

Conceptual Study of Yakruta as a Mulasthanana of Raktavaha Strotasa with Special Reference to Liver Functions

Review article

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Abstract

Ayurveda believes that human body is structured with different *srotasa* which are basic and fundamental parts. These *srotasas* are very closely associated with their respective *mulasthanana*. These *mulasthanana* are very important from treatmental and prognostic aspect as its involvement in the formation, examination and control over the *bhavapadartha* flowing through the *srotasa*. The *rakta dhatu* (blood) which is also referred as fourth *dosha* by Ayurveda, is one of the important functional element of body of which formation, transformation and conduction is carried out by *raktavaha srotas*. The *yakruta* (liver) is advocated as the *mulasthanana* of *raktavaha srotas*. The modern science especially has mentioned the cardiovascular system for blood circulation and the liver as metabolic gland and an integral part of digestive system. Most of the blood related concepts like haemopoiesis, storage and blood constituents are rooted in liver. In present research paper, the relationship between *yakruta* and blood components is studied. Also an attempt has been made to find out the reasons for mentioning the *yakruta* (liver) as *mulasthanana* of *raktavaha srotas*.

Key words: *Haemopoiesis, Mulasthanana, Raktadhatu, Raktavaha srotas, Yakruta.*

Introduction

The *srotasas* (systems) are fundamental and basic concept in Ayurveda unanimously accepted by all contemporary *Acharyas*. The energy required for our day to day bodily metabolic processes is been provided by the external basic factors i.e. *prana* (Oxygen), *anna* (food) and *udaka* (fluid). The *ahara* (food) is initially converted into '*ahar-rasa*' by *agni* (several metabolic

processes) which contain nutrients essential for the formation of *saptadhatu* (*rasa, rakta* etc).

In this process, there is also formation of excretory products like *purish, mutra* termed as '*mala*'. The homeostasis is been maintained by each and every *dhatu* by performing special type of functions such as '*jeevan karma*' by *rasa*, '*preenan karma*' by *rakta*. *Dhatu*s and *malas* are synthesized and circulated in a specific manner in assistance with certain group of organs termed as *srotasa*.

Acharya Sushruta in *Dhamanivyakaran Sharira adhyaya* of *Sharirsthana* (1), *Acharya Charaka* in *Strotovimana Vyakhyasyamaha adhyaya* of *Vimansthana* (2) and *Acharya Vagbhata* in *Angavibhaga adhyaya* of

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Sharirsthana(3) has elaborated this concept with respect to comprehensive and profound knowledge of its *vyakhya* (definition), *samkhya* (number), *bhed* (classification), *strotodushti lakshanas* (systemic pathological signs/symptoms) and their *mulasthanas* (origin).

The *srotasas* are enumerated with different numbers by different *acharyas*. *Acharya Sushruta* has mentioned 11 pairs of *srotasa* in *Sushruta Samhita* (4) while *Acharya Charaka* has realized the presence of 14 *srotasas* (2). All these *srotasas* are grossly classified as *antarmukha* and *bahirmukha srotasa* (5) on the basis of their external and internal appearance.

Acharya Sushruta has defined the *srotasa* in much more scientific way (1) with following characters -

1. *Mulat khadyantare dehe* (1) :

This particular characteristic of *srotasa* is a representative of its structural composition regarding its storage capacity and its extensibility when it matters. The *srotasas* are originating either from individual organ or group of organs which have *akash mahabhuta* dominance and these same organs are considered as “*mulasthanas*”(prime organ).

2. *Prasutam* (1):

It describes its extending capacity throughout the body via various channels. Eg-in *rasavaha srotasa*, *hridaya* (heart) circulate its content through *rasavahini* (vessels) to whole body. *Acharya Vagbhata* has compared this particular characteristic of *srotasa* with “*kamalana*” (pores in lotus) (3).

