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Conceptual study of Hematopoiesis (*Raktotpatti*)

Kuldeep Kumar^{1*} and Ashok Kumar²

¹PG Dept. of Rachana Sharir, NPA Govt. Ayurveda College, Raipur, Chhattisgarh, India

²PG Dept. of Kriya Sharir, NPA Govt. Ayurveda College, Raipur, Chhattisgarh, India

ABSTRACT

Ayurveda is an ancient and broad source of fundamental principles related to medical science. Many more principles of modern science are influenced by *Ayurveda*. *Sushrut Samhita* is one of the oldest treatises in the world dealing with surgery while *Charak samhita* deals in medicine. In *Ayurveda*, the process of formation of *Raktadhatu* was explained many years ago. Modern science has given almost same concept but hematopoietic organs are described differently in foetal life and after birth.

Acharya Sushrut says that *Raktadhatu* (blood) itself is a *jeev* (life) because loss of blood mostly leads to death. The blood plays a very important role in our body. All the nutritional elements reach entire parts in the body through blood and keeping us at an abeyance from diseases. So, it is important to know the concept of the formation of the *Raktadhatu* in *Ayurveda* as well as the concept of hematopoiesis in modern science in parallel. While diagnosis and making prognosis of any *Raktaj vyadhi*, one can perform some RBCs related investigations may prove very helpful. Therefore, the study of these two concepts is very essential.

KEYWORDS

Raktadhatu, Ranjak pitta, Raktagni, Srotas, Moolasthan, Yakrit, Pleeha, SaraktaMeda



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INTRODUCTION

According to *Ayurveda*, the body is a combination of seven *Dhatus*'. *Raktadhatu* is second *Dhatu* in the body which is formed after the formation of *Rasadhatu* in *Dhatuposhan kram*. It performs many vital functions and is quite essential for *Dehadharan*. Its vitiation as well as imbalance causes various sign and diseases that hamper normal health of the body. According to modern science RBC are red cells present in the blood. Function and properties of RBC are very much similar to *Raktadhatu*.

In *Ayurveda*, *Yakrit* and *Pleeha* are mentioned as organs of hematopoiesis. Almost all the *Acharyas* have same opinions about the formation of *Raktadhatu*. *Tejo Dravyatmak Ahar*, *Ranjak pitta* and *Raktagni* are the essential substances responsible for the formation of *Raktadhatu*. Modern science also accepts that liver and spleen are the hematopoietic organs in the foetal life but after birth liver and spleen are replaced for the hematopoiesis by red bone marrow of long and flat bones.

RAKTADHATU-: All *Acharyas* of *Ayurveda* have mentioned that seven *Dhatu* are present in the body. *Raktadhatu* is one of them which is formed after the formation of *Rasadhatu* in *Dhatuposhan Kram*¹.

Raktadhatu is also mentioned under the group of *Dasha Pranayatana* (seats of life). *Raktadhatu* should be regarded as pure when it has colour like that of heated gold, red velvet mite, red lotus, lac and *gunja* (abrus seed)².

According to *Ayurveda* the *Raktadhatu* is also named as *Rudhir*, *Lohit*, *Shonit*, *Ashrik*, *Kshataj* which indicate the red colour. Total amount of *Raktadhatu* in the body is eight *Anjali*. *Acharya Sushrut* has stated about the importance of *Raktadhatu* that it is a *Moola* of the body because it provides nutrients so that, the body is maintained by *Raktadhatu*. Therefore it should be protected by all efforts. *Raktadhatu* itself is a life because loss of *Rakta* mostly leads to death³. The *Raktadhatu* enhances the tone and complexion of skin. The whole physiology of the body is totally dependent on *Raktadhatu* because it strengthens the body and keeps it healthy. So that the *Raktadhatu* increases life span and keeps the person active⁴.

RAKTAVAHA SROTAS-: The word *Srotas* has originated from Sanskrit root which means to flow or to circulate⁵. *Srotas* is a hollow transporting channel through which some vital substances like *Prana*, *Udaka*, *Anna*, *Dosha*, *Dhatu*, *Mala* etc are transported from one place to another⁶.



