

## THE CONCEPT OF BLOOD CIRCULATION IN ANCIENT INDIA W.S.R TO THE HEART AS A PUMPING ORGAN

P.N.Vinaya<sup>1</sup>, J.S.R.A. Prasad<sup>2</sup>

<sup>1</sup>Ayurvedic Physician and Research Scholar, Department of Sanskrit Studies, University of Hyderabad, Hyderabad, India

<sup>2</sup>Associate Professor, Department of Sanskrit Studies, University of Hyderabad, Hyderabad, India

### ABSTRACT

Most scientific discoveries of the past 300 to 400 years find initial mention in the *Vedas*. Human physiology, in particular the circulatory system is one such concept dealt with in the *Vedas* and later in the *Brihat trayee*. Not just the organs/structures associated with this system like the *Hridaya* (heart), *Dhamani* (arteries) and *shira* (veins) but also diseases of the *Raktavaha srotas* (circulatory system) like clogged arteries have found description in Rigveda and Yajurveda. Blood, its structure and functions, its importance as a carrier of nutrients and oxygen too find mention. Atharvaveda being the source and origin of Ayurveda is a storehouse of all aspects pertaining to health and medicine. The concept of blood circulation described in Atharvaveda is amazingly accurate. The *Samhitas*, Charaka and Sushruta built upon the concept of the *Vedas* with extensive scientific research and cadaver dissection. It is no surprise that the subject of blood circulation and its purpose i.e. carrying of *Prana* (oxygen technically) and *rasa* (nutrients) to the entire body in a cyclical manner with the heart acting as a pump to carry out this function were known to our ancient seers long before William Harvey discovered the circulation of blood in the 17<sup>th</sup> century. Such was the precision of this science that the entire physiology of circulation was summed up by the term *Hridaya* or heart.

This paper is an attempt to bring to light the scientific analysis that went into the concept of Blood Circulation in ancient India and to underline its excellence.

**Keywords:** *Dhamani, Hridaya, Rakta, Raktavaha, Rasa, Srotas, Shira.*

### INTRODUCTION

The Vedas are the repository of all material and spiritual knowledge. No aspect of existence physical or metaphysical has been left unexplained in the Vedas. Rigveda, Yajurveda and Atharvaveda contain hymns dealing with health and disease, physiology and pathology in short the concepts that were the harbinger of Ayurveda, the science of life. Atharvaveda is regarded as the source of Ayurveda so much so that

Ayurveda is referred to as the *Upaveda* of Atharvaveda. Some seers regarded Ayurveda as a Veda in its own right and called it the *Panchamaveda*.

Understanding physiology is fundamental to understanding pathology or illness. The scientific and logical analyses that were applied to understand each physiological concept underlines the depth of knowledge that existed in India. The seeds of medicinal

knowledge sown in the Vedic period developed into a full-fledged health science in the Samhita period.

One such physiological concept described with amazing accuracy in ancient times is the concept of blood circulation in the body. The heart the seat of *Chetana*<sup>1</sup> was rightly understood to function as a pumping organ. There was no room for ambiguity with regard to the different entities associated with circulation like, *Rakta*, *Raktavaha srotas*, *Hridaya*, *Dhamani*, and *Shira*. Their very nomenclature defined their respective functions.

### LITERATURE REFERENCES

The earliest text known to mankind the Rigveda contains the nascent concepts of Ayurveda and single drugs<sup>2</sup> which could be used for medicines. The heart has been understood as the centre of circulation. There is some reference to pathological conditions too. It has been discussed that *Kapha pitta kara* substance (lipids) cause clogged arteries and hamper blood circulation<sup>3</sup>. When circulatory diseases (pathology) could be referred so clearly, the physiology of circulation could not but have been in the knowledge of our ancient seers. Atharvaveda as mentioned earlier was replete with the knowledge of Ayurveda. Hence it was no wonder that conceptual knowledge of Human anatomy and physiology existed in it. The heart was described as an inverted lotus bud with nine gates.

*Pundarīkam navadvāram  
tribhirguṇairabhiravṛtam | Tasmīnyat  
yakṣma mātmavta tadvaibrahmavidōviduh*  
||<sup>4</sup>

Indeed the anatomical structure of the heart appears like a lotus bud if held

with its apex upwards with nine openings in all. Three in right atrium, 4 in left atrium and one each in right and left ventricles. The Atharvaveda also refers to *Dhamanis* (arteries) as ducts with thick walls, *Shiras* (veins) as ducts with thin walls and still finer ducts are mentioned which could mean capillaries<sup>5</sup>.

In the oral tradition of imparting knowledge flowery and poetic language was used to retain inputs in memory. Careful interpretation of the mantras/shlokas keeping the context in mind rather than mere translation is needed. The given quotation from Atharvaveda which aptly describes the vascular system is a case in point.

