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REVIEW ARTICLE

A CRITICAL APPRAISAL OF *GARBHA AVKRANTI* VIS-A-VIS MODERN EMBRYOLOGY

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ABSTRACT

With the latest advancement in the field of medical science, each aspect of human embryology has been studied in detail and still more and more is being explored. This has been made possible with the help of different tools and techniques. But in the present era of scientific world one cannot put aside the thousand years old literature of *ayurveda*, where *Acharyas* have beautifully described human embryology in terms of *Garbhadhan Vidhi(*method of conception*), maasanumasik Garbha vriddhi* and other aspects of *Garbha shareera (*embryology*)* with their deep insight of knowledge even in the absence of present diagnostic tools/aids. Detailed description is available in *Samhitas* regarding *Garbhavkranti* (fertilization) and monthly development of *Garbha*. The present article aims to put forth the relevance of *ayurveda* concept of human embryology explained by *Harita* and by reviewing the available literature it is concluded that description given at that time holds quite true even today.

Keywords: *ayurveda*, *Garbhadhana vidhi*, human embryology

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INTRODUCTION:

Mother nature has provided the bestow of reproduction to all living beings enabling them to preserve their species. Starting from the ancient period to the contemporary era embryology is a matter of great curiosity for the ancient sages as well as the modern embryologist so as to solve the mystery of reproduction and explore the secrets of embryonic development. Ancient sages have explained the concepts of conception, formation of zygote and foetus, the inheritance of various qualities, formation of different organs and system and monthly development of foetus in a subtle, detailed and interesting way. *Garbha Shareera* (embryology*)* is a proof of the unparalleled knowledge, the *Acharyas* had regarding the embryology irrespective of the fact that era, thousands of years ago lacks such modern scientific parameters and techniques to carry out researches to discover new facts and figures. Various ancient *Acharyas* and scholars belonging to the *brihatyee* and *Laghutrayee* had very well observed and documented the concept of *Garbhavkranti* and various stages of development of *Garbha*. In *Ayurvedic* Texts *Charaka* has described *Garbha* as combination of three factors i.e. *artava(*ovum*),* *sukra*(sperm*)* and *jiva(atma*). *Garbha* is a product of *akasha*, *vayu, jala, agni* and *prithvi* five *mahabhutas(*five great elements*)* and *cetana*[1] (consciousness)

Sushruta is also of the view that of *Charaka* but instead of using the word *jiva*, he has mentioned *prakriti*(nature*)* and *vikara(*change*)* words along with *atma(*soul*)*. He has termed *Garbha* as *agni-soma-samyoga(*union*)* which along with all the *panchamahabhutas, sattva(*harmonious*), raja(*confused*), tama(*destructive*)* and other *bhavas* with stimulation of *vayu* that takes part in the formation of *Garbha* [2].

REVIEW OF LITERATURE:

Starting from the *Vedas* and *Brahmana* one of the *Brahmana Granthas* are of the opinion that all the body parts of the *Garbha* do not develop simultaneously, rather develop one after the other. During *upanishad* period the concept of various stages of fetal development has been mentioned very systematically. *Garbha upanishad* is one of the milestones having the description of fetal development. Buddhist texts like *Samyuttanikaya, Jataka, Milindapanho, Visuddhimagga* etc have gross description of embryology. As per *Samyuttanikaya* embryo is called '*kalala*'(zygote) after fertilization. It is the first stage. Second stage is '*abbuda'(*morula*)*. This *abbuda* in due course gets elongated and attains the shape of '*pesi*'. Later *pesi(*gastrula) becomes '*ghana(*Blastula*)'*. Now from this stage differentiation of both the extremities

along with head, hairs, body hairs and nails etc grow [3].

In *puranas* a brief description of embryology can also be traced in *Garuda Purana*. Its description is based on certain philosophical concepts and says that there exists two germ cells stages in the uterus during the course of development, first it passes through the stage of '*kalala*' super imposed by '*budbuda*'. Then blood like fluid, muscles and finally a round shaped germinating seed like structure is obtained. The other body parts like digits, nose, etc having little movement come in view.

But the most elaborate and accurate description of the intial stages of development of *Garbha* which resembles the most to the modern embryological concepts is mentioned in *Harita samhita* which has been taken as the study matter in this article along with the view of other *Acharyas* as well as its modern perspective.

A*yurvedic* Perspective of Organogenesis:

Charaka opines that in the first month, *atma* gets mixed up or vitiated by all the *dhatus(*tissues*)* and attains a mucoid appearance. Previously due to *prithvi ttatva*, the shape is solid, which later on becomes blastocyst due to predominance of *jala tattva*. He believes that at this stage all the body parts are present in this mucoid structure but in subtle form [4].

