Contributions of ancient Indian knowledge to modern medicine and cardiology

1. Preamble

Prof. Rakesh Yadav, the Editor-in-Chief of Indian Heart Journal, during his conversation with Prof. Jagat Narula asked, “We have often claimed that earliest application of systematic medicine began in India and that Sus'ruta and Charaka Samhitas were the oldest sources of medical knowledge. What is not clear is as to how did the knowledge spread to the Western world and how did the Indian medicine influence modern medicine? Or even more specifically how has ancient Indian medicine influenced cardiology in particular?” With a chuckle Narula responded, “Implies more! What more, the name HEART itself is derived from Hridaya!! We knew about the anatomy and physiology of heart many hundreds of years ago.” Working with Dr. Raj Vedam and Prof. Tabassum Pansare, Prof. Narula tries to substantiate his claims herein.

2. Origins of Indian medicine

Ancient Indians made great advances in medicine, as exemplified in the classic works by Sus'ruta and Charaka among others. In addition to authoritative texts, through an interesting pedagogical approach in ancient India, the wisdom, morals and learning were passed down as stories. The wisdom became apparent provided one could unlock the metaphors inherent in the folklore. Failure to appreciate the metaphors kept understanding at the periphery.

As narrated by Sitaram Ayyagari, a Vedic scholar, the story of Karkati from Yoga Vasistha, a compendium made over several periods of time, and dated variously by different people to the Ramayana period, spread the message of healthy lifestyle and hygiene.

3. Chronology of Ancient Indian Medical Knowledge

The earliest corpus of medical works is embodied in the Atharvaveda, transmitted from antiquity in oral form. Atharvaveda contains sections that discuss longevity, treatment of ailments, cures for specific diseases, eradication of germs, antidotes to poison, prudent food habits and healthy lifestyle.

Ayurveda viewed the human health in terms of three doshas (fundamental energies or governing principles of body) comprising 5 elements — Vata [air (Vayu) + space/ether (Aakash)], Pitta [fire (Agni)], and Kapha [earth (Prithivi) + water (Jala)], imbalance of which gave ill-health, and sought correction to the ideal. The universe was considered composed of the Pancha Mahabhootas (5 great elements) and the physiological functions controlled by the doshas. The human body was defined as comprising saptaadhatus (7 fundamental principles/tissues) — Rasa (tissue fluids), Rakta (blood), Mamsa (muscle), Meda (fat), Asthi (bones), Majja (marrow), and Shukra (reproductive tissue). Praying to divinities for healing and for good health was common in northern India by worshiping Sheetala Mata or Ma Durga, and in southern India by worshiping Mariamman.

References:
1. Sus'Ruta
2. Charaka
3. Atharvaveda
4. Pancha Mahabhootas
5. Ayurveda

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4. Archeological record of medical practice

The early evidence of medical practices in India can be traced through the archaeological finds. A 9000-year-old tooth was found in Baluchistan\(^1\) with apparent drilling to remove rotten dental tissue, and several skulls were recovered from Mehrgarh and Harappa Cemetery dating to 2300 BCE showing trepanation and the bone healing. In yet another find, near Baluchistan in the burnt city dating to 2800 BCE, a skeleton with a bitumen prosthetic eye was retrieved from a grave.\(^7\)

The use and construction of surgical instruments has been found in the medical compendium, Sus'ruta Samhita (code of practice), unsatisfactorily dated variously between 600 and 200 BCE by Western scholars. Surgical instruments made of copper were recovered from Taxila dating to this early period.\(^7\) One of the earliest extant scripture of Indian medicine was recovered from the Xinjiang province, the Bower Manuscript — a birch bark document written in Gupta Prakrit (a vernacular), from about 200 CE. One might wonder how Sus'ruta's date was fixed. Rudolf Hoernle, an osteologist, who translated the Bower Manuscript, also attempted to date Sus'ruta by studying the bone and altar descriptions in the Satapatha Brahmana (100 paths of vedic commentary).

