</sup>.



3. “*Sravanam syandanam*” means the structures through which circulation of *poshaka dhatu* (nutrients) takes place in body<sup>6</sup>.

*Sushruta* has described It is a continuous channel (blood vessels) which forms a closed tubular system, originating from a vacant space (*mulat khadhantaram*), spreads throughout the body, carries materials *rasa, rakta* etc., known as *srotas*; apart from *sira* and *dhamani*<sup>2</sup>.

*Sushruta* has excluded *sira* and *dhamani* from the *srotas* and compared the *srotas* to the fine channels present in the lotus stem through which fluids circulate and exude<sup>7</sup>.

*Dalhana* has accepted that all structures through which *prana, anna, lala, rasa, rakta* circulated are *srotas*<sup>8</sup>.

Therefore, all visible and invisible structures, having an influence of *akash mahabhoota* and lumens, are *srotas* which transport the progressively variable *dhatu*s, *upadhatu*s, *malas, anna, jala, prana, mana, shabdha* etc from one place to another place in the body due to this *sravana kriya*.

The *srotas*, in broad term, refers to the channels of circulation present in human body. *Srotas* constitutes the internal transport system of the body and is specially related to the fine channels of circulation and pathways, carrying out all the vital functions of the body.s

### C. Synonyms of *srotas*

*Sira* (vein), *dhamani* (artery), *rasayani* (lymphatic ducts), *rasavahini* (capillary), *nadi*(tubular conduits), *panthana* (passages), *marga* (pathways, tracts), *sharirachidra* (body orifices), *samvritasamritani* (open or blind passages), *sthana* (sites), *ashaya* (repositories), and *niketa* (resorts) are the synonyms of *srotases* (channels)<sup>9</sup>.

### D. Number of *srotas*

According to *Charaka* *srotas* are *aparisanakhyeya* in the body, but in that he has described 13 *srotas* only<sup>10</sup>. But *Sushruta* has stated 11 pairs of *srotas*<sup>11</sup>. He has not described *asthivaha, majjavaha, svedavaha* *srotas* described by *Charaka*, in addition to that mentioned *srotas* (Table: 1).

**Table 1:** Showing names of the *srotases* described by *Charaka* and *Sushruta*

Name of the <i>srotas</i>	<i>Charaka</i>	<i>Sushruta</i>
<i>Rasavaha srotas</i>	✓	✓
<i>Raktavaha srotas</i>	✓	✓
<i>Mamsavaha srotas</i>	✓	✓
<i>Medovaha srotas</i>	✓	✓
<i>Asthivaha srotas</i>	✓	Not explained
<i>Majjavaha srotas</i>	✓	Not explained
<i>Sukravaha srotas</i>	✓	✓



<i>Pranvaha srotas</i>	✓	✓
<i>Annavaha srotas</i>	✓	✓
<i>Udakvaha srotas</i>	✓	✓
<i>Purishahavaha srotas</i>	✓	✓
<i>Mutravaha srotas</i>	✓	✓
<i>Svedavaha srotas</i>	✓	Not explained
<i>Artavaha srotas</i>	Not explained	✓

### E. Structure of *srotas*

1. *Srotas* are also called as ‘*Kha*’ meaning ‘hollow’<sup>12</sup>.
2. *Srotamsi* are described as having the same colour of the *dhatu* in which they are present *vrutta* (round), *sthula* (large) or *anu* ( minute ), *dheerga* (long) and spread like the veins in a leaf<sup>13</sup>.
3. Apart from *sira* and *dhamani srotamsi* arise from a hollow organ as its *mula* and then spread throughout the body. In other words, *srotamsi* are minute branches of big vessels<sup>6</sup>.
4. *Srotamsi* are present everywhere in the body and so man is a conglomeration of *srotas*<sup>14</sup>.
5. Just as the body has many structures which have a form (size, shape) similarly the *srotamsi* and they are of many kinds<sup>15</sup>.
6. *Srotamsi* are the *ayana mukha* (orifices, pores) for the movement of *prasada* (essence) and *mala* of the *dhatu*. Through these orifices /passages, *rasa dhatu* travels throughout the body<sup>16</sup>.
7. The structure of *srotas* is similar to the fine channels present in the lotus stem<sup>12</sup>.

