

‘Hridayotpatti’ a Special Embryological Concept of Foetal Heart Development in Ayurveda: A Review

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Abstract

Background- *Hridaya* (Heart) is considered a vital organ in both *Ayurveda* and modern science, serving as the seat of life consciousness and circulation. Classical texts describe it as *Trimarma* and *Sadhyapranahara Marma*, highlighting its physiological and clinical significance.

Objective: To elucidate the *Ayurvedic* and contemporary concepts of cardiac embryology with special emphasis on *Hridayotpatti*.

Materials and Method: A qualitative, comparative review was conducted using classical *Ayurvedic* texts (*Brihatrayi*, *Laghutrayi* and their commentaries) and modern embryology literature. Relevant literature concepts were analyzed and correlated to identify similarities if any in cardiac development.

Discussion: *Ayurveda* describes the origin of *Hridaya* as “*Shonitakaphaprasadajam*” formed from the essence of *Shonita* and *Kapha* along with contribution of *Matruja*, *Pitruja* and *Atmaja Bhavas* and *Panchamahabhuta*. Acharya’s state it develops early and becomes functionally active in intrauterine life. Modern embryology similarly identifies the heart as the first functional organ beginning in the third week post-fertilization from primary and secondary heart fields. The presence of cardiac jelly crucial for morphogenesis, shows resemblance to *Kapha Prasada Bhaga* due to its cohesive and supportive properties.

Conclusion: Significant parallels exist between *Ayurvedic* and modern view regarding early origin, functional primacy and development mechanisms of the heart.

Keywords: Cardiogenesis, Embryology, Heart, *Hridaya*, *Hridayotpatti*.

Introduction

The *Hridaya* (heart) is regarded as one of the most vital organs in both *Ayurvedic* and contemporary scientific perspectives, serving as the seat of life, consciousness, and circulation. *Acharya Charaka* and *Acharya Sushruta* have emphasized the central importance of *Hridaya*, describing it not only as a physical organ but also as the locus of *Chetana* (consciousness)[1], *Prana*[2] and *Ojas*[3]. In *Ayurveda*, *Hridaya* is described as a *Sadhyapranahara Marma*[4], indicating that any injury here leads to instantaneous loss of life, highlighting its supreme physiological importance. It is also one among the *Trimarma* (*Basti*, *Hridaya*

and *Shiras*)[5], which are considered the three most critical centers sustaining the body. Classical *Ayurveda* texts have elaborately described the concept of *Hridayotpatti* under *Garbha Vijnana*, explaining the development of the heart through the involvement of maternal (*Matruja*)[6], paternal (*Pitruja*)[7], and *Atmaja* factors[8]. The formation and functional attributes of *Hridaya* are governed by the principles of *Panchamahabhuta*, where each *Mahabhuta* contributes to its structural integrity and physiological activity. Furthermore, *Sushruta* and *Charaka* have highlighted *Hridaya* as the origin of *Rasavaha*[9, 11] and *Pranavaha Srotas*[10,12], reinforcing its role in sustaining life processes. Contemporary embryological concepts show its own way of terminologies and development.

Objective-

To elucidate the embryological development of *Hridaya* through an integrative approach combining concepts of *Ayurveda* and contemporary science.

Materials And Methods

Classical literature-

The concepts related to *Hridaya* were excavated from *Brihatrayi*, *Laghutrayi* with their commentaries and all other relevant literature available.

Modern Literature-

- Previous research work related to the subject.
- Books of embryology and modern anatomy.

Methodology-

This study adopts a qualitative and comparative approach by reviewing classical *Ayurvedic* texts to analyze references related to *Hridayotpatti* through textual interpretation, alongside modern embryology literature to understand heart development, both perspectives are then compared to identify similarities if any in the origin and development of heart.

Literal review

Hridaya

Etymology -The term *Hridaya* has a profound etymological significance, reflecting the functional attributes of the heart. It is derived from three root syllables- *Hra*, *Da*, and *Ya*, each denoting a specific physiological role.

Hra- Harati, meaning that which takes away, referring to the heart's function of receiving or drawing impure (deoxygenated) blood from the body.

Da- Dadati, meaning that which gives, indicating the heart's role in supplying pure (oxygenated) blood to all parts of the body.

Ya-Yacchati, meaning "to move or circulate," highlighting the continuous rhythmic activity of the heart that ensures the circulation and movement of blood throughout the body. Thus, the word *Hridaya* itself encapsulates the essential functions of the heart receiving, supplying, and maintaining circulation.

Synonyms- *Mahat* and *Artha*[13].

