

Greco Arabic Philosophy on Formation of Foetal Organs

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ABSTRACT

Background and Objectives: The philosophy is one of the oldest branches of knowledge by which ancient philosophers and physicians sought truth through reasoning rather than empiricism. Since, during the ancient time no any modern techniques or instruments were available to investigate truth of embryology; philosophy was found one and only approach for knowing the truth. This study provides the basic knowledge and philosophical reasoning about the complex phenomena regarding organogenesis during intra uterine life of the foetus. Current research addresses the issues like what kinds of faculties are inherent in sperm and ovum? How these faculties work for the formation of foetal organs?

Interpretation and Conclusion: Unani system of medicine or *Tibb* has very crucial concept of faculties regarding the foetal organogenesis. The transformative faculty forms the foetal organs through the action of *Kayfiyat-i-Arba'a* (four prime qualities of matter) i.e. heat, cold, moisture, and dryness. This faculty makes some changes in the embryo by transforming the thin consistency of *Mani* (sperm and ovum) and *Dam* (blood) towards the thickness. The formative faculty gives the shape and appearance which is similar to that particular species to which that sperm and ovum belongs or any other shapes close to that particular individual. This study furnishes more comprehensive view of the mechanism involved in the process of organogenesis. The significance of this study is that it reveals comprehensive work of earlier physicians on the topic of formation of foetal organs.

Key words: Embryo; Foetal organs; Nutfah; Unani Medicine.

INTRODUCTION

The organs (*A'dā'*) are defined as the *Kathif* (dense) and *Jamid* (solid) parts of the body which are composed by primary arrangement of *Mani* (sperm, ovum) and blood. An organ is a fully differentiated structural and functional unit in an animal that is most suitable for particular function. The formation of *A'dā'-i-Janin* (foetal organogenesis) occurs from third to eight weeks of foetal development. This period of organogenesis is also known as the embryonic period. The first two weeks of

development are known as pre embryonic period or zygotic period. The period from the beginning of ninth week or third month to birth is known as the foetal period. [1] According to Hippocrates (460-370B.C) and Haly Abbas (D.994); all the events from the beginning of fertilization to the birth may be divided into four periods. First period is that in which the dominant forms or shapes of the sperm and ovum still remains in the *Nutfah* (zygote). At this time, the *Nutfah* is described as *Mani* (mixture of both male and female semen) by Hippocrates. The

second period of development starts when zygote is filled by the percolation of the *Dam* (blood) and the differentiation of heart, brain and liver do not occur at this time but begins to form. At this time, due to hidden form or shape of the organs or foetus, Hippocrates called it as *Janīn* (embryo) which means a hidden object which has to grow or swell. The third period of development is that when the shape or form of brain, heart, and liver appears prominently and all remaining organs begin to develop. The fourth period is that in which the differentiation and occurrence of all remaining organs are completed. At this time, Hippocrates gave the name of embryo as *Ṭufl* (foetus) because of movements of the foetus. Hkm Ghulam Husnain Kantoori gives the explanation of the word *Ṭufl*. He said that *Ṭufl* is the name of soft and smooth thing. It also means a small thing. [2] Thus, according to these meanings; Hippocrates has given the name *Ṭufl* for the embryo when movements of the feet begin to appear.

Concept of Quwā (faculties) Regarding the Formation of Foetus:

The Quwā is an Arabic word which means faculties or powers. *Quwwat-i-Tanāsuliyah* (Reproductive faculty) is a kind of *Quwwat-i-Tabī'ah* (vegetative faculty/physical faculty) which acts on the *Ghidhā* (foods/nutriments) for the preservation of the species. [3] This faculty ensures propagation and preservation of species to replace what is lost through the death of its members. This faculty has two kinds of sub-serving faculties known as *Quwwat-i-Muwallidah* (generative faculty) and *Quwwat-i-Musawwirah* (formative faculty). *Quwwat-i-Muwallidah* deals with the *Tawlīd* which means genesis or formation, so it is called as generative faculty. According to Ibn-i-Nafis; generative faculty is that faculty which separates essence of *Manī*, i.e. sperm and ovum, from *Amshāj-i-Badan* (compounds of the body) inside the testes (and ovaries) and primes each of its part to become a

particular organ. [4,5] This is responsible for formation of *Manī* (semen) i.e. sperm and ovum, and responsible for formation of the foetus in mother's womb. [5] *Quwwat-i-Musawwirah* gives shape and appearance with final characteristics to the organ, so it is called as *Musawwirah* which means formative faculty. According to Haly Abbas; Reproductive faculty forms the foetus by using *Manī* and *Khūn-i-Ṭamth* (blood retained in uterine bed which is excreted through vagina during menstrual cycle). The action of this faculty in the *Raḥim* (uterus) begins when sperm and ovum meet with each other (fertilisation takes place) into the uterus and its action continue till the time of the foetal birth. [2]

Gestational Events of Developing Embryo:

Zubdah Stage of developing embryo: According to Ibn-i-Hubal Baghdadi and Ahmad Al Hasan Jurjani; the first week of developing embryo is known as *Zubdah* (froth). [6,7] Haly Abbas mentions that when the *Manī* of both male and female are mixed together and forms the zygote, then it shows froth or foam like appearance due to its innate heat. [2] The formation of bubbles in *Zubdah* or froth may be similar to cleavage according to modern science in which mitotic divisions of cells occur.