### F. Functions of *Srotas*

1. *Srotamsi* are so called because they have ‘*sravana*’ (oozing)-allow materials to pass through them very slowly, in small quantities<sup>3</sup>.
2. *Srotamsi* are the channels of “*parinama apadyamana dhatu*s (tissues undergoing transformation-intermediary metabolites). These are variously called as a *poshaka dhatu*s (or *poshakamsa* present in *rasa dhatu*), *asthayi dhatu* (circulating tissues) and *margaga dhatu* (moving through channels)”<sup>17</sup>.
3. Increase (growth and development) and decrease (depletion) of the *dhatu*s takes place only through the functioning of *srotas* and not by anything else<sup>17</sup>.
4. *Srotamsi* are *vishista* (specific in their function). It has the capacity to discriminate which materials are to be allowed/taken into the *dhatu* and which to be sent out of it (known as selective permeability in modern terminology)<sup>18</sup>.
5. *Srotamsi* are the channels for the *doshas*<sup>19</sup>.
6. Structural and functional abnormalities of *srotas* give rise to disease. Circulation of *rasa dhatu* gets obstructed due to the



abnormalities of *srotas* and consequent aggravation of the *doshas*, excited by indulgence in improper food and activities<sup>20</sup>.

## DISCUSSION

The term *srotas* is seen to have a special usage and reference to channels of transport which are microscopic in their dimension and through which the oozing of fluids takes place. *Sushruta* is seen to have excluded *siras* and *dhamanis* from the purview of *srotases*. He has described *srotases* as channels which have their origin in *khadantaram* i.e., an organ cavity, the *hrudaya* for example, and spread throughout the body, transporting *rasadhi dhatus*. In his view, *srotas* have *kham* (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. *Vagbhata* has, likewise, compared *srotases* to the extremely fine passages and pores present in the lotus stem. He observes: “spreads throughout the body through very fine *dwaras* (pores) of *srotamsi* which are distributed extensively in the body, very much like the minute channels, present in the lotus stem”<sup>21</sup>.

The word *sravana* means flowing, trickling and oozing. It also said that in the body increase or decrease of the substances are

due to *srotases* itself. So the exchange of substances can take place at the capillary level only, which can help in increase/decrease of substances in the body. Due to this reason, capillaries can be allied to *srotas*<sup>22</sup>.

*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 microchannels that are blood capillaries, lymph capillaries and cell membrane. In this, the function of 'capillaries' is the transport of nutrients to the tissues and removal of cellular refuse. These microchannels are highlighted only in one word in *Ayurveda* i.e. '*srotas*'<sup>23</sup>.

*Srotas* is the word derived from '*Sru-sravanae*', meaning the structure responsible for the exchange of substances in the body. The phenomenon of '*sravana*' has been taken in three bio-physical terms- filtration, diffusion, osmosis. Many schools of *Ayurveda* have perceived the knowledge of *srotas* from different angles. *Charaka* has highlighted a basic characteristic of *srotas*



that is the colourless structure which transmits the colour of contents of conduits *dhatus* and been '*ayanmukha*' for exchange. But *Sushruta* has differentiated it from *sira* and *dhamani*. *Sira*, *dhamani* and *srotas* collectively form the system of circulation or transportation. But the difference between them is that. *Dhamani* is designed for *dhaman karma* (with pulsation), *sira* for *saran karma* (without pulsation) and *srotas* for *sravana karma* (neutral pressure) and according to *Ayurveda* they are recognised by their specific function. They are the continuous structure. *Dhamani* is branched out into minute capillaries which ultimately unite into the vein. *Vagbhata* has envisaged that *sira* and *dhamani* are nothing but the special types of *srotas*. This *sira* and *dhamani* may be considered as 'macro *srotas*' while *srotas* are micro *srotas*. In other words, all the large and visible structures having *kha* (space) from its *mula* (root) to *anta* (end) responsible for transportation of substances are termed as macro or *sthulasrotas*. Whereas the fine networks like structure responsible for *sravana* (exchange) of life-sustaining substances through the pores are only the micro or *sukshmasrotas*. Microchannels or blood capillaries are the actual *srotas* which help in the nourishment of body<sup>24</sup>.

