

Raktadhara Kala: The Endothelial disfunction in Covid 19**Dr. Prachi Pravin Pimparkar**Rachana Sharir,
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Abstract:

Kala is prime topic described by Acharya Sushruta in Sharir sthana. Kala is limiting membrane between the Dhaatu and Aashaya. Raktadhara Kala is a second prime Kala. It is situated in a mamsa and holds the Rakta present in Sira, Yakrut and Pleeha.

Raktadhara Kala can be correlated with endothelial lining of the blood vessels. Endothelial cells release substances that control vascular relaxation, contraction, as well as enzymes that control blood clotting immune function and platelet adhesion.

Covid-19 which is a zoonotic in origin and mostly spread through respiratory droplets. Corona Virus is a causative agent. SARs-CoV2 has spike protein which plays a key role in ACE2 receptor recognition. The second stage of covid-19 is characterized by pulmonary inflammation and coagulopathy. Normal function of Endothelium is hampered in second stage of covid-19. Increased levels of inflammatory biomarkers such as CRP, ferretin , IL-6, IL-1, D -dimer are seen .

Endothelial activation due to covid-19 and dysfunction with comorbidities are suggested for be coagulation cascade in the blood vessels.

Key Words: - Raktadhara Kala, Sira, Yakrut, Pleeha, Covid19, Spike Protein, ACE₂

Introduction: -

Ayurved sharir has many terminologies which are explained at many places in ancient campaign India. Especially many terminologies like Kandara, Kurcha Mamsarajju, Sanghat, Simanta are described in 5th chapter of Sushruta Samhita. Kala sharir is also one of them.

Acharya Sushruta mentioned the concept of Kala in Garbhvyakaran Sharir Adhaya of sharirsthan with detail development of body parts of Garbha.

Kala is limiting membrane or layers in the body situated between Dhatu and Ashaya¹.

Seven kalas are not only the limiting, covering membrane but also perform some vital functions of the body. These are special membranes in the body which are having important role in performing body physiology. They provide support and protection to the organs. The cell membranes

separating each and every cell can be considered as Kala.

Among seven Kala Raktadhara Kala is said to be second prime Kala in the body. It is situated in mamsadhara Kala (the membrane that holds muscle tissue) and holds the Rakta present in Sira, Yakrut (liver), Pleeha. (Spleen).²

Therefore, the major role of Raktadhara kala is to support Rakta and help for its circulation throughout the body. As per present knowledge of contemporary science, Raktadhara Kala, mentioned in Ayurveda can be correlated with endothelial lining of the blood vessels and sinusoids of liver and spleen³.

Kala as per Ayurveda performs vital functions of the body and any deformity or its malfunction will lead to pathology. The Doshs are moving across the body in their normal as well as in abnormal form but wherever they get suitable environment they get stuck to respective body part and results in formation of disease.

If this principle of Ayurveda is applied in case of kala then it can be said that kala can also be a sight of pathology. If Kala performs its normal functions then it will hold body physiology but when it will not able to perform its normal function then it will lead to some disease.⁴

Certain group of diseases is transmitted from one person to another by direct or indirect contact. Another group of disease is born from a common source of polluted water, air, land and or disturbed climate which refers to the board heading of “Janapadadhwasma”. Janapada means community, Dhwasma means perishing or destruction.⁵

This Janapadadhwasma is closely associated to modern scientific knowledge of epidemics. Now a day corona virus which is pandemic.

Coronavirus disease covid-19 which is zoonotic in origin and mostly spread through respiratory droplets, has caused a big threat to mankind. Outbreak of covid-19 has been declared pandemic by WHO. Novel virus belonging to corona virus CoV family is causative agent. It causes systemic disease with possible involvement of kidneys, heart, blood vessels. Severe damage to the blood vessels leads to thrombosis⁶.

AIM: -

- To study basic concept of Raktadhara Kala in Ayurveda.
- To find out applicability of Raktadhara Kala in covid19.

Objective: -

Raktadhara Kala can be one of treatment site for management of covid19.