Features of Hridaya- The heart is of the shape of a lotus bud hangs with its apex downward, constrict itself up during sleep and expanding with the return of awakening[14].

Hridaya is a *Sira Marma*[15], measuring approximately size of a closed fist of own[16], belongs to the *Sadhyapranahara Marma*[4] category which means injury to this *Marma* leads to death from immediate to seven days. *Charaka* kept it in *Trimarma* Category (*Basti, Hridaya* and *Siras*)[5] and given top most priority.

Table-1 Hridaya is considered as the seat of following-

1. Para Oja	<i>Para Oja</i> resides in heart and its loss leads to certain death.[17]
2. Vyana Vayu	Heart is the place of <i>Vyana Vayu</i> which is responsible for all movement of the body[18].
3. Sadhaka Pitta	<i>Sadhaka Pitta</i> is responsible for achievement of dream and goals through his intellect[19].
4. Avalambaka Kapha	Provides support and stability to the heart and surrounding structures[20].

Hridaya is situated in the thorax between the two breasts and above the opening of the *Amashaya* and forms the seat of the qualities of *Sattva, Rajas* and *Tamas*[21].

Origin-

“*Shonitakaphaprasadajam Hridayam*” indicates that the heart (*Hridaya*) is formed out of essence of *Shonita* and *Kapha*. The heart is the special seat of consciousness in all creatures[22].

Ayurvedic concept elucidate the formation of *Garbha* by the union of *Shukra* (sperm) and *Shonita* (ovum) along with the presence of *Atma, 8 Prakriti* and *16 Vikar* in the uterus (*Garbhashaya*)[23].

In this process female contribution (ovum) plays a major role, as it contains protoplasm supports development in the womb. *Shonita* is also referred as *Raja* and *Artava*.

Charaka quoted *Kankayan’s* view that *Hridaya* is the first organ to develop[24].

Sushruta attributes the view to *Kritavirya’s*, stating that *Hridaya* is the earliest organ to develop in the embryo, it serves as the seat of *Buddhi* (intellect) and *Manas* (mind)[25].

In the third month of intrauterine life, five small protuberances (*Pancha Pindika*) appear, marking the future sites of the head and four limbs. By the fourth month, these structures become more distinct and with the development of heart, the foetus attains consciousness expressing desires this stage is termed as *Douhrida*[26]. According to *Acharya Charaka*, the foetal heart begins pulsating in the third month[27].

Heart is one of the soft organs having comparatively more contribution of maternal end[28].

Kapha Dosha is characterized by qualities which are *Guru, Shita, Mridu, Snigdha, Madhura, Sthira* and *Pichhila*[29].

Table-2 The growth of the Garbha is governed by the coordinated contribution of the Panchamahabhuta each plays a specific structural and functional role-[23]

<i>Vayu Mahabhuta</i>	<i>Teja mahabhuta</i>	<i>Apa Mahabhuta</i>	<i>Prithvi Mahabhuta</i>	<i>Akasha Mahabhuta</i>
It governs all movements and divisions within the embryo. It is	It facilitates metabolic and transformative processes and	It maintains the fluid environment essential for foetal survival. It keeps	<i>Prithvi Mahabhuta</i> provides solidity and structural	It creates spaces and facilitates growth and expansion. It

responsible for cellular differentiation, segmentation and the proper distribution of nutrients.	regulates cellular metabolism, enzymatic activity and tissue differentiation.	the tissues in a soft, moist and pliable state, provide lubrication and contributes overall stability and nourishment.	integrity. It is responsible for the formation of dense tissues such as muscles, bones and organs.	allows for the formation of cavities, channels and organ spaces.
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Embryological Development of Heart

The heart is the first organ which starts to develop and function in human embryo. It begins beating as early as the 21st day of post fertilization (PF), and starts pumping blood by the 24th to 25th day (PF). Much of cardiac development, including remodeling and septation, occurs while the heart is pumping blood. This is necessary to provide nutrients and oxygen and to dispose of wastes during embryonic and foetal development, but this mechanical and electrical activity also plays an important role in the morphogenesis of the heart. The embryonic heart is first morphologically identifiable as a single tube composed of contractile myocardium surrounding an inner endocardial (endothelial) tube, with an intervening extracellular matrix[30].

Progenitor heart cells lie in the epiblast, immediately adjacent to the cranial end of the primitive streak. From there they migrate through the streak on approximately day 16 of gestation into the visceral layer of lateral plate mesoderm where some form a horseshoe shaped cluster of cells called the primary heart field, which forms portion of the atria and the entire left ventricle. The secondary heart field resides in visceral (splanchnic) mesoderm ventral to the pharynx forms the right ventricle and outflow tract (conus cordis and truncus arteriosus), which also contributes to formation of atria at the caudal end of heart[31].