3. *Abhivahi* (1):

This characteristic of *srotasa* is purely functional. The *dhatu*s are carried and transferred to the various parts of body. ‘*Abhivahi*’ is broad spectrum function anticipated by *acharyas* because

its assistance with some additional functions specified below –

a. *Utpatti: (Production)*

The different *dhatu*s are formed in different *srotasa*. *Rasa* is formed in *rasavaha srotasa*. *Rakta* is formed in *raktavaha srotasa*.

b. *Parinaman: (Transformation)*

The *dhatu*s are formed only after being processed by specific ‘*agni*’ (fire element). *Rakta* is formed after being processed by *raktagni* on *rasadhātu*.

c. *Utsarjan: (excretion)*

There are very few *srotasas* performing this function. The *mutravaha srotasa*, *purishavaha srotasa* are involved in the excretion of *mutra* and *purisha* respectively.

All these *srotasas* and their functions are very essential to maintain the homeostasis as well as the proper metabolic status of the body.

Discussion:

Rakta dhatu is one of the important *dhatu*s mentioned by *Ayurveda* which is the principle and functional element by keeping the whole functioning of body in a proper manner. It may be the reason why *Acharya Sushruta* has mentioned *rakta* as fourth *dosha* (6). According to *Ayurveda*, *rakta* has unique and exclusive function i.e. *jeevanam* (7). *Rakta dhatu* carries the oxygen and nutrients with itself and circulate through the whole body to provide nourishment. The ‘*jeevanam*’ is an inclusive term comprising additional functions specified below

1. *Uttardhatu poshan-* Formation and nutrition of next forming *dhatu* (*mansa*).
2. *Dhatunam puranam-* *Purana* and *tarpana*.
3. *Varna prasadan* – To provide normal complexion.
4. *Avyahat paktruvega-* Digestion of *pitta*.

5. *Sparshadnyanam asanshaman*- Proper circulation and normal sensation.
6. *Bala and oja vruddhi*- Proper growth of *bala* and *oja*.

The important *rakta dhatu* is dependent on *raktavaha srotasa* for its formation, transformation and distribution. The *yakruta* (liver) is supposed to be one of the *mulasthanas* of *raktavaha srotasa* (9). *Ayurveda* believes that the *raktadhatu* is formed as an outcome of different processes on *ahar-rasa* with the help of *raktagni* and *ranjak pitta*. From here only the *raktadhatu* is distributed and circulated through *raktavaha srotasa* (9).

Acharya Sushruta has mentioned the presence of *raktadhatu* in *raktadhara kala* which is predominantly present in *yakruta* (liver) (10).

According to modern science, the liver, one of the most important metabolic organ in human body has wide range of functions. Most of them are blood related functions as mentioned below-

1. Production of Red blood cells (11):

In the early weeks of embryonic life, primitive nucleated red blood cells are produced in the yolk sac. During middle trimester of gestation, the liver is the main organ for production of red blood cells, but reasonable numbers are also produced in spleen and lymph nodes. *Acharya Sushruta* has clearly mentioned the *yakruta* is only site where production of *raktadhatu* takes place after being processed by *raktagni* and *ranjak pitta*.

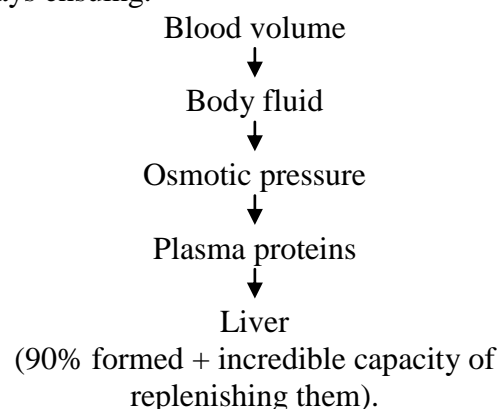
2. In the absence of erythropoietin, few red cells are formed by bone marrow. At the other extreme, when large quantities of erythropoietin is found available and if there is adequate availability of iron and other required nutrients, the rate of red blood cells production can rise to perhaps 10 or more times normal. For the above mentioned process, the required quantity of iron is stored in the liver in the form of ferritin (12).

3. Blood volume (12): Blood contains both cellular and extracellular parts. However, the blood is considered to be separate fluid compartment because it is contained in a chamber of its own, the circulatory system. The blood volume is especially important in the control of cardiovascular dynamics.