Materials and Methods: -

Classical texts of Ayurveda – Sushruta Samhita, Astangasangraha, Astangahridaya and Sharangdhar Samhita.

Reviewing of Journals, Article, Internet Material and previous research paper related to this article are referred.

Observation: -

Kala is one of the basic structures that has been described in Ayurveda. Kala is a thin membrane, which lines the internal cavity of Ashayas (organ that hold the vital elements), blood vessels and fibrous capsule of the joints and so on.

Kala separate the Dhaatu (vital elements) and the Ashaya.

The Ashaya is the cavity that gives Ashraya (holds) to the Dosha, Dhatu and Mala (waste products of the body). The Dhatu lives in Ashaya and inner lining of the Ashaya is called Kala. If we cut wood, the cross section of a wood shows its internal structures with its different layers and parts. In the same way, we have to cut a 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 covering to reveal these Dhatus. Each Kala is different from other⁷.

According to Acharya Sushruta, Seven kalas are Mamsadhara kala, Raktadhara kala, Medodhara kala, shleshmadhara kala, purishdhara kala, pittadhars kala, shukradhara kala⁸.

Raktadhara Kala is second Kala which remains deep in mamsadhara kala.

Sira (blood vessels without pulsations), Yakurt (liver) and Pleeha (spleen) are the locations of Raktadhara Kala.²

Sushruta elaborates the characteristic feature of Raktadhara Kala with the help of simile. We take incision, a plant which produces exudate i.e., milky substance (kshiri). In the same way when there is incision to the skin, blood oozes out⁹.

Yakurt, Pleeha and Raktavahi Dhamanya are the moolsthana of Raktavaha strotas¹⁰.

Inclusion or exclusion of Dhamani makes a big difference in the basic nature of the structure of kala and strotasa.

Acharya Sushruta has described the Viddha lakshana of Raktavaha strotas are shyavangata (darkening of the skin) cyanosis, Pandu (pallor skin). These are the symptoms of mild-to-moderate hemorrhagic shock but he has not described viddha lakshana of Raktadhara kala because of Ashray Ashrayi Sambandha between Raktvaha Strotas and Raktadhara Kala⁷.

Traumatological injuries and communicable diseases damage Raktadhara kala. In viral infections such as AIDS, Dengue, Ebola thrombosis is common. So as in covid19 hypercoagulability is seen. SAR-COV2 infection can be grouped into Asymptomatic infection, mild illness, moderate illness, severe illness and critical illness. As the

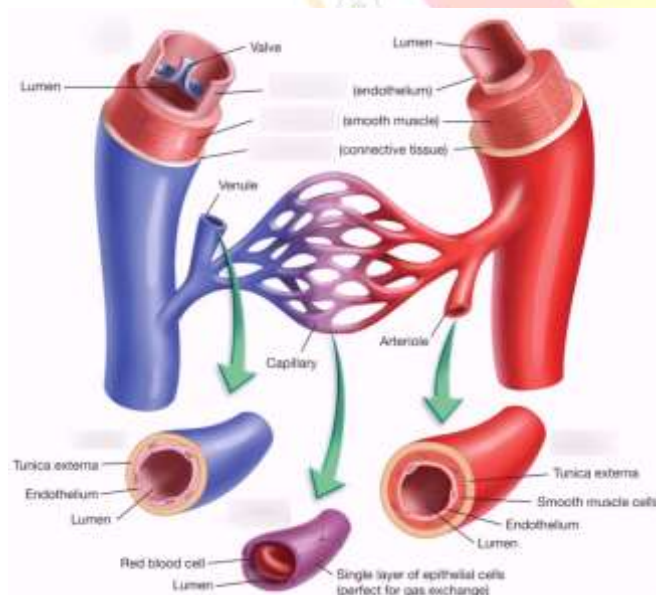
severity advances there is involvement of organs (lungs, heart, kidneys) and blood vessels¹¹.