5. Date of Sus'ruta

Hoernle used Buddhist sources to place Sus'ruta to the East at Kasi, and Charaka as a physician in the court of King Kanishka.\(^9\) He noted that Charaka Samhita counted 360 bones of the human body in 30 categories in contrast to 300 bones in 23 categories in Sus'ruta Samhita. He stated that Atreya's theory of the skeleton as found in Bheda Samhita concurred with Charaka and counted 360 bones of the human body in 30 categories, even though there were significant differences in the categories and the bones that were counted. Hoernle claimed that the reference to 360 bricks in a Vedic altar mentioned in Satapatha Brahmana in 4th and 12th paragraphs of 5th chapter in the 10th section is in relation to bones of the human body.

Placing the author of Satapatha Brahmana- Yajnavalkya, in the court of Videa King Janaka, a contemporary of Kasi King Ajatasatru, Hoernle proposed the time-period of 500 BCE for Yajnavalkya, citing Weber's works as a reference.\(^10\) Hoernle noted that Yajnavalkya was aware of both descriptions of human skeletons proposed by Sus'ruta as well as Atreya and Charaka, and noted a strong influence of Sus'ruta description of bones, marrow and fat (absent in Atreya-Charaka description) in the description provided by Yajnavalkya. Hoernle claimed that Sus'ruta was aware of Atreya's bone classification, but introduced his own pointing out the differences from Atreya's method of exposition. Using Buddhist Jataka (newborn/birth) records that mention medicine as taught in the famous universities of Taxila and Kasi in the time of the Buddha, Hoernle placed Atreya at Taxila and Sus'ruta as his younger contemporary in Kasi, in the 6th century BCE. Given that Yajnavalkya in 500 BCE was aware of Sus'ruta's works, the latter was placed in an earlier time-frame to 600 BCE.

Such a dating leaves much to be desired. If one considers the internal evidence in Satapatha Brahmana, the astronomic observations encoded in the text lends to much earlier dating. Dikshit\(^11\) noted verses 2.1.2(1)-2.1.2(3) that described setting the fires under open star cluster, Krittika (or Pleiades).\(^12\) One of the statements therein that Krittika does not “move away from the eastern quarter” was highlighted as an ancient astronomical observation by Dikshit, and is a reference to heliacal rising of Krittika on the celestial equator, around 2980 BCE.\(^11\) Therefore, if we pay attention to this evidence of Satapatha Brahmana and accept this early date, then Sus'ruta must be placed at least about 100 years prior to Satapatha Brahmana, opening the possibility of very ancient date for the master surgeon, with supplements to his work in later periods by his disciples. Such mysteries abound in Indian texts and the origins of systematically practiced medicine could have been more ancient than proposed by the Western investigators who used latest recensions or methods from linguistics.

It is instructive to see what ancient books such as Sus'ruta Samhita dealt with. Sus'ruta Samhita has 120 chapters in 5 sections, where it discusses anatomy, physiology, pathology, pharmacology, diagnostic medicine, pediatrics, geriatrics, obstetrics and gynecology. Sus'ruta describes human anatomy in details and discusses 1120 diseases. Sus'ruta also describes surgical methods including excision, incision, suturing, scraping, puncturing, blood-letting, probing, extraction, rhinoplasty, and cataract surgery, and describes 121 surgical instruments.\(^11\)

6. Spread of Indian knowledge

Climate studies indicate that India experienced a multi-century drought about 4000 years ago.\(^14\) triggered a great migration out to the fertile crescent and other areas. Cattle genomics show introgression of the Indian Bos Indicus (Zebu) drought-resistant cattle in that time frame in the Fertile Crescent, indicating an out of India migration.\(^15\) Interestingly, we also see some early medical works of Egypt such as Smith Papyrus (1500 BCE), Ebers Papyrus (1550 BCE) and Kahun Papyrus (1800 BCE) that contain a mix of spells and topics on surgery and medicine, arising in this post-migration period. Royle has discussed plants and materials from India in use in Egypt, hinting ancient transfer of knowledge.\(^16\) We can also see some parallels in the medical works of the Mittani, Hittite and Kassite people, again in the post-migration period.