Acharya Charak has mentioned 13 *Srotas* while *Acharya Sushrut* has mentioned 11 pairs. They have described their specific *Moolasthan* (roots)⁷. The organ whose proper functioning is very important and needful for healthy status of *Srotas* and any abnormality or disease occurring in that organ will produce symptoms of *Srotodushti* in concern *Srotas*, is called as a *Moolasthan* (root) of that *Srotas*⁸. *Acharyas* stated that *Yakrit* (liver), *Pleeha* (spleen) and *Raktavahi Dhamani* are the roots of *Raktavaha Srotas*. So, any abnormality in these organs will cause alteration in function of the *Raktavaha Srotas* and many symptoms are produced due to *Raktavaha Srotodushti* and finally affected by many *Raktaj vyadhi* (blood related diseases).

Raktavaha Srotas are the channels which carry *Raktadhatu* from one place to another place in the body. Therefore they may be compared with blood circulatory system of the body. So, the microscopic, macroscopic, large, small or rounded structures which carry the blood within it are called *Raktavaha Srotas*. *RohiniSira* (artery) and *NeelaSira* (vein) should be included under the term *Raktavaha Srotas* and capillaries of these *Sira* may be taken under the term microscopic structure.

RANJAK PITTA -: *Ranjak pitta* is one of five pitas which present in the body. *Ranjak* means coloring agent that gives specific color to the tissue by the process of *Ranjan*. *Pittas* have their specific sites in the body. Almost all *Acharyas* of *Ayurveda* have same opinions about the site of *Ranjak Pitta* that are *Yakrit* (liver) and *Pleeha* (spleen) but *Acharya Vagbhat* has described the *Amashaya* (stomach) as the site of *Ranjak Pitta*⁹.

Acharya Sushrut says when the *Ahar Rasa* passes through *Yakrit* and *Pleeha*, it gets converted into *Raktavarna* (red color) due to the process of *Ranjan* by the heat of *Ranjakagni* which is situated there. So, it is clear that *Ranjak Pitta* is also called *Ranjakagni* and it bestows *Raktavarna* to *Rasadhatu*¹⁰.

RAKTOTPATTI -: In *Ayurveda*, four *Nyayas* of *Dhatuposhan* are explained through which we can understand the formation of *Raktadhatu*. First, *Ksheeradadhi nyaya* (Transformation theory) explains that *Ahar Rasa* completely converts into *Rasadhatu* and then *Rasadhatu* transforms into the *Raktadhatu*. Before the formation of *Raktadhatu*, only *Rasadhatu* circulates into the body¹¹. Second, *Kedarikulya nyaya* (Transportation theory) explains that different *Dhatus* of the body



get nutrition one by one in sequence through vessels. So, *Rasadhatu* gets nutrition from *Ahar Rasa* then *Raktadhatu* from the rest part of *Ahar Rasa* and likewise till the last *Shukradhatu*¹². Third, *Khalekapota nyaya* (Selectivity theory) explains that all *Dhatus* are directly nourished by *Ahar Rasa* without considering the sequence of nutrition. The *Ahar Rasa* circulates to the different *Dhatus* through different channels. In the beginning, the nearby *Dhatu* gets nourishment from *Ahar Rasa* and the distant one gets nourished later. This theory believes that each *Dhatu* has its specific nutrient called *Poshakamsha*¹³. Fourth, *Ek Kaala Dhatusposhan nyaya* (Simultaneous nourishment theory) has been introduced by the commentator *Arun Datta* and he says that the *Ahar Rasa* nourishes all the *Dhatus* simultaneously through the respective *Srotasa* of that *Dhatu*¹⁴.

All *Acharyas* of *Ayurveda* have mentioned that *Tejo dravya* (blood forming elements) of *Ahar Rasa* (digested food) are converted into the *Raktadhatu* by the action of *Ranjak Pitta* and *Raktagni*. The quantity and quality of *Raktadhatu* mostly depends upon the intake of *Tejo Dravyatmak Ahar*. Intake food must first be digested by the *Jatharagni* and produces *Ahar Rasa* which is then digested by *Rasagni* to produce

Rasadhatu and its related tissues. Some part of *Rasadhatu* is then digested by *Raktagni* and at the time *Ranjak Pitta* gives red color to *Rasadhatu*. This produces red colored specific substance called *Raktadhatu*. When *Raktagni* is functioning properly and has received adequate *Rasa* for transformation, the *Rakta* produced will be of an ideal quantity and of better quality.

So, according to *Ayurveda* the essential substances for the formation of *Rakta* are the *Tejo Dravyatmaka Ahar*, *Ranjak pitta* and the *Raktagni*. Absence of any one of them, it is not possible to form *Raktadhatu*.

