

TO STUDY RAKTADHARA KALA IN PERSPECTIVE OF ACHARYA SUSHRUT- A REVIEW

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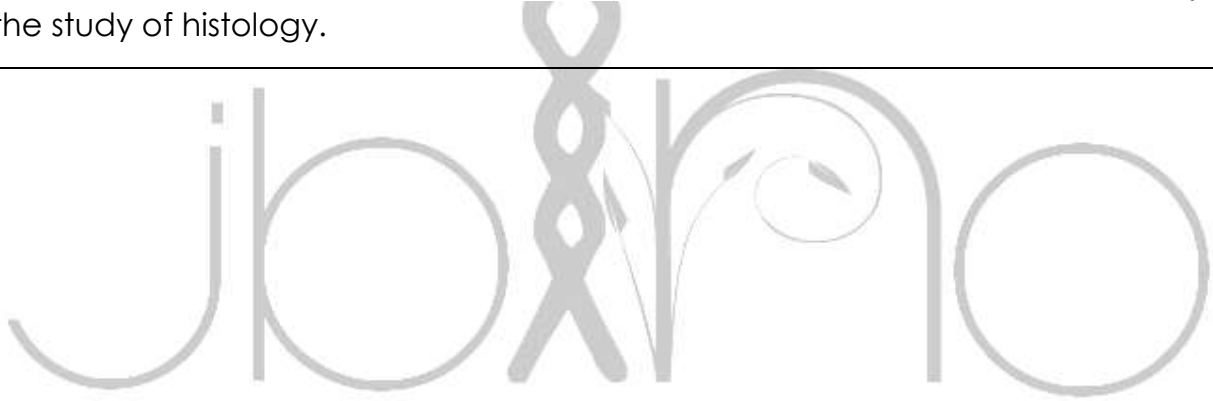
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ABSTRACT

Literature of Ayurveda contain a treasure of concepts. Many Ayurveda scholars and experts are continuously working on various concepts. Still the scope of research seems to be unending. Some topics have been studied lesser and *Kala Sharir* (membranous structures in body) is one of them. Though many people have worked a lot on this topic, we wanted to concentrate on the basic concept of *Raktadhara Kala* (a fine membrane that lines the blood vessels) and its relation with *Mool Sthana* of *Raktavaha Strotasa* (vital component of the *Raktavaha Strotasa*). We have tried a critical analysis of the concept of *Raktadhara Kala* described by Acharya Sushruta. The concept is studied in conjunction with the study of histology.



INTRODUCTION

Ayurved Sharir has many terminologies which are fairly explained at many places in ancient compendia. Especially many terminologies like Kandara, Kurcha, Mansarajju, Sanghat, Simanta are described in fifth chapter of Sushruta Samhita. Kala is one of prime topic described by Sushruta in Sharirsthana. There are many basic principles of Ayurved like Tridosha, Panchamahabhut, Dravyaguna etc. used by Ayurvedist for management of diseases. But till date there is no such any clinical significance of Kalasharir is established. Aims & objective: To find out the applicability of Kalasharir described in Ayurved in the light of contemporary science. Material & Methods: Thorough critical review of available literature from Ayurved and modern science related to Kala. Observations & Results: Total seven Kala are present in the body and these are the limiting membranes between the Dhatu and Aashaya. Kala are not only the mere partitions between the Dhatu and Aashaya but also they possess some properties and perform some activities in the body. Raktadhara Kala is the second prime Kala in the body which is situated in Mamsa and holds the Rakta present in Sira, Yakrut and Pleeha. Discussion: Raktadhara Kala can be correlated with endothelial linings of blood vessels. The endothelial linings of blood vessels initially were considered as a semi permeable barrier separating lumen from vessel wall. But the endothelium is now recognised as a complex endocrine organ responsible for a variety of physiological processes vital for vascular homeostasis. These include the regulation of vascular tone, luminal diameter and blood flow; hemostasis and thrombolysis; platelet and leucocyte vessel-wall interactions; the regulation

of vascular permeability and tissue growth and remodelling.