Primary heart field induced by underlying pharyngeal endoderm to form cardiac myoblasts, and blood islands that will form blood cells and vessels by the process of vasculogenesis. With time, the islands unite and form a horseshoe-shaped endothelial lined tube surrounded by myoblasts. This region is known as cardiogenic region. The intraembryonic (primitive body) cavity over it later develops into the pericardial cavity[32].

By the 21st to 22nd day (PF), the primitive endocardial tube is surrounded by a mass of splanchnic mesoderm containing myocardial progenitors that aggregate around fused endocardial tubes to form the myocardium. A thick layer of acellular extracellular matrix, the cardiac jelly, is deposited mainly by the developing myocardium, separating it from the endocardial tube. The epicardium (visceral lining of the pericardial cavity covering the heart) is formed later by a population of mesodermal cells that are independently derived from splanchnic mesoderm that migrates onto the outer surface of the myocardium[33].

The primary heart tube is initially suspended in the developing pericardial cavity by a dorsal mesocardium (dorsal mesentery of the heart) formed by splanchnic mesoderm located beneath the foregut. Subsequently, this dorsal mesocardium ruptures over almost the entire length of the heart tube, with the exception of the caudal most aspect, where a small but very important component of the dorsal mesocardium persists. As a result, the heart is left suspended in the pericardial cavity by its developing arterial and venous poles, with the region of the ruptured dorsal mesocardium becoming the transverse pericardial sinus within the pericardial sac of the definitive heart[34].

Initially, the central portion of the cardiogenic area is anterior to the oropharyngeal membrane and the neural plate. With closure of the neural tube and formation of the brain vesicles, however the central nervous system grows cranially so rapidly that it extends over the central cardiogenic region and the future pericardial cavity. As a result of growth of the brain and cephalic folding of the embryo, the oropharyngeal membrane is pulled forward, whereas the heart and pericardial cavity move in following manner:-

1. Anterior to the oropharyngeal membrane and the neural plate.
2. Move first to the cervical region
3. finally it descends to the thorax region[35].

Discussion

Ayurvedic literature emphasizes the primacy of the Hridaya, not merely as a structural organ but as a functional and metaphysical center. References from classical texts, along with views attributed to *Kankayana* and *Kritavirya*, consistently suggest that the *Hridaya* is among the earliest organ to develop in the embryo. This aligns with modern embryology, wherein the heart is recognised as the first organ to develop and attain functional activity in the human embryo during the third week of intra-uterine life with in the formation of cardiogenic field within the pericardial cavity, situated anterior to the pharyngeal membrane and neural plate, which subsequently relocates to the thoracic region following cephalocaudal folding.

Classical literature emphasizes *Hridayotpatti* as “*Shonita-Kapha-Prasadajam Hridayam*,” denoting the origin of the heart from the *Prasada Bhaga* of *Shonita*. This may be correlated with contemporary embryological development; wherein cardiac progenitor cells lie in the epiblast adjacent to the cranial end of the primitive streak and migrate to visceral layer of the lateral plate mesoderm to form the primary heart field. Concurrently, additional progenitor cells reside in (splanchnic) visceral mesoderm ventral to the pharynx constitute the secondary heart field, contributing to further cardiac development.

An elastic irregular layer of extracellular matrix which is rich in hyaluronic acid called cardiac jelly is formed which occupies the myo-endocardial interval is responsible for the instigation of function of Foetal heart. These properties closely resemble properties of *Prasada Bhaga* of *Kapha* which is characterized by *Snigdha*, *Manda* and *Picchila*, all of which are reflected as cardiac jelly.

Sushruta describes that extremely small papillae (*Sukshma Avastha*) are formed and minor limb and organs to be formed from those papillae. Similarly, in modern embryology the Foetal heartbeat begins by the end of third week, and becomes clinically detectable only around 16th to 20th weeks. This parallels the *Douhridini* Avastha (from the fourth month), when Foetal activity becomes appreciable. These, both perspectives indicate early functional existence followed by later clinical or perceptible manifestation at around same time.

Conclusion

This study revealed the two concepts of Ayurveda science, first, woman bearing two hearts from 2nd to 4th month and same is described in modern embryology as formation and function of heart starts from 3rd week and become fully functional and audible in 3rd to 4th month, and second the formation of heart from *Shonita* and essence of *Kapha* shows the maximum resemblance with the concept of cardiac jelly and extranuclear contribution of female gamete (ovum) i.e. *Shonita*.

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