*“Who stored in him floods turned in all directions moving diverse and formed to flow in rivers, flashy red, copper hued and purple running all ways in Purusha upward and downward.”*<sup>6</sup>

Arterial circulation with oxygenated blood and venous circulation with deoxygenated blood could be interpreted from the above passage. With a deeper understanding the passage could be rewritten as

*“who filled these liquids (blood) in this body which are spread throughout the body (circulation), which flow from all sides (venous circulation) to Sindhu (heart) and flow out from there (arterial circulation) who’s movement is rapid and is of bright red colour (oxygenated) which contain iron hence red (haemoglobin) and which is also reddish blue(deoxygenated) in colour. This blood flows upward, downward and sideways”.*

It is *vyana vata* that controls circulation<sup>7, 8</sup>. Blood is the very basis of life. It nourishes body tissues and provides strength and colour to the body. Srimad

Bhagavatam, one of the 18 Puranas although not a medicinal treatise, has a quotation which indicates a sound awareness of the blood circulatory system. The story in 4<sup>th</sup> Canto<sup>9</sup> hints at circulation of blood being an indicator of life and stoppage of circulation inducing coldness and a sign of imminent death.

Nowhere is precision the hallmark of Sanskrit, more evident than in the term given to the word heart, *Hridaya*. *Shatapatha Brahmana* the Brahmana of Yajurveda elucidates the *Niruktha* of *Hridaya* Shabda beautifully.

*Tadetat trvksramhridayamiti, hr-ityekamakṣaram, da-ityekamakṣaram| Yamityekam yīvam haraterdadāterayatērhrdaya śabdaha nruktaha||*<sup>10</sup>

**Hri** comes from *Harati* which means ‘to receive’, **Da** is the short form of *Dadati* which means ‘to give’ and **ya** stands for *Ayati* which means ‘to go’, ‘to move’ or ‘to circulate’. It is interesting to note that the heart performs exactly these three functions of giving blood, receiving blood and circulating blood by acting as a pump. *Brihad Aranayaka* Upanishad also echoes the same. The heart has sometimes been referred to as ‘*Sindhu*’ or ocean. Just as the origin and culmination of rivers is the oceans so is heart the origin and culmination of blood circulation. This signifies cyclic circulation. There seems to be a good understanding of the tissue comprising the heart. It has been described as a muscular organ in *Taitiriopanishad*. The inverted lotus bud appearance of the heart has been accepted by most ancient texts.

*Hridayamiti pundarikākāro māmapiṇḍaha praṇāyātānō anēka nādiṣusira*

*Ūrdhvanaḷoadhōmukhō viśasyamānē paśou parasidhōplambhyate* |<sup>11</sup>

Post vedic period saw the flourishing of Ayurveda as reflected by the anatomy and physiology described in scientific detail in the *Brihat Trayee*, the *Charaka samhita*, *Sushruta samhita* and *Astanga Hridaya*. Yet no contemporary *Samhita* has described blood circulation as cryptically as the *Bhela Samhita*.

*Hṛdōrasah nissarati tatayūna ca sarvatah Sirabhirhṛdayam caiti tasmāthrtprabavah sirāh*||<sup>12</sup>

*Rasa* (blood) flows from the heart and then to all places. Through the veins it again reaches the heart.

The most celebrated book of Ayurveda the *Charaka Samhita* recognized the heart as the centre of circulation and of vitalizing *Pranavaha Srotas*.

*Tava praṇa vahānām srotasām hrdayam mūlam mahāsrotasca*||<sup>13</sup>

The heart was one of the 10 resorts of life or *Pranayatan*<sup>14</sup>. *Charaka Samhita* differed slightly with the view presented in *Atharvaveda*. *Charaka* described heart as having 10 outgoing (arterial) and incoming (venous) trunk vessels seen from the following shloka where as *Atharvaveda* spoke of 9 gates of the heart.

