

INDIAN KNOWLEDGE OF BLOOD CIRCULATION

By

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I. Introduction :

According to the historians of medical knowledge the discovery of the circulation of blood came at a very late period in the history of sciences. This opinion is mainly due to the importance thrust on Harvey (1578–1657) by the British for his demonstration of the circulation of blood. But the dispute regarding the true discoverer of the circulation was always a point of controversy among the medical historians. The knowledge of the heart and blood vessels held by the Egyptians and early Greeks, even by such great intellectuals as Hippocrates and Aristotle was rudimentary. The Alexandrian school (3rd century B.C.) formed an approximate idea of the anatomical conditions of the vessels connecting heart and lungs.

Galen (129–201 A.D.) widened this knowledge by his interesting physiological experiments. According to Galen, the movement of blood was of shuttle-wise ebb and flow between the closed arterial and venous systems. His theory was accepted for 14 centuries. But Galen never spoke about the circulation of blood as it is understood now, because he did not seem to have formed a clear idea of the full process. His theories were accepted by Byzantine, Syriac, and Islamic physicians of the later centuries. The theory that the blood was continually created or renewed by the liver and carried to the peripheral organs where it perished was formulated in an organized system by Avicenna (980–1037). This Avicenna's view was transmitted to the medical science of Western Europe and accepted and not contested even by Vasalius (1514–64).

According to Elgood, Ibn An-Nafis (1810–88) made a special study of the anatomical works of Galen and Avicenna and criticised correctly the views of Galen, Haly Abbas and Avicenna regarding the purification of blood and blood circulation. Meyerhof brought to light about the discovery of lesser circulation by Ibn An-Nafis as explained in the thesis for the doctorate of Tatawi. Michael Servetus (1511–1553) and Realdo Colombo (1516–59), independent of each other, explained the lesser or pulmonary circulation.

The features of the general circulation were explained by Andria Cesalpino (1524–1603), but without any support by convincing experiments. The methodological and experimental exposition of the entire circulation of blood stand to the credit of William Harvey. This experimental proof of the circulation by Harvey won credit as the discoverer in the Annals of Medical History.

II. Indian Knowledge

The critical study of the works on medical history clearly indicates that all historians have ignored the scrutiny of the oldest medical science of the world, i.e., the Indian system "Ayurveda". By the time the Western civilisation tried to understand the implications of the circulation through the so called experiments based on the trial and error methods, Indians have already recorded the importance of the (thoracic) heart working as a pump to eject the blood into the circulation and also the necessity of such function for the nourishment of the body. The following references taken out from Charaka Samhita, Satapatha Brahmana and other classics of oriental knowledge will clearly explain this fact.

The circulation of blood is maintained by three factors :

- (1) The muscular structure of the heart through its contractions and relaxations.
- (2) The heart working as a pump, i.e. the heart, through its working, takes in the blood during relaxation and gives out the same during contraction.
- (3) The circular movement of the blood in the body.

(1) Muscular structure of the heart :

The functions of the incorporeal and unstable Vata, the powerful and important of the Dosha-triad, are understood through the work it performs. The term "Vata" is derived from the root "Va Gatigandhanayoh" (Susruta Samhita, Sutrasthana 21-5), i.e. to move, to enthuse, to make known and to become aware of and to enlighten. The function of "gati" or to move is expressed through the movements of the muscles. The muscles, wherever they are located in the body, act by their movement, i.e., contraction and relaxation. The muscular structure of the Hridaya (thoracic heart) has been referred to by Susruta and Arunadatta.