In *Ayurvedic* classics, it is accepted that *purush* is an aggregation of *srotas*, but the only principle behind it that *srotas* are innumerable. This innumerable *srotamsi* constitute the internal transport system of the body. They relate especially to the finer channels of circulation and pathways. The mode of exchange of nutrients is governed by a term used in classical literature that is '*sravana*' which after analysis of the literature modern as well as ancient focuses upon three biophysical law- filtration, diffusion and osmosis. These laws are specifically applicable for the exchange of solid, liquid and gas. The *srotas* is specifically designed to facilitate "*sravanakriya*" (filtration, osmosis and diffusion). To achieve this physiological status these microtubular structures become so thin that it is transparent and transmits the colour of the content of the tube. It is devoid of musculature, therefore, it adopts the shape of the prevailing circumstances. This may be called in modern terms microcirculatory vessels or blood capillaries<sup>25</sup>.

The above references are concluded and find the following similarities in between *srotas* and capillaries-

1. *Srotases* are extremely fine branches of bigger vessels which originate in such organ cavities as the *hrudaya*. Thus, *hrudaya*,



*dhamanis*, *srotamsi* and *siras* (including, *rasavaha srotamsi*) constitute a single circulatory unit, which regulates the proper flow of blood and nutrition supply to and the clearance of waste products from *sthayi dhatus*.

Blood vessels are not just tubes through which the blood (*Rakta*) flows. Blood vessels carry blood from the heart (*hrudaya*) to all areas of the body. The blood circulation is carried from the heart via arteries to smaller arterioles, then to capillaries or sinusoids, to venules, to veins and back to the heart. Capillaries are the network of microscopic vessels (minute channels present in lotus stem) which connect arterioles with the venules. The capillaries have intimate contact with the tissues (*dhatus*) for a free exchange of nutrients and metabolites across their walls between the blood and the tissue fluid<sup>26</sup>.

2. *Dhamanis* (arteries) and *siras* (veins) are excluded from the purview of channels described as *srotases*.

The blood vessels i.e. arteries, veins and capillaries are structurally and functionally different. The arteries are the thick-walled big channels of the body convey pure blood from the heart to the tissues. The veins are smaller and thin-walled vessels return impure blood from the different tissues of

the body to the heart. The capillaries are minute vessels within the tissues. The walls of capillaries are very thin and transparent. Due to this virtue of thinner walls, blood exudates (*sraavana*) out of the capillaries and supply the blood to the tissue (*dhatu*) for the nutritional purposes<sup>27</sup>.

3. The structure of *srotas* is comparable to that of the fine channels and pores present in the lotus stem.

Fenestrated capillaries have endothelial cells in which are found small openings or pores (*ayanamukha or dwara*), called fenestrae, of about 80- 100 nm in diameter<sup>27</sup>.

4. *Rasa* oozes through the pores of the *srotases* to nourish the *dhatus*.

According to modern science osmosis/diffusion (*sraavana*) occurs in capillaries of the tissues (*dhatus*) of the body. The main functions of capillaries are the exchange of nutrients, metabolic waste products and gases between the blood and the tissue cells. The capillary wall allows the substances by the process of diffusion, filtration, and osmosis. Oxygen and carbon dioxide move across the capillary wall by diffusion. The combination of hydrostatic and osmotic pressure indicates that the fluid movement across a capillary wall. The capillary microcirculation created by hydrostatic and osmotic pressure is that





substances leave the blood at one end of the capillary and return at the other end<sup>27</sup>.

## CONCLUSION

Keeping in mind, both the ancient and modern knowledge, attempt at correlation between them can be made in the following manner- *srotamsi* are the capillaries and their *ayana mukha* are the pores in their wall. Through these, the nutrient portion (*poshakamsa*) of *rasadhatu* goes into the tissues (*sthayi dhatus*) and *kitta* (waste material) produced by the *dhatus* comes into *rasadhatu*. Structural and functional features of *srotas* described so far correspond very closely to the structure of known nowadays as capillaries.



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