In ancient Greece, we note the travelers such as Pythagoras and Democritus who visited India for knowledge and see the impact on their societies. For example, Hippocrates (460-370 BCE) who was a student of Democritus, proposed a model for the human condition using the elements of air, fire, earth and water, and the conditions of hot, dry, cold and wet, and the humors bile, blood and phlegm, whose prototype appears to be the Ayurveda dosha model. With Buddhist missionaries active in the area, and the Selucid empire stretching from India to Turkey, it is not surprising that knowledge from India spread to these areas. The Roman trade as exemplified in the Periplus of Erythrean Sea shows that Indian medicines, herbs and spices were also part of the trade. In fact, Dioscorides (~70 CE) wrote a 5-volume Materia Medica with large number of Indian herbs. Greek and Nestorian refugees from the Byzantine Empire and pre-Islamic Persians were also students of Indian medical works at Gundeshapur in Persia. Indian medical works were propagated over the Silk Route to China, Southeast Asia as well as to Mediterranean lands, as exemplified by the finding of Bower Manuscript in Xinjiang province.\(^17\)

The Islamic period from 711 CE saw several Indian medical works translated to Persian and Arabic and injected into several cities along the Abbasid Empire, stretching from Sindh to southern Spain. This medical knowledge eventually reached Western Europe via translation schools in Toledo in Spain, and Sicily in Italy, where the Arabic works were translated to Latin, between the 10th and 13th centuries. This allowed medieval Europe to ramp up on Indian medical knowledge, until such time the European colonialists got direct knowledge from India. Garcia da Orta's 1534 CE book on Ayurveda and herbs was translated to Latin. Dutch botanist Hendrik van Rhoede (1636–91) wrote a book with Ayurvedic physicians help in Kerala, Johann Koenig (1708) wrote based on earlier works on Indian botany. These instances support the spread of Indian medical knowledge through the Old World in various periods of time.\(^17\)
7. Contributions to cardiology

It is believed that the old European terms describing the Heart took their roots in the Sanskrit word- Hridaya. The search in English encyclopedia for the origin of the word-heart lead to horte that meant breast, soul, spirit, will, desire, courage, mind and intellect. It could also be connected to Proto-Germanic hertan, old Saxon herta, old Frisian herte, old Norse hjarta, Dutch hart, old high German herza, German Herz, and Gothic haerto.28 Spelling with -ea- could reflect to origin before c.1500, reflecting what was then a long vowel, and the spelling was retained when the pronunciation shifted. Most of the modern figurative senses were present in old English, including the notion of heart as the seat of innermost feelings, emotions, love and affection, or courage from late 14c.

The Sanskrit word, Hridaya was derived from 3 verbs as per Satpath Brahaman and Brihadaranyak. (i) HRU for harati i.e. to receive from or to abduct, (ii) DA for dadati i.e. to give or to donate, and (iii) YA for either yagati i.e. to control through self-generated rhythmicity, or Yuma i.e. maintaining balance for contraction and relaxation, or to circulate.29 Therefore, the word hridaya in itself was a comprehensive physiologic expression. The concept of hridaya was illustrated in Charak Samhita within the chapters including Arthe Dash Mahamully Adhyaya and Trimarmiya Adhyaya. The hridaya was described as the organ engaged in contraction and relaxation ceaselessly during waking and sleep. Described first in Atharva Veda, hridaya was considered as an organ system including sirasthridhriyae i.e. brain and urusthahridhriyae i.e. heart. Yogaovishththa also clearly mentioned a thoracic and a cranial hridaya,20 and expressed the emotional component of the heart.