- (a) Susruta in Sarirasankhyavyakaranam Sariram chapter of Sarirasthana states that Hridaya contains Mamsa peshi (Muscle tissue) in it.
- (b) Arunadutta, the commentator of Ashtanga Hridaya, while commenting on the Avalambaka Sleshma, discusses the structure of the heart as mentioned in the Agama (Vedas) : "Hridaya is made of the muscle and its shape is similar to that of the red lotus" (Arunadutta on Astanga Hridaya Sutrasthana 12-15)

Susruta has also described the heart giving it the shape of the lotus-bud with its apex downward (Susruta Samhita, Sarirasthana)

(2) Heart as a pump :

- (a) The definition of the word "Hridaya" as mentioned in Satapatha Brahmana will explain its functional nature. The term "Hridaya" consists of three roots

“Hṛi”, “Da” and “In” which respectively mean “Harana”, “Dana” and “Ayana”. The meanings of these three words are respectively “receipt, giving away and to sustain or maintain the two earlier functions”. Even the three letters of the word “Hridayam” separately explain its function in a similar fashion. (Satapatha Brahmana, Brihadaranyakam, Kanda 14, chapter 8, Brahmana 4-1).

Therefore, in view of the above explained functional aspects of the organ, the Hridaya (thoracic heart) takes in and gives out the blood (the Rasa-rakta combination according to Ayurveda) by continuously functioning for the maintenance of the circulation.

- (b) The actual reference regarding the contraction and relaxation of the heart is found in Yogavasishtha, supposed to have been written by Sage Valmiki. This subject is a part of discussion between Vasishtha and Rama. Vasistha says : “Whenever expansion (relaxation) and contraction in the duct situated in the heart occurs, then Pranavayu enters and exits through the cavities (nostrils), that is Pranavayu is inhaled or exhaled. Like the external instrument called Bhastra or the bellows (of the blacksmith), the movement of which is created only by the air that either enters or comes out from its space, the heart is also put to motion by the air”.

Eventhough the above reference indicates the relationship between the heart and Pranavayu, it is clearly explained the heart contracts and relaxes regularly and its movement during this action is similar to that of the bellows of the blacksmith.

- (c) That the heart works continuously for the maintenance of the circulation is implicitly explained by Charaka while dealing with the functions of Vyana Vata which is located in Hridaya: “The Rasa dhatu or nutrient fluid is circulated continuously through every part of the body simultaneously, by the Vyana Vata, by virtue of its physiological function of projection” (Charaka, Samhita Chikitsasthana 15-36). The two words used regarding the continuity of this function are “Ajasram” and “Sada”. The meaning of the word “Ajasram” is “Avisrantam” i.e. without any rest and of the word “Sada” is “Sarvakalam” i.e. at all times.

In Chakrapani’s contention, the other liquid dhatus like Rakta also should be taken along with the Rasadhatu, Even though, Rasadhatu is stated to be located in Hridaya by Susruta (Susruta Samhita, Sutrasthana 14-3). Charaka and his commentator, Chakrapani, emphasize that Hridaya is the seat of those dhatus which are liquid and move throughout the body. (Charaka, Samhita Chikitsasthana 24-35 and Chakrapani on it).

This function of the heart, to take in and give out the blood continuously without any rest, resembles the action of a pump which supplies a liquid material. But there is no reference in Ayurveda about the chambers and valves of the heart.

(3) *Circular movement of blood:*

The circular movement of the "Dhatus" in the body has been mentioned while describing the dhatuparinama, or the transformation of one dhatu into another:

"The movement of the dhatus (which nourish the body) goes on eternally like (the motion of) a wheel", (Charaka Samhita Chikitsasthana 15-21). Chakrapani has pinpointed the "dhatus" as the "Rasa dhatu etc."

The simile of the wheel is significant here. This indicates not only the circular movement which is continuous without any rest but also without any time limit for such movement. But it is imperative that the time taken for this circular movement is dependent upon the ejecting force of the hridaya, i.e., the stimulus of the Vyana Vata to the heart.

(4) *Internal transport system of the body:*

According to Ayurveda, the internal transport system of the body is represented by srotamsi (Sing: Srotas). The term srotas means a channel. It is derived from the root "Sru Sravane" meaning to exude; to ooze; to filter; to permeate. Charaka has defined it as "Sravanat srotamsi" meaning, the structure through which "Sravanam takes place (Charaka Samhita, Sutrasthana. 30-12). According to Charaka, no structure in the body can grow and develop or waste and atrophy, independent of srotamsi that transport dhatus, which later, are constantly subjected to (metabolic) transformations and the srotamsi subserve the needs of transportation (Charaka Samhita, Vimanasthana. 5-3), The Srotamsi of the body comprise of channels of different kinds and they are separately named according to the site and functions. In the present context, the names dhamani and Sira are relevant to the circulation of the blood. Says Charaka: "They are spoken of as dhamanis because they pulsate, as srotamsi because they permit oozing and siras because they maintain a continuous flow of blood (rasa-rakta)". (Charaka Samhita Sutrasthana 30-12). The dhamanis are stated to have their origin in the heart (Charaka Samhita Sutrasthana 30-3).