*Arthē daśa mahāmūlāha sirah saktā mahāphalāha | Mahajnyāśa hrdayam paryaaojai ruchyate budhah*||<sup>15</sup>

*Sushruta* differed completely with this view. He spoke of 24 arteries of the heart although he too discussed the seat of *Ras* as the heart<sup>16</sup>. However there is perfect description of *Ischemic Heart Disease*<sup>17</sup> in *Sushruta Uttara Tantra*. Thickening and narrowing of arteries due to deposition of *Kapha pitta* factors leads to acute pain in the

chest producing breathing difficulty. Sushruta samhita further went into the physiology of circulation as indicated in *Sa śabdarcijal santānavadguṇa viśeṣeṇanu dhāvayatyēvam śarīram kēvalam*<sup>18</sup>

Rasa circulates very minutely in the body like *Shabda*, *Teja* and *Jala*. Dalhana the commentator of Sushruta Samhita aptly interprets *shabdasantana* as *Tiryagamitva* , *Archisantana* as *Urdhwagamitva* and *Aalasantana* as *Adhogamitva*. *Rasa* converts to *Raktha* and gets pumped from heart into *Mahadhamani* (aorta) and goes in three directions, sideways, upper and lower directions and spreads in the body, *Shabdarchijala santana upama* could also indicate the diffusion and osmosis taking place in capillaries. The arteries, veins and capillaries also find wide coverage in *Brihat trayee* the terms used for them in Sanskrit, *Dhamani*, *Shira* and *Srothas* also are cryptic indicators of their respective function *Dhmānāddhamanyaha saravaṇat srōtōmsi saraṇat śirah*<sup>19</sup>

Blood flows with force in *Dhamani* , seepage takes place in *Srotas* and blood flows in *shira*. The inherent relationship between arteries, capillaries and veins in cyclic circulation with the heart acting as a pump is established beyond doubt in the *Brihat trayee*.

Ashtanga sanghra echoes the description of heart in Charaka samhita.

Blood as we understand today is connective tissue. Sushruta applied this aspect of blood in repairing and regenerating ischaemic wounds. Before suturing or uniting wounds he used to ensure circulation in the area. In case of poor circulation scrapping of the

wound margins was done to let blood flow before the margins were sutured.

## DISCUSSION

From various references to blood circulation in Ancient India right from the Rigveda it is clear that knowledge that originated in the Vedas has only been rediscovered in the past few centuries. Although William Harvey was credited with the discovery of circulation of blood in 1628 CE, he could not establish the relationship between arteries and veins in cyclic circulation. It was only in 1661 CE that Marcello Malpighi discovered capillaries (*srotas*) and solved the missing link between arteries and veins. In contrast these entities *Dhamani*, *Srothas* and *Shira* find unambiguous mention right from Vedic period in India.

The knowledge that heart was muscular tissue and blood, connective tissue is thousands of years old. Blood is the second *Dhatu* formed after *Rasa* and has been recognized as the carrier of *Prana* (oxygen) and *Rasa* (nutrients) which was in fact the purpose of blood circulation. Another purpose of circulation was acknowledged as providing warmth to the body and hence was considered vital for temperature control. Absence of circulation meant coldness in the body and death. Extensive scientific studies were conducted to gain knowledge of anatomy and physiology. Cadavers were dissected to study internal organs. Although there are some differences in the anatomical structure and number of arteries, veins, etc, the physiology of circulation is near accurate. For instance it refers to blood pulsating with force in arteries and flowing without force in veins. Blood was considered as having

bright red hue and also purple or bluish red meaning oxygenated and deoxygenated blood respectively. Ancient texts agreed on the heart as the center of circulation pumping blood to different parts of the body. The description of the heart in Atharveda is clearly the most accurate one. The 9 gates of the heart may have been the 6 main trunk veins and 3 arteries. 1. Superior venacava 2. Inferior venacava 3.to 6. vena pulmonalis 7. Left pulmonary artery 8. Aorta 9. Right Pulmonary artery. Charaka Samhita and Astanga Samagrah were almost accurate with their description of 10 vessels from the heart. The 10<sup>th</sup> one could have meant coronary sinus.

## CONCLUSION

The oral tradition of imparting knowledge in the Vedic times necessitated the requirement of mnemonic techniques. The flowery language, the similes meant for scientific terms and in some cases stories and fables encompassing technical details were but tools for retention of knowledge in the absence of writing. Translation and more importantly interpretation of the language used requires an integrated approach. Greater collaboration is called for among Sanskrit Scholars, Ayurveda Doctors and Scholars and Scientists to unravel the gems of wisdom of our ancient texts. Blood circulation is but one of the many scientific concepts that existed thousands of years ago. There are many more such scientific concepts which if understood and unraveled might yield solutions to the present day problems. It is ironical that while India the cradle of civilization has not got the due credit for scientific discoveries, we are losing patents for some

of the most commonly used herbs and medicines. Needless to emphasize, while awareness regarding the conceptual scientific knowledge hidden in the Vedas definitely needs to be raised, a framework for the protection of our intellectual property rights must be put in place.

## DECLARATION

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### **CORRESPONDING AUTHOR**

**Dr. P.N.Vinaya**

Ayurvedic Physician and Research Scholar,  
Department of Sanskrit Studies,  
University of Hyderabad, Hyderabad, India  
**Email:** vinayaballakur22@yahoo.co.in

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