HEMATOPOIESIS -: In human life, production of the blood starts from 3rd week of intrauterine life. Between the 3rd week till 3rd month of intrauterine life, erythropoiesis occurs within the blood vessels in the mesoderm of yolk sac. It is called intravascular erythropoiesis. Between 3rd to 5th month, erythropoiesis occurs principally in the liver and partly in the spleen. After 5th month of intrauterine life and after birth erythropoiesis occurs in the red bone marrow. When there is extreme necessity of producing RBCs in some diseases after birth, erythropoiesis can occur in the liver and spleen also. In the red bone marrow, hematopoietic stem cell (HSC) is formed from totipotent stem cell and from



HSC; committed stem cells (progenitor cells) are formed. From progenitor cells, the pronormoblast cells then early normoblast develops. Early normoblast produces intermediate normoblast. Intermediate normoblast gives rise to late normoblast. From late normoblast, reticulocyte develops and reticulocyte gives rise to matured RBCs¹⁵.

Some factors which influence the erythropoiesis are (1) Hematopoietic Growth Factors (HGF) which includes erythropoietin, myeloid growth factors and thrombopoietin. HGF stimulate the production of different blood cells. Erythropoietin is a glycoprotein which is mainly (90%) produced by the kidney and partly (10%) by the liver. (2) Vitamins include vitamin B₁₂, folic acid, pyridoxine and vitamin C. (3) Iron¹⁶.

Vit B₁₂ is not synthesized by human beings, so they depend on food or medicine for this vitamin. Vit B₁₂ combines with intrinsic factor which is secreted by parietal cells of the stomach then it travels down to the terminal intestine. After absorption from the ileum, Vit B₁₂ being bound with transcobalamine-2 and reach to the liver where it is stored. From the liver, Vit B₁₂ goes to red bone marrow and other organs.

Folic acid is mainly found in vegetable foods. In the human intestine, it is absorbed from the upper part of small intestine then it enters the blood stream. In the blood, it converts into methyl tetrahydrofolate (CH₃FH₄). Methyl radical (CH₃) is captured by cobalamin (Vit B₁₂) which thus becomes methyl cobalamin and free FH₄ is the active form of folic acid. If free FH₄ is not formed, no maturation and cell division of primitive erythroblast can occur. This means, in total absence of Vit B₁₂, folic acid is useless. Pyridoxine and Vit C also play important roles in erythropoiesis.

Iron is required for the synthesis of Hb, myoglobin and cytochrome oxidase. Food iron is of two types - (1) Heme iron which present in food (2) Non-heme iron which is inorganic iron. Usually, the bulk of food iron is non-heme iron and these are in ferric (Fe³⁺) state. It is absorbed mostly from 2nd part of duodenum then it converts into ferrous (Fe²⁺) state by iron reductase enzyme. Ferrous iron is absorbable. Iron is extracted from heme during formation of bilirubin in the liver and ultimately sent to bone marrow for reutilization¹⁷.

DISCUSSION

According to *Ayurveda* three essential substances are required for the formation of



blood that are *Tejo Dravyatmak Ahar*, *Ranjak Pitta* and *Raktagni*. *Tejo Dravyatmak Ahar* means dietary requirements of hematopoietic elements like iron, copper, cobalt, folic acid, vitamins etc. These elements accelerate the process of hematopoiesis. The quality and quantity of *Raktadhatu* depends upon the intake of the *Tejo* elements. Food must first be digested by the *Jatharagni* (digestive enzymes). This produces *Ahar Rasa* which is then digested by own *Agni* of *Dhatu* to produce corresponding *Dhatu*. In this sequence, when *Rasadhatu* is digested by *Raktagni*, the *Raktadhatu* and its related tissues produced.

The substance which gives red color to blood is *Ranjak Pitta*. The red color of blood is attributed by hemoglobin (Hb) which present in RBCs. Hb is a red, oxygen carrying pigment of blood. It consists of the protein globin united with the pigment heme. Heme is an iron containing porphyrin called ironprotoporphyrinIX and the iron in heme is in the ferrous (Fe^{2+}) form¹⁸. According to *Ayurveda*, *Ranjak Pitta* is located in *Yakrit* and *Pleeha*. In human body, iron is stored as ferritin and hemosiderin. 30% of iron is stored in liver, 30% in red bone marrow and rest in spleen and muscles. So, we can say that ferritin and

hemosiderin form of iron is the coloring agent of blood and is similar to *Ranjak Pitta*.