Actually, Kala means different types of membrane like fibrous, serous and mucus, supporting and separating the fascia, septa, sheath and the capsule which covers the organ externally or internally and separates from one structure to another¹².

"Dhatva -shayan-tar maryadah" It is clear that Raktadhara Kala is a membranous limitation between Rakta dhatu and Aashaya (cavity of vessels). Raktadhara Kala is present within the capillaries, blood vessels and also the vascular organs. Sharirbhav (Dosh, Dhatu Mal) are permanu Swarup. They cannot be seen and they perform normal function to target organs. So as Rakta Dhatu, Raktadhara Kala are also permanu Swarup i.e., Microscopic¹³.

Modern science has explained the different types of blood vessels which include artery, vein, capillary, arteriole and venules. Anatomically there are three distinct layer which form wall of vessels that is tunica externa, tunica media, tunica intima¹⁴.

The three layered structure is present within all vessels.



The tunica externa and tunica media are not in direct contact with the blood. Tunica intima is direct contact with blood.

Special type of structure called sinusoids are present inside the liver and spleen in very large amount. Wall of sinusoids consists of endothelial

cells and its Prime layer which holds the blood under circulation. The wall of human heart is composed of three layers epicardium, myocardium and endocardium. The inner lining of the heart is in direct contact with blood. It merges with inner lining of endothelium of the blood vessels¹².

Covid-19 is a pandemic situation caused by respiratory virus which makes beeline for the cells lining blood vessels, filling them up like a Gumball machine and shredding the cell from Inside out. Blood vessels are blocked and blood clots are formed because of the lining damage¹⁵.

Discussion: -

Kala is important concept described in Ayurveda. Kala is one of the special membrane in the body which performs some functions to assist and maintain body physiology. Snayu pratichanna, Jarayu santat, and shleshma vestita can be correlated with fibrous, serous and mucous membranes in the body¹⁶.

Both Sushruta and Vagbhata 1 metioned that Raktadhara Kala is generally present Mamsaabhyantara. While describing manasadhara Kala both Aacharya mentioned that inside the Mansa, Sira, Dhamani, Srotases are spread. Within the muscle, Rakta is circulating in the Tubular structure i.e., Sira, Dhamani.

In modern science, blood vessels are spread inside the muscle and lined by membranous structure.

The functional aspects of Raktadhara Kala is Raktadhatu which carries 'Pranavayu' and cells present in Raktadhatu are responsible for Jeevan Kriya. Raktadhara Kala is holding the Rakta and it gives protection to the Raktadhatu. Life is holded or protected by Raktadhara Kala. रक्तं जीव इति स्तिति.

Blood is in direct contact with tunica intima and sinusoids of liver and spleen. It flows through the lumen or interior opening of the vessel. The main component of tunica intima and sinusoids are endothelium which lie the entire vascular tree including heart and lymphatic vessels. Endothelium is thin layer of flattened cells that lines the inner surface of entire cardiovascular system. Sub endothelial layer, basement membrane and internal elastic lamina forms tunica intima¹⁷.

Raktadhara Kala is considered as semipermeable barrier separating lumen from the

vessel wall. Endothelium is recognised as a complex endocrine organ responsible for variety of physiological processes vital for vascular homeostasis. Endothelial cells transduce a wide range of physiological stimuli, produce a variety of signalling molecules that exerts autocrine and paracrine effects. Therefore, endocrine system is responsible for maintaining vasomotor tone, haemostasis thrombosis, inflammatory processes, platelet leukocyte vessel wall interactions and controlling vascular permeability¹⁶.

In viral infections such as AIDS, Dengue, Ebola, thrombosis is common. The present era which is fearful due to rapid cases of covid-19 throughout the world. It has heavily affected the global population with more than 5.2 million infected and more than 337000 death are recorded.

Structure of corona virus

Corona virus particles are organised with long RNA Polymers tightly packed into the centre with nucleocapsid and surrounded by a protective capsid. Membrane glycoprotein (M), Spike protein (S) and Envelop protein (E) are present in corona virus.¹⁸

Stages of Covid19

Covid-19 has three consecutive stages in increasing severity.