Ayurveda is a science of life. The first principle of Ayurveda is to maintain a healthy body and mind of a person and second, to give relief to the patient. The basic knowledge of *Sharira* (human body) is essential for application of the above said principles. Hence, Ayurveda physicians and surgeons must be perfect with basic knowledge. For this article, we have studied a basic *Sutra* of Acharya Sushrut regarding *Raktadhara Kala*. The grammatical part of the *Sutra* is studied first. Various *Samhitas* have been studied further for detailed knowledge. Histology of various tissues was also studied to find out any similarity between the characteristics of the *Kala* and the tissues. Source of information for collection of data is secondary.

Kala is one of the basic structures that has been described in Ayurveda. *Kala* is a thin membrane, which lines the internal cavity of the *Ashayas* (the organs that hold the vital elements), organs, blood vessels, and fibrous capsule of the joints, and so on. The *Kala* separates the *Dhatu* (vital elements) and *Ashaya*. The *Ashaya* is the cavity that gives *Ashraya* (holds) to the *Dosha*, *Dhatu*, and *Mala* (waste products of the body). The *Dhatu* live in *Ashaya*, and the inner lining of the *Ashaya* is called as *Kala*.^[1]

If we cut a wood, the cross section of the wood shows its internal structures with its different layers and parts. In the same

way, we have to cut superficial layer of *Mamsa* (flesh) to reveal the *Dhatu*. It means that *Dhatu* are principle factors of our body and they are located deeply. We have to incise the coverings to reveal these *Dhatu*s. These coverings are *Kala*.^[2] Each *Kala* is different from the other. The *Kalas* must be studied thoroughly and independently to unearth the facts about it. This study is a step taken toward this task.

Aim

To study basic concept of *Raktadhara Kala* as defined by Acharya Sushrut in conjunction with the study of histology.

Objectives

1. To study the *Sutra* of *Raktadhara Kala* defined by Acharya Sushrut thoroughly.
2. To study the *Sutra* along with all the relevant aspects.
3. To study *Raktadhara Kala* in conjunction with histology that is relevant with the selected topic.

Ancient literature has been studied in detail to explore the *Raktadhara Kala* (the membrane that holds blood). Acharya Vagbhata has stated that the *Kleda* (lubricating factor), which lies in the internal part of *Ashaya*, becomes *Pakva* (transformation due to various developments) by *Dhatvagni* (ability of a tissue to change itself into new form) and forms *Kala*.^[3] This is a thin membrane. It covers the internal organs of the body. It holds, supports, absorbs, secretes, and lubricates the different parts of the body.

Acharya Sushrut has described *Raktadhara Kala* as follows:

Raktadhara Kala is the second *Kala*, which remains deep to *Mamsadhara Kala* (the membrane that holds muscle tissue). *Sira* (blood vessels without pulsations), *Yakrut* (liver) and *Pleeha* (spleen) are the locations of *Rakta* (blood) along with the *Raktadhara Kala*.^[2] He further elaborates the characteristic features of the *Kala* with the help of a simile. He has used examples from nature to illustrate his prior said verses. He says, when we take an incision of a plant, which produces exudate, white milky substance oozes out and when we incise skin, blood oozes out in the same way.^[2]

Sira, *Yakrut*, and *Pleeha* are the locations of *Raktadhara Kala*. These organs are the *Mool Sthana* (principle organs of *Strotasa*) of *Raktavaha Strotasa* (channels for blood circulation) also. Acharya Sushrut has said that *Yakrut*, *Pleeha*, and *Raktavahi Dhamanya* (blood vessels) are the *Mool Sthana* of *Raktavaha Strotasa*.^[4] Besides *Yakrut* and *Pleeha*, Acharya Sushrut added the *Raktavahi Dhamanya* as the *Mool Sthana* of *Raktavaha Strotasa*. His compendium that has been written for surgery branch mainly, has offered some different opinions than physicians. In surgery, if nourishing vessel is injured, system goes at stake. This could be the reason his compendium offered conveying vessels in almost all *Strotasa*.^[5]

A comparative study of histology helps us

to understand the concept of Acharya Sushrut better. We have to consider the histology of *Mool Sthana* one by one, that is, arteries, liver, and spleen. The histological structure of an artery varies considerably with its diameter.