Sushruta and *Vagbhata* are of the opinion that during the first month, the embryo is in the shape of *kalala*[5]. As per *Garbhopanishad*, the fertilised egg becomes *Kalala* in one night, *budbuda* in 7 nights, *pinda* in 15 days and solid in one month [6].

Yajnavalkya Smriti has described that after union of *sukra* and *shonita(*ovum) carrying *pancamahabhutas* as well as descent of *atma* all these get mixed up and are moistened in the first month [7].

Harita has elaborated the views of *Yajnavalkya* and said that after union of *sukra* and *sonita* on the first day, it attains the form of *kalala.* On 10^{th} day, it becomes becomes *budbuda*, on 15^{th} day a solid and on 20^{th} day a mass of flesh. The *mahabhutas* get associated with it on 25^{th} day and by the end of one month all the *tattvas* become conspicuous [8].

Modern Embryological Concept:

- Fertilization of the ovum takes place in the ampulla of the uterine tube. The fertilised ovum is a large cell .It undergoes a series of divisions i.e cleavage [9].
- When there are 16 cells,the ovum is called a **morula [9]**. It has an inner cell mass covered by an outer layer of cells, the trophoblast.
- Fluid partially seperates the inner cell mass from trophoblast. The morula now becomes a **blastocyst [9]**.

- The cells of the inner cell mass multiply and are rearranged to form an embryonic disc having two layers. These layers are the epiblast and the hypoblast [9]. Later the epiblast differentiates into three germ layers the ectoderm, endoderm and mesoderm. Cells of the hypoblast become flattened and line the yolk sac.
- A cavity appears on the ectodermal side of the disc. This is the amniotic cavity. Another cavity appears on the endodermal side. This is the yolk sac.
- At first the walls of the amniotic cavity and yolk sac are in contact with trophoblast. They are soon separated from the latter by extra embryonic mesoderm [9].
- A cavity the extra embryonic coelom appears and splits the extra embryonic mesoderm into a somatopleuric layer [9] (in contact with trophoblast) and a splanchnopleuric layer [9](in contact with yolk sac).
- The trophoblast and underlying somatopleuric mesoderm form a membrane called the chorion [9].
- The cells forming the wall of the amniotic cavity form the amnion.
- The amniotic cavity is now attached to the trophoblast by some mesoderm into which the extra embryonic coelom has not extended. This mesoderm forms the connecting stalk [9].
- On viewing the embryonic disc from the ectodermal side we see that near one edge it has a rounded area called the prochordal plate [9]. Here ectoderm and endoderm are not separated by mesoderm.
- An elevation the primitive streak is also seen on the embryonic disc [9]. A line drawn through the prochordal plate and the primitive streak divides the embryonic disc into right and left halves.
- Cells multiplying in the primitive streak move into the interval between ectoderm and endoderm and form the mesoderm.
- Caudal to the primitive disc we see a round area called the cloacal membrane [9]. It is made up only of ectoderm and endoderm.

Table 1. Stages of Initial Development of *Garbha* [10] (According to various ancient literatures):

	SAMHITA	**1ST MONTH**	**2nd MONTH**
1.	*Garbha upanishat*	1st night *kalala*;7th night *budbuda*;15th night *pinda*	Buds of various body parts
2.	*Charaka Samhita*	Mucoid than *kalala*	*Ghana/Pinda/pesi/arbuda*

3.	*Sushruta Samhita*	*kalala*	*Pinda/pesi/arbuda*
4.	*Ashtanga Samgraha*	*kalala*	*Ghana/Pinda/pesi/arbuda*
5.	*Vrahat Jataka*	Liquid	Solid
6.	Jain Literature	Zygote for 7 days and of 3 *varnas*	*Mamsa pinda*
7.	*Yajvalkya Smriti*	Liquid form	*Arbuda*
8.	*Padma Purana*	1st day *kalala*;5th day *budbuda*; one month solid with five buds for neck, head, shoulder, vertebral column	Appearence of both extremities flank back etc

DISCUSSION:

Table 2. Comparative analysis of development of fetus

S.no	STAGE	DAYS ACCORDING TO TEXT				MODERN CONCEPT
		GU	CS	SS	HS	
1.	*Kalala*	1st	30th	30th	1st	Morula(1-3 day)
2.	*Budbuda*	7th	-	-	10th	Blastocyst(4th day)
3.	*Pinda*	15th	-	-	-	Implantation of embryo in uterus complete by the 12th day and embryo appears rounded in shape
4.	*Ghana*(soli dification)	30th	-	-	15th	Embryo becomes more solid due to rapid division of cells and the formation of primitive streak and neural groove.
5.	*Pesi*	-	-	-	20th	In the last 3rd week the embryo becomes 1.5 to 2mm long and apparently may resemble with pesi as described in *ayurveda*

