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Analytical Study of *Raktvaha Srotas* and *Raktavahi Sira* w.s.r. to Enucleated Erythrocyte

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ABSTRACT

Dhatus are the constitutional elements of the body having properties of *Dhaaran* and *Poshan* and to restore their specific function is the principle of Ayurveda. *Rakta Dhatu* is the base of living being as it maintains life. To fulfill this purpose, *Rakta* circulates to each n every cell of body through its channel (*Raktavaha Srotas*). *Acharya Charaka* described only two *moola* of this *Srotas* viz *Yakrit* and *Pleeha.* Liver and spleen is the productive site and *Raktavahi Dhamni* (By *Sushruta*) are the conductive site to be consider as *Raktavaha Srotomoola* as *Srotas* includes *Ashaya, Dhamni, Rasayni, Sira* etc. *Raktavahi Sira* are the conductive sites of *Rakta Dhatu* i.e., the vessels loaded with newly formed blood cells. Life is the chief function of *Rakta Dhatu* as it conducts *Prana* to every *Dhatu* of body. So *Rakta Dhatu* should be considered in treatment of *Pranakshaya*, *Sammoha* (weakness, malaise, faint etc). *Dhatu Kshaya* and *Vriddhi* of other *Dhatu* are dependent on *Rakta Dhatu. Snayu* and *Sira* are formed during the formation of *Rakta Dhatu* as they are the *Upadhatu* of it. So, in the vitiation of them (diseases of *Snayu* & *Sira*), *Rakta Dhatu* should be considered in treatment plan. In *Raktajvikaar* like *Raktakshayaja* (Anemia, thrombocytopenia, leukopenia, Polycythemia, leukocytosis, thrombosis), *Rakta* should be primarily considered and for that *Yakrit* and *Pleeha* should also be considerable in management of above.

Key words: *Enucleated Erythrocyte, Erythrocyte, Raktavahasrotas, Raktavaha Sira, Yakrit.*

INTRODUCTION

In Ayurveda *Dhatus* are the constitutional elements of the body as *Dosha*, *Dhatu* and *Mala* are the building blocks of body.[1]. Dhatu have properties of *Dharan* and *Poshan* and to restore their specific function is the principle of *Ayurveda*. The human body is a conglomeration of the *Srotas* to facilitate the circulation "*Srotas*" can be described as channels or passages where nutrition flows, interact and transfers. *Rakta Dhatu* is the base of living being as it maintains life. To fulfill this purpose *Rakta* circulates to each n every cell of body through its channels (*Raktavaha Srotas*). *Yakrit* and *Pleeha* are the two *moolas* of this *Srotas*. *Rakta Vahi Sira* is one of the four types of *Sira* on the *Dosha*.

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REVIEW OF RAKTA DHATU

Sushruta said that four factors are responsible for any deviation of body from its homeostatic state namely *Vata*, *Pitta*, *Kapha* and *Rakta,* and body is always constituted by these.[4] *Rakta* is the fourth entity which is responsible for existence and maintenance of living body. This *Rasa Dhatu* though *Apya* (liquid, possessing actions of water), after reaching *Yakrit* and *Pleeha* attains red color due to the action of *Teja*[5] and *Ranjaka Pitta*.[6],[7]

Life is the chief function of *Rakta Dhatu*[14] as it conducts *Prana* to every *Dhatu* of body. *Rakta* brings

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luster to skin color, nourishes *Mamsa Dhatu.*[15] *Kshaya* and *Vriddhi* of other *Dhatu* depends on *Rakta Dhatu.*[16] *Upadhatu* of *Rakta Dhatu are Kandara* & *Sira*[18] and the *Mala* is Pitta.[19] This is the reason why its qualities resemble with that of *Pitta* and is affected by *Pitta* dominant *Aharvihar.*

Raktavaha Srotas

Liver (*Yakrit*) and spleen (*Pleeha*) are roots of *Raktavaha Srotas.*[10] According to *Sushruta*, Liver and spleen are sites of formation and vitiation of *Rakta Dhatu*[11] and blood vessels supplying *Rakta* is also a root of *Raktavaha Srotas*. *Raktadhara Kala* is present inside liver, spleen and blood vessels. It is concerned with formation and storage of *Rakta Dhatu.*[12] Liver and spleen are considered as *Raktashaya* (organ where blood is stored) or controlling organs of this system.[13]

Rakta Vahi Sira

In the disrciption of *Sira, Acharya Sushruta* has mention four types of *Sira* on the basis of *Dosha* vis *Vataja, Pittaja, Kaphaja, Raktaja Sira*. Out of this *Raktaja Sira* is having characteristics Red in color and neither they are neither too hot nor too cold. These *Sira* nourishes the *Dhatu*, improves the complexion, causes a definite perception of *Sparsa* and maintain normal functions of the body.