On the basis of the kind of tissue that predominates in the tunica media, arteries are often divided into the following:

1. Elastic arteries (large or conducting vessels)
2. Muscular arteries (medium arteries)

Elastic arteries include the aorta and the large arteries supplying the head and neck (carotid) and limbs (subclavian, axillary, and iliac). The remaining arteries are muscular.^[6] When traced distally, muscular arteries progressively decrease in caliber till they have a caliber of 100 μm . They then become continuous with arterioles. The larger or muscular arterioles are 100–50 μm in diameter. Arterioles less than 50 μm in diameter are called terminal arterioles. All the three layers, that is, tunica adventitia, tunica media, and tunica intima are thin as compared to arteries. In arterioles, the adventitia is made up of thin network of collagen fibers.^[7]

The muscular arteries can be taken as *Sira* and the elastic arteries as *Dhamani*. Action of *Dhamana* (pulsation) is seen in elastic arteries. *Viddha Lakshana* (symptoms occurred due to injury) of *Strotasa* also support this inference. The *Viddha Lakshana* of *Raktavaha Strotasa* are *Shyavangata* (bluish

discoloration of skin), *Panduta* (pallor), and *Shonitagamanam* (bleeding).^[8] When *Raktadhara Kala* bleeds, the blood oozes out. If the bleeding is not forceful, it can be a capillary bleeding.

Terminal arterioles are continued into a capillary plexus that pervades the tissue supplied. Capillaries are the smallest blood vessels. The average diameter of the capillary is 8 μm .^[9] Exchanges between blood and tissue take place through the walls of the capillary plexus. The arrangement of the capillary plexus and its density varies from tissue to tissue, the density being the greatest in tissues having high metabolic activity.^[10] The wall of the capillary is formed essentially by endothelial cells that are lined on the outside by a basal lamina.^[10]

In some tissues, the exchange network is made up of vessels that are somewhat different from capillaries, and are called sinusoids.

Sinusoids can be seen in organs that are made up of cords or plates of cells. The organs that have sinusoids include the liver, the cortex of adrenal gland, the pituitary gland, and the parathyroid glands. Sinusoids are also present in the spleen, in the bone marrow, and in the carotid body.

The walls of sinusoids are made up of endothelial cells supported by a layer of connective tissue. The walls may be perforated at places so that blood may come into direct contact with the cells of the tissue.^[11] Sinusoids have a broader lumen than capillaries. The lumen may be irregular. Because of these features, the

blood flow through them is slightly sluggish.^[12]

Arteries are the blood vessels that take blood from the heart to various tissues. The smallest arteries are called arterioles. Arterioles open into a network of capillaries that penetrate the tissues. The walls of capillaries allow the exchanges of various substances between the blood and the tissues. Capillaries are replaced by slightly different vessels called sinusoids in some situations. Blood is collected from capillaries or from sinusoids by small venules. The venules join to form the veins.^[13]

The substance of the liver appears to be made up of hexagonal areas known as the hepatic lobules.^[14]

The connective tissue fills the angular intervals that are along the periphery of each lobule. Blood from the branches of the portal vein and from the branch of the hepatic artery, drains in the sinusoids at the angles of the hexagon of the lobule and passes toward its center. Blood from the sinusoids drains into a central vein that occupies the center of lobule. The central veins are tributaries of the hepatic veins.^[14]