GU-*Garbha Upanishad* **CS-***Charaka Samhita* **SS-***Sushruta Samhita* **HS-***Harita Samhita*

The above table describes the various stages of initial embryonic development described by *Acharyas* in various *Samhitas* corresponding to their days in contrast to the various stages described by the modern embryologist. If we thoroughly go through the literature described in four thousand years old treatise *Garbha upanishad* we will find a very minute and explicit description of each and every stage of embryonic development and that to in its initial stages which are unveiled by the present day embryologist by means of highly sophisticated and ultra modern techniques and equipments available nowadays and our *Acharyas* had acquired this truthful knowledge by their divine insight, observation and intellect. After *Garbha upanishad Acharya Harita* has described these stages minutely. In this study an effort has been made so as extract out the observations and facts in support of the insight of the *Acharyas* those are even up to date to the present scenario of *Garbha shareer* given in *ayurveda*. For instance if we take the word *kalala* its word derivation means that the product of fusion of *virya* and *raja* on the first day in the form of *sukshma pinda* is *kalala* [11].On the modern counterparts it could be correlated to zygote. The word zygote is derived from the greek word meaning yoked or joined or junction and the consistency and texture of of zygote was found to be similar as a *sukshma pinda* like structure i.e. *kalala*. It can further justified by the study done on "Stages of normal development in the medaka *Oryzias latipes* [12]. If we think about the word derivation of the word *budabuda* [13] it means *bulbula* in hindi or in English its bubble. Bubble is a small globule in a transparent solid something that is hemispherical or semicylindrical .In the modern embryology it has been said that morula is an early stage embryo consisting of cells called blastomeres in a solid ball contained within the zona pellucida. It is produced by a series of cleavage divisions of the early embryo starting with the single celled zygote. Once the embryo has divided into 16 cells, it begins to resemble a mulberry hence the name morula [14].The structure morula and *budabuda* bears a strict resemblance with each other. This fact is further supported by the evidence provided by the study entitled "Time sequence of early events in fertilization in the medaka egg [15] in which each stage of initial embryonic development has been studied with light microscopy**.** The next stage of development of *Garbha* is that of *pindaakara* [16] .The word *pinda* in Sanskrit means to gather and pile up materials like mud or any other mass etc. The next developmental stage post morula is that

of blastula and blastocoele. The word blastos in latin means to sprout i.e to grow. The blastula is a hollow sphere of cells referred to as blastomeres surrounding an inner fluid filled cavity called the blastocoele formed during an early stage of embryonic development. This structure blastula bears a quite similar appearance to because there is a common property of collection of matter in both these structures. In blastula there is a collection and arrangement of layer of cells in one one layer filled with a fluid filled cavity. The evidences are provided by the study mentioned in above where it has been observed in light microscopy. The next stage in development is *Ghana akara garbha*. This word *Ghana* means a structure undergoing the process of gradual solidification, the structure undergoing *nirantara sandrata(*gradual solidification) and attaining *murtarupa* [17](Stability).The next stage in the process of development is that of gastrulation or the formation of trilaminar germ disc. The word germ means a living substance capable of developing into an organ, part or organism as a whole or primordium and disc means a circular or rounded flat plate. The change in structure from blastula to gastrula is that a simply connected sphere like surface is converted into a non simply connected surface torus like. The torus means a surface or solid formed by rotating a closed curve especially a circle about a line which lies in the same plane but does not intersect it [18].This structure gastrula and blastula at the stage of implantation shows a close resemblance to the structure *Ghana* because at this stage it is undergoing the process of stability by means of implantation and solidification by the formation of germ disc, neural groove and primitive streak which will result in the formation of vertebral column thus resulting in solidification. The last stage before the beginning of organogenesis is the formation of *peshi akara Garbha*. The word *peshi* in Sanskrit means *mansa pinda* means collection of muscle like tissue. The process of neurulation has the complete resemblance with that of *peshi akara* because here the trilaminar germ disc now completely develops into primitive streak and notochord and *peshi* has a longer and horizontal appearance just like primitive streak. Further studies mentioned above also supports this fact.

CONCLUSION:

The conclusion which has been extracted out from the present study that the deep insight , observation and valuable knowledge described in our *Samhitas* holds quite truth and accuracy as is discovered and explored by the modern day embryologists that to with the help of latest tools and aids. In this study only a tiny sphere of *Ayurvedic* concept of *Garbha shareer* had been tried to explore. So an effort

should be made by the *Ayurvedic* physicians for more and more exploration and extract out the beautiful ideology of *Acharyas* into its practical significance.

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