Acharya Vagbhat has stated that *Ranjak Pitta* is located in *Amashaya* (stomach). In the stomach, parietal cells secret a type of glycoprotein called castle's intrinsic factor (CIF). The CIF is essential for the absorption of VitB_{12} . Vit B_{12} combines with CIF and travels down to the terminal intestine. After absorption from the ileum, combined vit B_{12} reaches to the liver and stored there. From the liver, vit B_{12} goes to red bone marrow to participate the hematopoiesis. Therefore, the castle's intrinsic factor may represent *Vagbhat's Ranjak Pitta*.

Ayurveda mentioned the *Raktagni* as an important factor for the formation of blood. Modern science has also accepted an another factor besides vitamins and iron that is Hematopoietic Growth Factor (HGF) which includes erythropoietin, myeloid growth factor, thrombopoietin and interleukins. The HGF are the regulatory proteins which stimulate the production of different blood cells. Functions of HGF are much similar to the function of *Raktagni*.

Ayurveda says that the *Yakrit* and *Pleeha* are the organs where *Raktadhatu* is formed. In the intrauterine life, from 3rd week to 3rd month hematopoiesis occurs in the blood



vessels of yolk sac. From 3rd month, hematopoiesis occurs mainly in the liver and partly in the spleen. Liver also produce various hematopoietic growth factor. After birth the formation of blood is processed in red bone marrow of long and flat bones. *Ayurveda* has not given any reference of that. Liver and spleen are not involved directly but some substances which come from these organs to red bone marrow, are participate the hematopoiesis.

According to *Ayurveda SaraktaMeda* is present in small bones. Though the hematopoietic function of *SaraktaMeda* is not described in *Ayurveda*, yet it may be red bone marrow.

CONCLUSION

After this conceptual and correlative study we found out some important facts about hematopoiesis. *Ayurveda* and modern science have almost same opinions about hematopoiesis in intrauterine life. After birth hematopoiesis takes place in red bone marrow but *Ayurveda* has not given any reference of that. In *Ayurveda*, liver and spleen are described as hematopoietic organs because many hematopoietic substances come to red bone marrow from liver and spleen. So, these organs are indirectly involved in hematopoiesis.

Sarakta Meda can be compared with red bone marrow. *Ranjak Pitta* is a main coloring agent of *Raktadhatu* which is similar to iron and castle's intrinsic factor. Concept of *Raktagni* can be much similar to the function of various HGF.



REFERENCES

1. Charak Samhita – Jadavji Trikamji (Chakrapaniteeka) – Satyabhamabai pandurang Mumbai
2. Charak Samhita – Shri Kashinath Shastri – Chowkhambha vidyabhavan Varanasi 1
3. Sushrut Samhita, 5th ed. – Dr. Ambikadatt Shastri – Chawkhambha Sanskrit sansthan Varanasi
4. Sharangdhar Samhita – Shri Bramhanand Tripathi – Chowkhambha Sanskrit series Varanasi
5. Shabdakalpadrum – Shri Varada Prasad – Chowkhambha Sanskrit series Varanasi 1, P-467
6. Charak Samhita – Jadavji Trikamji (Chakrapani teeka) – Satyabhamabai pandurang Mumbai
7. Sushrut Samhita, 15th ed. – Pt. B. G. Ghanekar – Meherchand laxmandas publication New delhi
8. Sushrut Samhita, 15th ed. – Pt. B. G. Ghanekar – Meherchand laxmandas publication New delhi
9. Ashtang Hridayam, 13th ed. – Kaviraj Atridev Gupt – Chaowkhambha Sanskrit series Varanasi
10. Sushrut Samhita, 5th ed. – Dr. Ambikadatt Shastri – Chawkhambha Sanskrit sansthan Varanasi
11. Charak Samhita – Jadavji Trikamji (Chakrapani teeka) – Satyabhamabai pandurang Mumbai
12. Sushrut Samhita, 6th ed. – Dalhan teeka
13. Charak Samhita – Jadavji Trikamji (Chakrapani teeka) – Satyabhamabai pandurang Mumbai
14. Ashtang Hridayam – Arundutta Teeka – Chawkhambha Sanskrit sansthan Varanasi
15. Concise Medical Physiology, 6th ed. – S. K. Chaudhari – New central book agency Kolkata
16. Human Physiology, 11th ed. – C. C. Chatterjee – Medical allied agency Calcutta
17. Concise Medical Physiology, 6th ed. – S. K. Chaudhari – New central book agency Kolkata
18. Complete Medical Physiology – Dr. A. K. Jain – Avichal publishing company Sirmour (H.P.)