The hydrostatic pressure in the capillaries tends to force fluid and its dissolved substances through the capillary pores into the interstitial spaces. Conversely, the osmotic pressure caused by plasma proteins tends to cause fluid movements by osmosis from the interstitial spaces into the blood. This osmotic pressure exerted by plasma proteins normally prevents the significant loss of fluid volume from the blood into the interstitial spaces which is essential for the cardiovascular dynamics.

Essentially, all the plasma proteins with the exception of the gamma globulins are formed by the hepatic cells. This accounts for about 90% of all plasma proteins. The liver can form plasma proteins at a maximum rate of 15 to 50 gm/day. Therefore, even if as much as half the plasma proteins are lost from the body, they can be replenished in 01 or 02 weeks.

It means that the blood volume depend on the fluid level which in turn depend upon the osmotic pressure. The osmotic pressure is impossible without the pressure of plasma proteins which are formed in the liver. The body cannot dispense with the liver's contribution to protein metabolism for more than a few days ensuing.



According to the modern science, the liver is the largest organ in the body contributing 2% of total body weight. The liver structurally is made up of flat hepatic sinusoids which lie between the hepatic plates. These sinusoids are lined by typical endothelial cells and large kupffer cells (12).

As liver has these sinusoids and kupffer cells, it is having amazing capacity to expand. The large quantity of blood can be stored in the blood vessels of liver. Its normal blood volume including both in hepatic veins and hepatic sinuses is about 450ml or almost 10% of body's total volume. In cardiac failure and peripheral congestion, the liver expands and 0.5 lit of extra blood is occasionally stored in hepatic veins and sinuses.

About 1050 ml of blood flows from portal vein into the liver sinusoid and an additional 300 ml flows into the sinusoids from hepatic artery, the total averaging 1350 ml/minute. This amounts 27% of resting cardiac output (12).

Both these capacities of liver i.e. storage and inflowing with regards to the blood have very strongly mentioned by *Acharya Sushruta*. He has quoted the *yakruta* as *raktashaya* by only realizing its above described properties. Also he has introduced the liver as a *sthana* of *raktadharakala* which means a special type of membrane. The endothelial cells, kupffer cells lined internally to the sinusoids are the membrane like structures which may be considered as *raktadharakala*.

Except for the iron in the haemoglobin of blood, by far the greater portion of iron in the body is stored in the liver in form of ferritin. The hepatic cells contain large amount of proteins, apoferritin which is capable of combining reversibly with iron. Therefore, when iron is available in the body fluid in excess quantities, it is stored in the liver in the form of ferritin in hepatic cells until needed elsewhere. When iron circulating

in the body reaches a low level, ferritin releases the iron. Thus the liver act as blood iron buffer as well as iron storage medium.(12).

Conclusion:

1. 'Rakta' is one of the important *dhatu* synthesized in *yakruta* (liver) from *rasadhātu*. This concept in *Ayurveda* exactly coincides with modern functions of liver such as synthesis and storage of blood components.
2. In embryonic life, liver is the site for haemopoiesis. Iron is essential factor for erythropoiesis which is stored abruptly in liver. *Ayurveda* mentioned *raktadhātu utpatti* in *yakruta* (liver) exactly correlates with modern function of liver.
3. The portal vein empties blood enriched with nutrients into the liver. It is also responsible for the storage and end metabolism of end products and eventually its transport to the blood. *Ayurveda* describes scientifically the same concept as *rasadhātu* in precursor of *raktadhātu*.
4. Almost 10% of total blood volume circulates through the liver. Sinusoids of liver act as reservoir of blood. Site of *raktadharakala* mentioned in *Ayurveda* which is same as sinusoids in liver.
5. Blood circulation depends upon fluid level in the blood. Fluid level, osmotic pressure is influenced by blood plasma protein level. 90% of plasma protein are synthesized in liver. Most of coagulatory factors are stored and synthesised in liver. The excreting substances also formed in the liver.
6. The way *Ayurveda* has explained and described the concept of *srotasa* and its *mulasthana* is purely in a functional manner. *Ayurveda* has not explained the liver functions in details but inspite of that mentioning of *yakruta* as a *mulashtana* of *raktavaha srotasa* correlates with modern functions of liver.

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