Genetically, hridaya was considered a maternal organ.21 It originated from the essence of shonita (feminine genotype) i.e. rakta and kapha. A parallel was drawn between the evolution into a muscular organ similar to that of myometrium.22 A high mitochon- drial content of the myocardium also supports maternal origin. Shukra or masculinity genotype, responsible for reproductive function, was not considered an important player; cardiomycocytes are not capable of replication. By the fourth month of pregnancy the evolution of the heart was considered completed and began to work in mother’s womb23 when the mother was referred to as dvihridaya (dual hearted). In the Garbh Vyakarana (embryology) Sharir-opkrarnitya Adhyaya of Sharir Sthana in Sus’ruta Samhita, hridaya was described as a type of sira-marma (sira = vessel, marma = vital part)24 wherein hridaya gave rasa (plasma), rakta (blood) and oja (energy/nutrition) through srotas (tracts/vessels) to the entire body.25,26 Sus’ruta reported hridaya as Marmastham, Pranayatan (seat of vitality) or sadhyapranhar (a vital organ) based on fatal prognosis of injury to the organ.27 Kashyapa referred to hridaya as mahamarma (predominant vital organ),28 similar to Charaka who attributed the supreme vital organ status to hridaya being the seat of aatma (soul) and manas (spirituality).

Considered to be a hollow organ, hridaya was referred to as home i.e. aashaya or koshtha by Sus’ruta,29,30 and koshtha by Charaka and Vagbhata.31 When describing the location, Sus’ruta mentioned the hridaya to be situated between the two breasts, in the chest above the mouth of the stomach.32 About the size of individual’s fist, it was described to be shaped as adhomukhapundarika, i.e. an inverted lotus with apex directed downwards.33 In Garbh Vyakarana, Sus’ruta described the development of hridaya with adjoining organs including pleheha (spleen), phuphus (lung) and yakrut (liver), and within klome (mediastinum).34

8. Hridroga and pathophysiology of circulation

In a section on Kaya Chikitsa Tantra (physical medicine doctrine), Sus’ruta described symptoms and treatment of heart disease (Hridroga) in the 43rd chapter.35 The hridroga were reported due to dysfunction of vayu (wind or circulation), especially prana (air exchange) and vyana (omni present air or circulation) vayu.36 Furthermore, hridaya was also associated with sadhak pitta (heart-mind balance, consciousness),37 avalambak kapha (i.e. structural integrity of heart and lungs)38 and oja (metabolism or energy distribution).39

Pranavayu was associated with blood cleansing and acceptance of the rasa–rakta complex in the heart (aadaan), valve closure, and generating praspad (cardiac impulse). Pranavayu brought ambi-piyush (oxygen) with every inspiration and udanavayu provided bala (energy) to cardiac muscles. The latter was accountable for the force required to propel and circulate (vyana) the rasa–rakta complex along the mahadhamanee (aorta). Defects of pranavayu and udanavayu could result in enlargement or failing of heart. Sus’ruta described mandala sandhthi (or the valves) that controlled the unidirectional flow of rasa–rakta complex in and out of the heart. In amavata (arthritis) valves could become affected. The vyavanayu controlled the rhythmicity of the hridaya as well as contraction and relaxation.40 Vyanavayu was considered responsible for the circulation of rasa–rakta complex from the heart to the body along three directions i.e. upwards (heart to head and back), horizontally (por-tal circulation) and downwards (peripheral circulation). Samanavayu indirectly influenced the heart by bringing the nutritive fluid from digestive tract to the heart. On the other hand, whereas sadhakapitta could affect rhythmic control of the heart,41 the avalambaka kapha accounted for lubrication42 and could now consid- ered to be associated with pericardial effusion, pleural effusion and pulmonary edema.

9. Conclusions

The history of Indian medical systems shows rich contributions over the ages by several physicians and surgeons. In this brief paper, we have outlined the antiquity of Indian medical systems, its impact on the ancient, medieval and modern medicine and suggestion that substantial knowledge about the functioning of the heart existed BCE.

Declaration of competing interest

None declared.

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