'Alaqa stage of developing embryo: The second week of development is the stage of *'Alaqa* (like a leech). After a few days of fertilization, a layer (trophoblastic cell layer) is formed over the zygote, after that it is known as *'Alaqa* in Arabic. [7] The word *'Alaqa* is used for a leech symbolizing a fertilized egg sticking to the wall of the uterus and sucking the nutrients like a leech.

Mudghah stage of developing embryo: After the end of fourth week of development, the zygote is known as *Mudghah* (a piece of flesh) in Arabic because it looks similar as flesh. During this period *A'dā'-i-Ra'īsa* (vital organs) are differentiated and separated from each other.

Stage of *Janīn* in developing embryo: In the second month of development all organs are formed, during this period it is known as *Janīn* or embryo. After the appearance of sense and movements of the *Janīn*, it is called as *Haywān* or animal. [6,7]

Formation of Foetal Organs, Their Growth And Maturation:

According to Galen; the embryo is formed from the *Manī* and blood which are *Raṭab* (moist) in nature. Organs are formed by freezing and drying of these moist matters. As the age increases, hardness, dryness of the organs are also increases relatively. [8] According to philosophers and physicians; *Quwwat-i-Mughayyirah Ūlā* (primary transformative faculty) and *Quwwat-i-Musawwirah* (formative faculty) are responsible for the formation of foetal organs. These faculties are inherent in the *Manī* and *Nutfah*. [9,10] Primary transformative faculty acts in the zygote to prepare its different parts which later develop into different organs. Haly Abbas mentions that this faculty forms the organs of the embryo through the action of *Kayfiyāt-i-Arba‘a* (four primary qualities of matter) i.e. heat, cold, moisture, dryness. [2] Thus, this faculty produces different kinds of peculiar *Mizāj* (a mixed and uniform state of all four primary qualities of matter) into each parts of the embryo, through which each parts of different *Mizāj* becomes ready to develop into their future organs. [5,10] Haly Abbas says that Primary transformative faculty makes some changes in the zygote by transforming the thin consistency of *Manī* and blood towards the thickness. Due to this thick and adhesive nature of matter in fertilized egg, it becomes capable of developing into foetal organs. [2] These thick and adherent characteristics are also proved by modern science. According to modern science; once the cells of epiblast have invaginated, some displace the hypoblast, creating the embryonic endoderm, and others come to lie between the epiblast and newly created endoderm to form mesoderm. The cells remaining in the

epiblast then form ectoderm. Thus, the epiblast is the source of all of germ layer, because these layers are established from the epiblast through the process of gastrulation. Then the cells of these germ layers give rise to all the organs in the embryo. [1] Thus, it may be possible that all these germ layers are formed due to the action of Primary transformative faculty. According to modern science; the embryonic disc which is initially flat and round, that gradually becomes elongated, with a broad cephalic and narrow caudal end. The cells from the primitive streak region migrate mainly in the cephalic region due to this reason expansion of embryonic disc occurs in a cephalic direction. According to Unani physicians; Primary transformative faculty is responsible for all kinds of alteration and giving the specific *Mizāj* to each parts of the embryo. Thus, it may be responsible for thickening and elongation of cephalic part of the disc, but according to modern science, these changes are due to cascade of signal molecules and some specific gene, i.e. the secreted factors Cerberus and lefty, transcription factors OTX2, LIM1, HESX1, and some genes establish the cranial end of the embryo before gastrulation. [1] It may be possible that the activation of transcription factors and genes are due to the effect of *Kayfiyat-i-Arba‘a*, which are utilised by Primary transformative faculty. According to Ibn-i-Nafīs; when each parts of *Manī* have achieved the potency and capability to develop into different organs, then formative faculty gives them shape and appearance which is similar to that particular species to which this *Manī* belongs or any other shape close to that particular individual. This formative faculty produces lines in the organs, forms cavities and depressions, and performs other functions. [10] According to Haly Abbas and Avicenna; the formative faculty is that through which delineation and configuration of the organs is produced with all their cavities, foramina, positions and relations to one another, their smoothness or roughness

and so on. ^[2,5] This faculty gives the shape first to those organs which are like roots for many other organs. These root or base organs are brain, heart and liver which are formed first rather than other organs. ^[2] According to Aristotle; once the embryo is formed, it acts like a seed of plants. When this has been differentiated, the root and shoot are sent off from it. The plant gets its nourishment from its root. Therefore, the heart is differentiated first in actuality. ^[11]