In addition to deoxygenated blood reaching the liver through the portal vein, the organ also receives oxygenated blood through the hepatic artery and its branches. The blood entering the liver from both these sources passes through the hepatic sinusoids and is collected by tributaries of hepatic veins.^[15]

We must consider splenic blood

circulation in this context. Each branch of splenic artery divides and subdivides as it travels through the trabecular network. Arterioles arising from this network leave the trabeculae to pass into the intertrabecular spaces. The arteriole then divides into a number of straight vessels that are called penicilli. Either penicillar arterioles open into the red pulp or they open into splenic sinusoids. Veins from these sinusoids and the red pulp end in the trabecular veins.^[16]

An injury to the spleen or liver can lead to severe bleeding. Splenic rupture may occur when there is a localized trauma in the left hypochondriac region. It may be found with left lower rib fractures. The spleen has an extremely thin capsule. It is susceptible to injury in the situations where there is no damage to surrounding structures. When ruptured, it bleeds profusely into the peritoneal cavity because the spleen is highly vascular. In case of blunt abdominal injury, splenic rupture should always be suspected.^[17]

Yakrut and *Pleeha* are the locations of the *Raktadhara Kala* as well as it is the *Mool Sthana* of *Raktavaha Strotasa*. Study of histology of liver and spleen reveals that both organs are vascular. These organs have modified structures in their stroma to hold a large amount of blood. All the *Dhamani* also contain a large quantity of blood that is to be distributed to various organs of the body. Any injury to these organs can cause profuse bleeding.

Location of *Raktadhara Kala* is *Sira, Yakrut*, and *Pleeha*, whereas the *Mool Sthana* of *Raktavaha*

Strotasa is *Yakrut*, *Pleeha*, and *Raktavahi Dhamanya*. Inclusion or exclusion of *Dhamani* makes a big difference in the basic nature of the structure *Kala* or *Strotasa*. Acharya Sushrut has described the symptoms of injury of *Raktavaha Strotasa* (*Viddha Lakshana*) but he has not described it in case of *Kala*. Aforementioned observation can help us to infer that *Kala* is not a gross structure. It is an extensive but microscopic structure. We can consider the *Viddha Lakshana* of *Raktadhara Kala* as the *Viddha Lakshana* of *Raktavaha Strotasa* with the reference of *ashray ashrayi sambandha* (the relation between the tissue and the organ that holds the tissue). Various diseases also can damage *Raktadhara Kala*.

To understand the difference of the *Kala* and the *Mool Sthana* of *Strotasa* described by Acharya Sushrut, we must consider the definition of *Sira* and *Dhamani* (blood vessels with pulsations). *Sira* are the vessels in which blood is propelled without any force, whereas blood is propelled forcefully in *Dhamani*. With this definition, we can consider veins as *Sira* but many arteries also can be included in *Sira*. The arteries in which force of blood has been reduced can be considered as *Sira*. We can consider capillaries, blood sinuses as *Sira* in the same way. We can correlate this easily with the help of histology of arteries.

If we observe the symptoms of rupture or injury to the *Kala* described by Acharya Sushrut, we can draw some inference about the organs that we are

studying. He has used the example of milky plants to illustrate the nature of *Raktadhara Kala*. When a milky plant is scratched or injured superficially, milky exudate oozes out. The injury must be essentially superficial because if the plant has been excised completely, all the deeper tissues are damaged. In the same way, in case of superficial injury of skin, only superficial *Kala* is injured. Skin is supplied with blood capillaries richly. The walls of capillaries are made up of endothelial layer only. The endothelial lining of the capillaries that holds blood can be considered as *Raktadhara Kala*. Superficial injury damages this *Kala* and bleeding occurs in the form of oozing. Acharya Sushrut's example seems to be perfect in case of superficial injury.