First stage is characterized by infection with SARs-Cov2/covid. In this stage flu-like symptoms develop, subsequently patient can develop viral pneumonia requiring hospitalization and mechanical ventilation.

2nd stage is also characterized by pulmonary inflammation and coagulopathy. Increased levels of inflammatory biomarkers such as C-reactive protein (CRP), Ferritin, IL-6, IL-1 and D dimer are seen.

the final stage is fibrosis of lungs.¹⁹

In the second stage of covid 19, coagulopathy is seen. There is involvement of endothelium of blood vessels take place. This article is associated with endothelium of blood vessels i.e., Raktadhara Kala in covid-19.

As the spike protein (S) of SARs-Cov2 plays key role in ACE2 receptor (present in lungs, heart, Kidneys, liver and blood vessels) recognition and cell membrane fusion process. Replication and dissemination of SARs-Cov2 in systemic circulation

lead to extrapulmonary manifestation which play a major role in the disease progression.

In the body increased number of virus causes the host cell to undergo pyroptosis and release the damage associated molecular pattern (DAMPs), including nucleic acid, ASC oligomers. DAMPs recognition receptors are present on the lung's epithelial cells, endothelial cells of blood vessels, and alveolar macrophages. Triggering the generation of pro-inflammatory cytokines and chemokines are released. Recognition of viral RNA triggers type 1 interferon production (IFN α , IFN β) which protects from viral infection. SARs COV 2 is sensitive to IFN1. The young individuals after recognition of viral DAMPs, the Type 1 interferon is secreted and Virus replication is inhibited. That is why majority of the cases being asymptomatic but in the old individuals with comorbid conditions due to immune senescence, delayed IFN1 production may lead to the recruitment of inflammatory cells i.e. monocytes, macrophages and neutrophils. These cells secrete the use of pro-inflammatory cytokines known as cytokines storms that damage the lung alveoli causing ARDS.

Endothelial activation due to covid-19 and dysfunction with comorbidities are suggested to be related to the coagulation cascade.²⁰

covid-19 inducing a greater hypercoagulability SARs Cov-2 to infection induces the production of cytokines, resulting in a systemic inflammatory reaction which causes cytokine storm. Higher cytokine concentration can lead to systemic thrombus formation. Vascular endothelium by SARs Cov-2 appear to be involved in covid-19 thrombogenesis.

Covid-19 seems to attack the endothelial inside blood vessels. Raktadhara Kala mentioned in Ayurveda has great similarity with that of endothelial lining of blood vessels. Covid-19 a viral infection is associated with damaging the endothelium of the blood vessels.

So, keeping in mind the concept of Kala told by Ayurveda the treatment approach to this life-threatening viral infection can be obtained. Further research is needed for curing covid-19 conditions. Immuno boosters Drugs in Ayurveda helps in preventing covid-19. But what about curing patient at cytokine storm? Ayurvedic research is needed.

Conclusion: -

Kala described in Ayurveda are special membrane in the body present between Dhatu - Aashaya which performs the vital functions in the body.

‘Dhatva - shyantar maryadah’ it is clear that Raktadhara kala is membranous structure between Raktadhatu and Aashay.

Raktadhara kala is parmanu Swarup as said by Acharya Charaka. so, it can be correlated with Endothelial linings present in Tunica intima and sinusoids of liver spleen. Endothelial cells are responsible for maintaining vasomotor tone, haemostasis, thrombosis, inflammatory process, platelet and leucocytes vessel wall interactions and controlling vascular permeability.

Spike like projections are recognized by receptor proteins on the host cells. corona virus infects lung cells through receptor for Enzyme ACE2 present in heart, kidneys, blood vessels.

Thus, endothelium is injured causing vascular damage. To protect from direct or indirect damage, host innate defensive mechanism of blood clotting, vasoconstriction.

Thus, Raktadhara kala can be considered as one of the treatment sites for covid- 19.

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