There is a controversy between the philosophers about the organ which is formed first in the embryo? According to Hippocrates; the brain is formed first, because it is responsible for the perception and movements. According to Aristotle; heart is the first organ that develops in embryo, because it is a source of *Harārat-i-Gharīziyah* (innate heat) and all kinds of *Quwā* (faculties). ^[2,12] Heart is the first principle or origin of homogenous and heterogeneous parts, and also origin for the blood vessels. ^[11,13] Some other philosophers said that the liver is first organ in developing embryo, because it is responsible for growth and nourishment, and *Quwwat-i-Tabī'iyah* (vegetative or physical faculty) is mainly related to this organ. ^[6] According to Haly Abbas; the heart, brain, and liver are developed first in embryo, and the time of differentiation of these three organs is very close to each other. It is very difficult to say which organ differentiates first? But after the differentiation all these organs are separated from each other. ^[2] According to modern science; the heart is the organ which developed first very early in the life of embryo. It is also first organ which begins to work. Its mark or point of origin appears in the second week of the embryo, and during the third week it begins to develop from the mesoderm. ^[14] Haly Abbas said that three branches of organs originate from their respective root organs (heart, brain and liver). Thus, *Nukhā'* (spinal cord) and pairs of *A'sāb* (nerves) originate from the brain. One large artery begins to develop from heart and *Rag-i-Ajūf* (vena cava) originates

from the liver. ^[2] According to Hippocrates; the soft parts or organs of the foetus are formed by taking nourishment from soft and wet nutriment. The hard parts or organs are formed by hard or solid nutriment. Foetal organs originate like the shoots come out from the plant. Then after vessels and nerves originate and spread throughout the body. ^[15] According to Haly Abbas and Hakim Jurjani; Primary transformative faculty acts in the constituents of *Manī*. It produces the flesh by the effect of *Harārat* (heat) and *Ruṭūbat* (moisture) in the *Ajzā'-i-Manī* (constituents of fertilized egg). When it acts by higher degree of heat with some dryness or little quantity of moisture, the muscle of the heart is produced. If it acts by heat and moisture of *Mu'tadil Mizāj* (appropriate quality not more or less), then the mass of the liver is produced. When it acts by cold and moisture then the mass of the brain is developed. ^[2,7] When it acts at that part of embryo which have coldness but some or little moisture then *Nukhā'* (spinal cord) is formed. When it acts at that components of *Manī* which have the *Mizāj* as cold and dry but its dryness is of lower degree, then nerves, arteries, veins, ligaments, and membranes would appear. And from the components of *Manī* which have coldness and higher degree of dryness, formation of bones take place. Thus, through various proportion of these *Kayfiyāt-i-Arba'a*, Primary transformative faculty performs its action in all the remaining organs of developing embryo. ^[2] At the same time of organogenesis, formative faculty gives the shape and appearance to each part of *Manī*. It makes body cavities, like; it forms the space between visceral and parietal layers of lateral plate mesoderm known as primitive body cavity. Ibn-i-Hubal Baghdadi mentions that the functions of formative faculty are to make and expands the cavities of the body. ^[6] It makes the surface as rough or smooth according to characteristics of each organ. ^[2,6] Thus, the many cavities of the body are formed from the lateral plate mesoderm in the pericardial, pleural, and

abdominopelvic regions. Thus, both Primary transformative faculty and Formative faculty perform their functions till the foetus attains its desired shape and appearance.

After the formation of foetal organs, further maturation and growth of the foetus take place. Avicenna states that *Quwwat-i-Ghādhiya* (faculty of nutrition) and *Quwwat-i-Nāmiyah* (augmentative faculty) are the sub serving faculties of *Quwwat-i-Tanāsuliyah* (Reproductive faculty).^[16] The faculty of nutrition supplies the nutritive materials, and augmentative faculty increases growth of the organs. Haly Abbas mentions that *Quwwat-i-Ghādhiya* provides appropriate foods to each organ then assimilates and makes them similar to feed organ. *Quwwat-i-Nāmiyah* augments the foetal organs and transforms them from smaller to larger size and grows them in length, breadth, and depth.^[2]

MATERIALS AND METHODS

Literature related to mechanism regarding formation of foetal organs, was surveyed from various classical Unani books, journals, periodicals, manuscripts, and online citations from the subject specific websites. Collected material was then analyzed and systematized in comprehensive manner.

RESULTS

The findings and observations made after the diligent and utter examination of all existing literary information on formation of foetal organs on the basis of philosophical evidences and reasoning are as follows.

The literature regarding embryonic period of foetal development, its definition, events of its laborious phenomena are extensively vast and elaborated in *Tibb* or Unani System of Medicine.

The important tools for the formation of foetal organs were found *Quwā* (faculties), *Kayfiyat-i-Arba'a*, i.e. heat, cold, moisture, dryness and *Harārat-i-Gharīziyah* (innate or proper heat).

This study revealed that reproductive faculty plays core role in the process of foetal organogenesis. It is inherent in sperm and ovum.

Primary transformative faculty activates the transcription factors and genes by the effect of *Kayfiyat-i-Arba'a* to prepare different parts of embryo which later develop into different organs.

Formative faculty forms the shape and appearance of foetus according to each species by using different potentialities (genes) of *Manī* to which that genetic matter belongs.

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How to cite this article: Waqas AA, Rasool NA, Rahman O. Greco Arabic philosophy on formation of foetal organs. *Int J Health Sci Res*. 2018; 8(6):302-307.