If the injury is deep, deeper tissues are damaged. Larger blood vessels are damaged. *Raktadhara Kala* along with the *Raktavaha Strotasa* is damaged. *Viddha Lakshana* of *Raktavaha Strotasa* are seen in deeper injuries. When the *Mool Sthana* of *Strotasa* is injured, the symptoms produced are of severe bleeding. For example, *Shyavangata* (darkening of the skin) can be seen in cyanosis or subcutaneous bleeding, that is, subcutaneous hematoma, *Panduta* (pallor skin). These symptoms are found in mild and moderate hemorrhagic shock.

The illustration used by Acharya Sushrut gives us a much clearer idea of *Raktadhara Kala*. He has used an example of *Kshiri vruksha* (a plant that produces milky exudates when injured).

These *Kshiri vruksha*/milky plant start oozing when injured, same sort of oozing starts when skin is injured. Therefore, we can infer that, as the bleeding is very slow, it is not arterial bleeding because arterial bleeding is forceful. It can be venous or capillary bleeding. Acharya Sushrut in his first verse of *Raktadhara Kala* has said that the blood of this *Kala* is found in *Sira*, *Yakrut*, and *Pleeha*. It means that, when *Raktadhara Kala* is injured, it can be interpreted as venous or capillary injury.

This excludes the possibility of considering arteries as *Sira* in case of *Raktadhara Kala*. *Dhamani* or arteries should not be included as the location of *Raktadhara Kala*. Many times, we tend to consider *Sira* and *Dhamani* as synonym but in case of *Raktadhara Kala*, *Sira* means arterioles, capillaries, and sinuses in liver and spleen.

Another reason for considering the bleeding from *Raktadhara Kala* as venous bleeding is because anatomically veins are superficial than arteries. A superficial wound can cause a vein to bleed. There a possibility of venous bleeding in superficial injury. When an artery is ruptured, the bleeding is forceful and profuse.

Acharya Sushrut has given a simile of exudates of milky plants. These exudates, which occur on an injury to the plant, are not forceful. The white juice oozes out slowly. Similarly, when an injury to the skin does not cause forceful bleeding, we can interpret that the damage is up to *Raktadhara Kala* only. This way we can determine the *Sthana* (location)

of *Raktadhara Kala*.

The symptoms of an injury to the *Raktavaha Strotasa* include discoloration of the skin. Acharya Sushrut has described *Shyavangata* and *Panduta* as the symptoms of the injury to the *Raktavaha Strotasa*, which can be interpreted as cyanosis and pallor. Both the symptoms can be seen in case of severe blood loss. He has not included *Dhamani* in the location of *Raktadhara Kala*. He has included it in the location of *Mamsadhara Kala* and in *Mool Sthana* of *Raktavaha Strotasa*. Hence, we must be careful about the exclusion of *Dhamani* from the *Sthana* of *Raktadhara Kala*.

This study helps us to find a correlation between *Raktadhara Kala* and various tissues concerned with it. It can provide us an Ayurvedic approach toward the diseases of liver, spleen, and blood vessels. Ayurveda has a well-defined method of pathophysiology and treatment of various ailments. This study can extend a small help to the Ayurvedic physicians.

This study is a literary type of study only. The approach of this study is to reveal the basic concept of Acharya Sushrut's *Sutra*. The concept can be studied further in rats for histological study. The study can be further extended in the form of original study, in patients with the diseases of liver, spleen, or blood vessels.

Raktadhara Kala is found to have a close resemblance with endothelial tissue that lines the blood vessels internally.

Endothelium lines the sinuses of liver also. Sinuses are the major part of the liver substance.

Diseases of the liver and the spleen could be treated considering its relations with *Rakta Dhatu*, *Raktavaha Strotasa*, and the *Raktadhara Kala*. We need to study the *Shloka* (verse) described by *Acharya Sushrut* thoroughly before jumping into any conclusion. The *Sutra* has been studied for its grammatical part in the first stage. Later, various *Samhitas* have been studied for detailed knowledge. Histology of all the types of blood vessels, liver, and spleen was studied to find out any similarity between the characteristics of

References:

Sushrut. Sharir sthan, garbhavyakaran shariropakram adhyaya, 4/5. In: Sushrut Samhita. Hindi commentary by Dr. Bhaskar Govind Ghanekar. Reprint ed. Varanasi, India: Meharchand Lachhmandas Publications; 2017. p. 108.