In view of the arrangement made by Charaka, specially when studied together with the description of characteristic features of different parts of the vascular system, it is clear that the dhamanis end in the srotamsi (capillaries) which in turn unite to form siras (veins). Thus hridaya, dhamanis, srotamsi and siras constitute a single circulatory unit, which regulate the proper flow of blood and nutritional supply to the body.

The medical historians of Europe were more familiar with the writings in Europe on circulation. More recently references to earlier Arabic medieval works have been pointed out. Unfortunately due to various factors the ancient Indian medical literature has not been studied with a sympathetic understanding and proper commentaries by competent scholars.

It is possible that the Western medical historians are likely to point out that the Indians only imagined and theorised the process of circulation but did not make any observations and therefore cannot claim credit for the earlier knowledge of circulation. The knowledge of the circulation of blood was acquired mainly on the basis of ingenious dissections on cadavers and also careful observations on wounded and healthy persons and probably on sacrificial animals also.

The above are only a few most important references to establish the fact that the Indians knew about the circulation of blood and its implication in the nourishment of the body. If the matter is still pursued, more references can be gathered from the Ayurvedic classics to clarify further the concepts and observations on circulation of blood in human body as understood by the ancient Indian physicians. From the above it can easily be surmised that the ancient Indian medical writers accepted as authorities had a fairly clear concept about the blood circulation and that too, centuries earlier than in the West.

NOTES:-

Satapatha Brahmana: compiled between 800 to 500 B.C. (Macdonell: Max Muller)

Susruta Samhita: Written by Susruta and later redacted by Nagarjuna. Hoernle considered this book belonging to an earlier period than Bower's manuscript. Ray considered Susruta a Teacher of Buddha's times. Srivastava dates him somewhere between 1000 to 600 B.C.

Charaka Samhita: Originally written as Agnivesa Samhita but later named after the redactor, Charaka. Since Charak Samhita has been redacted many times, it is usually difficult to fix the period of its compilation. According to Hoernle, Charaka Samhita in its original form is anterior to Navaneetaka. Even though Charaka was not mentioned in the Bower's manuscript, Hoernle thought that the Charaka's date was between that of Kanishka (1st century A.D.) and that of Bower manuscript (2nd half of 4th century). Jolly and Muller did not agree with this. Mukhopadhyaya considered Charaka Samhita belonging to the period earlier than 2nd century B.C. After the thorough analysis of the subject and language, P. V. Sharma concluded that this book was written during the Sunga period (2nd century B.C.). This book has been redacted by Dridhabala. Since Dridhabala was quoted by Jajjata (7th century A.D.), the former should have lived at least in the 6th century A. D. The Chief Commentator of Charaka Samhita, Chakrapani belonged to the 11th century A.D.

Yogavasishta: Said to be an appendix to Ramayana and therefore attributed to Valmiki. Since Abhinanda the author of its abridgement, Yogavasishtasara, lived in the middle of 9th century A.D., Winternitz concludes that the Yogavasishta must be of an earlier age.

Astanga Hridaya : The author was considered as Vagbhata II by some of the historians. According to Hoernle, he belonged to 8th or 9th century A.D. On the authority of Rajatarangini, Cordier considered that Vagbhata lived at the time of king Jayasimha (1196-1218 A.D.). A. M. Kunte thought that *Ashtanga Hridaya* was written probably about 1st or 2nd century B- C. Jolly placed him in the 8th century A. D. Considering that Vagbhata II was mentioned by Itsing, he was placed in 7th century by Mukhopadhyaya. Arunadatta, the commentator of *Ashtanga Hridaya*, flourished about 1220 A.D.

