

PHYSIOLOGY OF HEMOPOIETIC SYSTEM IN AYURVEDA

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Abstract

Physiology of hemopoietic system is one of the topics which have been described in depth in Ayurvedic literature. In Ayurveda, the term 'Rakta' though means blood in general, it stands for Red Blood Corpuscles (RBCs) physiologically. In fact, 'Jiva' is another synonym of 'Rakta'. In the Sharngadhara Samhita, 'Jiva' is said to be nourished by a nectar-like substance derived from external atmosphere through the act of respiration. This explanation is indicative of the process of combination of oxygen with hemoglobin present in RBCs during respiration. This nectar-like principle is then supplied to all other tissues through 'Rakta'. As per Caraka Samhita, during the second stage of digestion, called 'Amla Avasthapaka', a substance called 'Achchha Pitta' is released into the small intestine. This is liquid in nature. Also, this is 'Malarupi'. Incidentally, the 'Mala' (byproduct) of 'Rakta' is also 'Pitta'. Moreover, the symptoms produced because of 'Pitta Vrddhi' refer to jaundice. So, 'Malarupi Pitta', is nothing but bilirubin, which, in fact, is the metabolic byproduct of hemoglobin. Also, 'Yakrit' and 'Pliha' are the organs basically related to Hemopoietic system ('Raktavaha Srotas'). Liver, in fact, produces RBCs during fetal life. Its role in storage of Vitamin B-12, Folic Acid and Iron is also well known. All these substances are required for normal Erythropoiesis. Spleen is the site where RBCs are destroyed after they have completed their life span. According to Vagbhata, the site of 'Ranjaka Pitta' is 'Amashaya (Stomach)'. Role of gastric intrinsic factor secreted by parietal cells of stomach is well known as far as the absorption of Vitamin B-12 is concerned. 'Sarakta Meda' is the term used in Sushruta Samhita to indicate the red bone marrow, and as the ratio of blood cell precursors and fat cells is 1:1 in red bone marrow, this term is highly scientific. Indication of liver in the treatment of extreme cases of blood loss is also highly rational because of its Vitamin B-12 content.

In 1934, Nobel Prize in physiology or medicine was awarded to three scientists viz., William Murphy, George Minot and George Whipple. Their discovery was related to the development of an effective therapy for pernicious anemia (a condition where, the bone marrow fails to produce mature, oxygen-carrying red blood cells). Together, they discovered that feeding patients with liver cured the disease. Whipple, purposefully induced anemia in dogs by extracting blood. He found that when the dogs were fed liver, their hemoglobin levels were restored.

But, surprisingly, this discovery was a mere re-discovery of the fact known to Ayurvedic stream of medical science. Sushruta too had performed similar experiment and had found similar results.

This has been described as follows:

अतिनिःसृतरक्तो वा क्षौद्रयुक्तो पिबेदसृक्।

यकृद्वा भक्षयेदाजमामं पित्तसमायुतम् ॥¹

(When there is extreme loss of blood, one should consume raw goat liver with all its contents. Consumption of fresh blood mixed with honey is another alternative.)

It is now known that it is actually the Vitamin B-12 that is stored in liver and is helpful in the treatment of this kind of anemias.

This explanation proves that ancient Ayurvedic scholars had a good understanding about the functioning of hemopoietic system.

Some other interesting references on this topic are as follows:

Oxygenation of blood through the act of respiration

नाभिस्थः प्राणपवनः स्पृष्ट्वा हृत्कमलान्तरम् ।

कण्ठात् बहिर्विनिर्याति पातुं विष्णुपदामृतम् ॥

पीत्वाचांबरपीयूषं पुनरायाति वेगतः ।

प्रीणयन् देहमखिलं जीवं च जठरानलम् ॥³

(Because of the activity of 'Prānavāta', which is situated in 'Nabhi', ['Nābhi' is probably indicative of respiratory center because, the site of 'Prān?ā Vāta' is described to be 'Head'] a nectar-like substance is consumed through the act of respiration. This substance in turn, nourishes the whole body, 'Jīva' (Blood) and also 'Jatharāgni' - the digestive and metabolic principles.)

This explains the purpose of respiration indicating oxygenation of blood.

Red Bone Marrow:

स्थूलास्थिषु विशेषेण मज्जास्त्वभ्यन्तराश्रितः।

अथेतेषु सर्वेषु सरक्तं मेद उच्यते॥³

(In the cavities of larger bones 'Majjā' is present. In the smaller bones 'Sarakta Meda' is situated.)

In fact, in an adult, red bone marrow is found mainly in cranial bones, ribs, vertebrae, pelvic bones and sternum. Blood cell precursors and fat cells are present in the ratio of 1:1 in the red bone marrow histologically. 'Sarakta Meda' is therefore, the most appropriate term to designate red bone marrow.

'Rakta Gaurava' has been described as a feature of 'Majjā-Vrddhi' in Astanga Sangraha and is indicative of increased viscosity of blood in conditions where bone marrow is hyper-proliferative i.e., conditions like polycythemia.

Role of Stomach in erythropoiesis:

आमाशयाश्रयं पित्तं रञ्जकं रसञ्चनात् ॥⁴

(The anatomical location of 'Ranjaka Pitta', which gives red color to the blood, is the stomach.)

This describes the role of stomach in erythropoiesis. Gastric intrinsic factor synthesized in the parietal cells of the stomach is required for the absorption of Vitamin B-12, which in turn, is needed for DNA synthesis of RBC precursors in the bone marrow. Pernicious anemia is a condition that results

from some autoimmune mechanisms targeted towards the parietal cells of the stomach.

Role of liver and spleen:

शोणितवहानां स्रोतसां यकृन्मूलं प्लीहा च॥⁴

(The 'Mūla' (roots) of Hemopoietic system are Liver and Spleen.)

The role of liver and spleen are well known in the functioning of hemopoietic system. The major functions of these organs include the following:

- a) RBC synthesis occurs in liver and spleen in between 3rd and 5th month of intrauterine life.
- b) Liver stores some important erythropoietic factors like Vitamin B-12, folic acid and iron.
- c) Liver produces clotting factors also. Spleen is the slaughterhouse of RBCs.

Production of Bilirubin:

असृतः पित्तं मलः॥⁶

(Byproduct (waste) of the metabolism of 'Rakta' is 'Pitta'.)

In fact, bilirubin is formed as a byproduct of hemoglobin metabolism. It then enters the hepatocytes of liver. In the liver, it is conjugated with glucuronic acid and is released in the second part of duodenum through the liquid bile.

Release of Bile:

परं तु पच्यमानस्य विदग्धस्याम्लभावतः।

आशयाच्च्यवमानस्य पित्तमच्छमुदीर्यते॥⁹

(The ingested food, undergoing digestion, attains acidic nature and thereafter, in the small intestine, the 'Accha Pitta' (Liquid Bile) is released.)

Hyperbilirubinemia and jaundice:

पीतविष्णुमूत्रनेत्रत्वक्क्षुत्तृद्धाहाल्पनिद्रताः। पित्तं॥⁶

(When this 'Pitta' exceeds its normal levels, there will be manifestation of symptoms like yellowish discoloration of feces, urine, eyes and skin. Excessive hunger, thirst, burning sensation and loss of sleep are other features.)

When the total serum bilirubin level exceeds 2mg/dl, there is manifestation of clinical jaundice. Yellowish discoloration of sclera, skin, mucous membranes, urine and feces are the typical features of hyperbilirubinemia.

CONCLUSION

The physiology of haemopoietic system has been described in Ayurveda at different contexts at a considerably scientific and detailed manner.

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