Kanthi G A Textbook of Ayurvedic Human Anatomy. 1st ed. Varanasi, India: Chaukhamba Orientalia; 2008. p. 289.

Sushrut. Sharir sthan, Dhamanivyakaran Shariropakram adhyaya, 9/15. In: Sushrut Samhita. Hindi commentary by Dr. Bhaskar Govind Ghanekar. Reprint ed. Varanasi, India: Meharchand Lachhmandas Publications; 2017. p. 271.

Dhargalkar ND Sarira-Kriya-Vidnana (A Textbook of Physiology in Ayurveda). 3rd ed. Varanasi, India: Chaukhamba Sanskrit Series Office; 2015. p. 401.

the *Kala* and the tissues. This is an attempt of analysis of *Acharya Sushrut's Sutra* about *Raktadhara Kala* for this purpose. *Kala* is a very subtle structure. Abnormality in *Kala* will lead to diseases. *Acharya Sushrut* has described the normal structure of *Kala*. With the help of the study, it can be concluded that *Kala* is a localized structure as in case of liver and spleen. It is a widespread generalized structure also and can be considered as microscopic internal lining of blood vessels, which are said to be the *Sthana* (location) of the *Kala*. Diseases of spleen and liver are increasing all over the world. This study can give a new approach to the treatment of these diseases.

Neelam V, Sabita M, editors. Inderbir Singh's Textbook of Human Histology. 8th ed. New Delhi, India: Jaypee Brothers Medical Publishers; 2016. p. 140.

Neelam V, Sabita M, editors. Inderbir Singh's Textbook of Human Histology. 8th ed. New Delhi, India: Jaypee Brothers Medical Publishers; 2016. p. 141.

Sushrut. Sharir sthan, garbhavyakaran shariropakram adhyaya, 9/16. In: Sushrut Samhita. Hindi commentary by Dr. Bhaskar Govind Ghanekar, Reprint ed. Varanasi, India: Meharchand Lachhmandas Publications; 2017. p. 240.

Neelam V, Sabita M, editors. Inderbir Singh's Textbook of Human Histology. 8th ed. New Delhi, India: Jaypee Brothers Medical Publishers; 2016. p.

142.

Neelam V, Sabita M, editors. Inderbir Singh's Textbook of Human Histology. 8th ed. New Delhi, India: Jaypee Brothers Medical Publishers; 2016. p. 143.

Neelam V, Sabita M, editors. Inderbir Singh's Textbook of Human Histology. 8th ed. New Delhi, India: Jaypee Brothers Medical Publishers; 2016. p. 144.

Neelam V, Sabita M, editors. Inderbir Singh's Textbook of Human Histology. 8th ed. New Delhi, India: Jaypee Brothers Medical Publishers; 2016. p. 145.

Neelam V, Sabita M, editors. Inderbir Singh's Textbook of Human Histology. 8th ed. New Delhi, India: Jaypee Brothers Medical Publishers; 2016. p. 139.

Neelam V, Sabita M, editors. Inderbir Singh's Textbook of Human Histology. 8th ed. New Delhi, India: Jaypee Brothers Medical Publishers; 2016. p. 193.

Neelam V, Sabita M, editors. Inderbir Singh's Textbook of Human Histology. 8th ed. New Delhi, India: Jaypee Brothers Medical Publishers; 2016. p. 197.

Neelam V, Sabita M, editors. Inderbir Singh's Textbook of Human Histology. 8th ed. New Delhi, India: Jaypee Brothers Medical Publishers; 2016. p. 99.