SUMMARY

Medical historians attribute the discovery of blood circulation to Harvey. But it is still a matter of controversy among the scholars of medical history. Even earlier than Harvey, the Egyptians and Greek and also the great intellectuals like Hippocrates and Aristotle had some knowledge about heart and blood vessels. Later Galen formulated a theory of blood circulation which was prevalent for 14 centuries until Avicenna's view about blood circulation came to be transmitted to the Western Medical Science. There were many research workers, viz. Ibn An-Nafis, Haly Abbas, Michael Serventus and Realdo Colombo etc., who worked independently on this topic but subsequently Harvey achieved the credit of the entire discovery, probably due to his experimental exposition.

In fact the Indian scholars possessed this knowledge centuries ago. The importance of the heart working as a pump to eject the blood into the circulation and also the necessity of such function for the proper maintenance of the body was put on record by the Indian scholars centuries before the western medical men could conceive the concept on the basis of their so-called experiments of trial and error methods. The maintenance of the blood circulation depends upon three factors-firstly the contractions and relaxations of the heart due to its muscular structure. Secondly the heart working as a pump and thirdly the circular movement of the blood within the body. All these three factors which came to be known at a very later stage in the west have been clearly described in the ancient medical and classical literature, whose period, despite all the divergence in opinion, ranges from 1000 B.C. to 1200 A.D. The muscular structure of heart has been described not only by *Susruta Samhita*, an ancient medical text but also in *Vedas*. *Satapatha Brahmana* and also the *Yogavasishtha* explain that the heart functions in a fashion that is comparable with that of a pump. The circular movement of the "Dhatus" through the blood for the nourishment of the entire body is narrated in *Charaka Samhita*.

The medical historians of Europe centralised themselves mainly on the writing on circulation in Europe. They have not taken any serious note of what was done or written on circulation in India, due to different reasons. The above given references clearly indicate the priorities of the Indians in the knowledge about the circulation of blood.

REFERENCES

1. Acharya, Jadavaji Trikamji : The Charakasamhita, 3rd ed., Bombay, the Nirnaya Sagar Press, 1941.
2. Acharya, Jadavaji Trikamji : The Susruta Samhita, 3rd ed., Bombay, Nirnaya Sagar Press, 1938.
3. Castiglioni, Arturo : A History of Medicine, 2nd ed., London, Routledge & Kegan Paul Ltd., 1947.
4. Elgood, Cyril : A Medical History of Persia and the Eastern Caliphate, London, the Cambridge University Press, 1951.
5. Garison, F. H.: An Introduction to the History of Medicine, 4th ed., Philadelphia, W. B. Saunders Company, 1929.
6. Jolly, J: Indian Medicine, Poona, Pub. by C. G. Kashikar 1951.
7. Macdonell, A. A.: A History of Sanskrit Literature, 5th ed., Delhi, Munshi Ram Manoharlal, 1958.
8. Meyerhof, Max: Ibn An-Nafis (13th century) and his theory of the lesser circulation. *ISIS*, 1935, pp. 100-120.
9. Mukhopadhyaya, G. N.: History of Indian Medicine, Vol. I, Calcutta, University of Calcutta, 1923.
10. Muller, F. M.: A History of Ancient Sanskrit Literature, Varanasi, Chowkhamba Samskrit Series Office, 1968.
11. Paradkar, Harisastry: The Astangahridaya, 6th ed., Bombay, Nirnaya Sagar Press, 1939.
12. Sharma, P. V.: Caraka Chintana, Varanasi, Chowkhamba Vidyabhavan, 1970.
13. Sharma, P. V: Vagbhata Vivechana, Varanasi, Chowkhamba Vidya Bhavan, 1968.
14. Satapatha Brahmana: Kashi, Achyutagrathamala Karyalaya, 1940.
15. Yogavasishta: Kashi, Achyutagrathamala Karyalaya. 1950.