Hemopoiesis

The first wave of primitive hematopoietic and endothelial cell development occurs via signals to the extraembryonic, endodermal yolk sac within the first two weeks of gestation, which results primarily in the formation of EryP (primitive erythrocyte), megakaryocytes, macrophages, and the endothelium.[25] These EryP cells are distinct from their erythroid progenitors in that they are larger, nucleated, have embryonic globin and are detected only in the yolk sac. EryP help in the formation of blood islands in which the centrally placed cells give rise to erythroid and myeloid cells while peripherally placed cells form endothelial cells that form these channels. These blood islands fuse to form vascular channels that span throughout the yolk sac. Through these vascular channels, oscillatory plasma flows containing EryP cells and various other primitive cell types, which is stimulated by the developing heart.[25] Once in circulation, the EryP cells are enucleated by the fetal liver and macrophages clear the nuclei. EryP cells continue to form only for a short period once vascular channels develop in the yolk sac while the remaining progenitor cells continue to mature and remain in the bloodstream until at least birth.[26] Hematopoietic stem cells (HSC) emerge from a specialized hemogenic endothelium within a limited region of para-aortic splanchnopleure colonizes the fetal liver by the 7th week of gestation, where they cycle at a continuous pace and begin to differentiate. At this point, the liver becomes a significant source of hematopoietic stem cell production. HSC cells also colonize the spleen around week 20 and produce red cells for a brief period. A vital organ that HSC starts colonizing around this time is the bone marrow. HSC seeding in the marrow is critical because it is the bone marrow that will predominate in erythropoiesis as gestation advances. The fetal liver provides the microenvironment needed for expansion and differentiation of definitive HSCs, from which definitive erythroid cells will differentiate from a hierarchy of progenitors. HSC in the fetal liver and spleen produces enucleated erythrocytes (EryD) that rapidly outnumber EryP cells in circulation.

EryD cells express fetal hemoglobin (HbF) and are composed of two γ-globin chains and two adult alpha-globin chains. HbF remains the predominant hemoglobin for most of gestation.[28] A switch from the HbF to adult hemoglobin (HbA) occurs at about 32 weeks and continues after birth. There is a transcriptional change from gamma- to beta globin, marking the end of erythroid ontogeny.

Toward the third trimester of development, as skeletal components begin ossification and bone marrow is developing inside bony cavities, the marrow of specific bones will become the essential hematopoietic organ. Both the liver and spleen at this point cease erythropoiesis as the bone marrow predominates in hematopoietic cell production. In postnatal life, definitive erythropoiesis originates from

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the bone marrow (BM) that occurs under normal physiologic conditions. In infants, all spongy bone and trabecular bone produce RBC. However, in adults, RBC production is limited to the vertebra, sternum, ribs, and proximal ends of long bones. HSCs in the BM give rise to all mature hematopoietic cells through a series of intermediate progenitors.[29]

Discussion

Raktavaha Srotas is the channel dealing right from formation to circulation of *Rakta Dhatu* (blood corpuscles) i.e., *Acharyas Charaka* has mentioned only *Yakrit* and *Pleeha* as *Raktavaha Sroto Moola*. In contemporary science it is mentioned that beside liver and spleen, yolk sac and bone marrow are also the sites of hemopoiesis. But erythrocyte produced by yolk sac are nucleated i.e., having large size nucleus having no space for Hemoglobin while Erythrocyte formed by liver and spleen are enucleated enrich with abundant hemoglobin. The fetal liver provides the microenvironment needed for expansion and differentiation of definitive HSCs, from which definitive erythroid cells will differentiate from a hierarchy of progenitors. Though erythrocyte formed by bone marrow are also enucleated but during the development of human (embryogenesis) liver and spleen are the major and initiative organs for enucleate erythrocyte (hemopoiesis) for most of the intrauterine life. Liver and spleen are the productive site and *Raktavahi Dhamani* are the conductive site to be consider as *Raktavaha Srotomoola* as *Srotas* includes *Ashaya, Dhamni, Raktavahi Dhamni* etc. *Raktavahi Sira* are the conductive sites of *Rakta Dhatu* i.e., the vessels loaded with newly formed blood cells.

Life is the chief function of *Rakta Dhatu* as it conducts *Prana* to every *Dhatu* of body. So *Rakta Dhatu* should be considered in treatment of *Pranakshaya*, *Sammoha* (weakness, malaise, faint etc). *Rakta* brings luster to skin color and according to *Arundatta*, *Ojovriddhikar* is one of the *Karma* of *Rakta Dhatu*. So *Rakta Dhatu* is considerable in treatment of *Prabha Vikaar* (Hyperpigmentation, decreasing glow of skin, freckle, blemishes etc.). It nourishes *Mamsa Dhatu*, *Kshaya* and *Vriddhi* of other *Dhatu* are dependent on *Rakta Dhatu. Snayu* and *Sira* are formed during the formation of *Rakta Dhatu* as they are the *Upadhatu* of it. So, in the vitiation of them (diseases of *Snayu* & *Sira*), *Rakta Dhatu* should be considered in treatment plan. In *Raktajvikaar* like *Raktakshayaja* (Anemia, thrombocytopenia, leukopenia, and *Raktavriddhija* (Polycythemia, leukocytosis, thrombosis) *Rakta* should be primarily considered.

Conclusion

On the above said basis only *Pleeha* and *Yakrit* as *Moolasthana* of *Raktavaha Srotas* can be considered as both produce enucleated erythrocyte and are the initiative site of hemopoiesis in the developmental journey of human being. In addition, liver provides the microenvironment for hemopoiesis. *Raktavahi Dhamni* and *Raktavaha Sira* are the conductive sites. *Moola* should be considerable in the management of *Rakataja Vikaras.*

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