रक्तपरिवहन का भारतीय ज्ञान

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रक्त परिवहन के आविष्कार का ज्ञान आर्यविज्ञान के इतिहासकार, शिव को देते हैं, यद्यपि यह विषय अभी भी विवादग्रस्त है। मिश्रणी, यूनानियों तथा बृकटात और अरस्तू जैसे महान् विज्ञान वेत्तियों को हैदय एवं रक्तवाहिनियों संबंधि कृच्छ्र जातकारी शिव के बर्तन पड़े ही थी। कालान्तर में गोलन में रक्त परिवहन पर एक सिद्धांत स्थिर किया जा चढ़ा जिससे भारतीयों के ज्ञानमय तब तक प्रचलित रहा जब तक कि पाश्चात्य चिकित्सा-विज्ञान ने रक्त परिवहन पर अवलोकन के विचारों को नहीं अपना लिया। रक्त-गन्धीस, शैली-अवशास, और सकल सर्वदेस आदि अनेक शोधकर्तवियों ने स्वतंत्र रूप से इस विषय पर कार्य किया था किंतु बाद में शिव की इसकी आविष्कार का पूरा यश, सम्भवतः उसकी यूनानिरेमक प्रतिपादन के कारण, प्राप्त हुआ।

वस्तुतः भारतीय विद्वानों की शालिह्यो पढ़ले इस विषय का ज्ञान था। शरीर में रक्त की स्थिति कायु करने हैं और परिवहन में रक्त सिद्ध करनेवाले हैदय का महत्त्व तथा इस प्रकार के कार्य की जीवनीयताओं काव्यकृतियों की अनेक उद्धृति पश्चात्तय चिकित्साविदों के अपने शोधकर्तव्य प्रयोगों की कल्पना करने के शालिह्यो पूर्व ही, इस ज्ञान की लिपिबद्ध कर दिया था। रक्त परिवहन का सिद्धि लेन शर्वी पर लिख करवा है—पहला, हैदय की मांसल संरचना के कारण उसका संकीर्ण और विस्तार का कार्य, हैदय का रक्त के समास कार्य करना और तीसरा रक्त का शरीर के शरीर परिवहन का सिद्धि लेन शर्वी पर लिख करवा है—पहला, हैदय की मांसल संरचना के कारण उसका संकीर्ण और विस्तार का कार्य, हैदय की गतिविधि का इस प्रकार वर्णन करते हैं कि उसकी गति का प्रत्यक्ष प्रमाण तथा शालिह्यो तथ्य, यूनानियों, हैदय की गतिविधि का इस प्रकार वर्णन करते हैं कि उसकी गति का प्रत्यक्ष प्रमाण तथा शालिह्यो तथ्य, यूनानियों, हैदय की मांसल संरचना का वर्णन मास सुश्रुत सिद्धि में ही नहीं है बल्कि वेदों में भी है। वस्तुतः भारतीय शालिह्यो में, जिसका समय ईसा के १०० वर्ष पूर्व से १२०० वर्ष बाद तक का है, स्पष्ट वर्तिलेखि में परिवहन करना। उपरोक्त लेखों बाद, विनका ज्ञान पाश्चात्य चिकित्साविदों की बर्तन बाद में परिवहन करना का कार्य, हैदय का रक्त के समास कार्य करना और तीसरा रक्त का शरीर के शरीर परिवहन का सिद्धि लेन शर्वी पर लिख करवा है—पहला, हैदय की मांसल संरचना के कारण उसका संकीर्ण और विस्तार का कार्य, हैदय का रक्त के समास कार्य करना और तीसरा रक्त का शरीर के शरीर परिवहन का सिद्धि लेन शर्वी पर लिख करवा है।

यूरोप के आर्यविज्ञान के इतिहासकारों ने रक्त की रक्तपरिवहन के शक्ति में बर्तन पर संपादन शालिह्यो तथ्य की कल्पना रखा है। विविध कारणों से उद्धृति इस विषय पर भारत में उपलब्ध प्रमाणों या कल्पों का भारतीयों से अवलोकन नहीं किया। उदाहरण संदर्भों से रक्तपरिवहन के ज्ञान के सादृश्य में भारतीयों की प्राणिकता का पता चलता है।