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Ancient Embryological Wisdom - A Scientific Explanation in the Light of Epigenetics

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Abstract: Ayurveda primarily deals with both healthy and diseased human conditions, from conception to death. Suprajanan (Healthy Progeny) is the primary goal of Garbhasharir (embryology) as described in Ayurvedic texts. Modern embryology describes in detail the formation, development, and structural teratogenesis of our body's organs, whereas Ayurveda describes the foetus' structural, physical, and mental status. There are numerous references to Garbhasharir that are quoted in Brihatrayee (the three major Ayurvedic compendia) and their commentaries that need to be elucidated in an appropriate way to make them relevant for the modern era.

The current critical appraisal is based on Garbhasharir concepts mentioned in Ayurvedic lexicons in relation to embryological concepts, to interpret and analyze processes related to progeny genesis using current scientific knowledge. Brihatrayee and other relevant literature were critically reviewed to uncover the hidden core of embryology described in Garbhasharir chapters. The fundamentals of Ayurvedic embryology are 'Tridosha' (three bodily humours), 'Triguna' (three psychological humours), and 'Panchamahabhoota', among others. Ayurvedic compendia roughly depict two types of processes (dependent & independent) related to progeny genesis.

Dependent processes are those that can be modified, whereas independent processes are those that cannot be modified by parental effort. Even though the embryology concepts described in Ayurveda date back centuries, they are still relevant in today's scientific world if proper insight is used to interpret them.

Keywords: Ayurveda; Garbhasharir; Shadgarbha Bhava; Garbha Upanishad; Prakriti

I. INTRODUCTION

Fetal development is a continuous process of structural maturation throughout the various stages of gestation. In Ayurveda, the term Garbhadhana refers to the changes that occur during pregnancy. According to Ayurvedic literature, Acharya Charaka describes Garbha as the union of Shukra, Shonita, and Jeeva (Atma) within the Kukshi. Garbha is formed by combining Panchamahabhutas. According to Acharya Sushruta, "Garbha" is a combined state of "Shukra" and "Shonita" in the Garbhashaya, mingling with the "Prakritis" (Mula-Prakriti and its eight categories) and "Vikaras" (sixteen modifications) and needed in by the Atma.

Vayu, Teja, Apa, Prithvi, and Akash are in charge of the body's structural development.

Sadabhava, proper diet by the mother during Garbhavastha, Upasneha, Upasveda, Kala, and Swabhava samsiddhi all play important roles in fetal growth. Sadabhava is concerned with the development of the whole person. Satva and Atma are two factors that are unique to the Garbha (fetus). Mahabhuta stimulates hormone secretion, cell mass separation, and influences nutrient transport through the umbilical cord.

The Garbha Upanishad (Garbhopaniad) is one of the minor Upanishads listed as number 17 in a modern anthology of 108 Hindu Upanishadic texts^[1]. The Garbha Upanishad is a text that almost entirely comments on medical and physiology related themes, dealing with the theory of the formation and development of the human embryo and human body after birth. Consider this Upanishad on the garbha or human embryo to be more like "a manual on physiology or medicine" than a spiritual text, with the exception of a passage that includes a number of statements about the foetus' awareness, including the assertion that including the claim that the foetus has knowledge of its previous lives as well as an intuitive sense of good and bad, which it forgets during the birth process^[2].

In addition, the union of Shukra and Shonitum results in the formation of "kalala," which is described as a Zygote in modern science. According to Vedanta, the manifestation of life begins at the moment of conception. Aristotle was the first westerner to describe the concept of Embryology, but his research was limited to a narrow circle when compared to literary descriptions. In the first chapter of Sharir Sthana, Sushruta also describes creation theory. Furthermore, the Bhavas mentioned in the grabha sharir play an important role in the formation of the embryo (Garbha) and organogenesis.

However, according to contemporary science, the concept of *Shadgarbhakara bhava* is classified as Epigenetics, which is a branch of biology that studies and investigates the effect of the environment and lifestyle on cellular behavior through changes in genetic expression [3]. Drugs and diets may be able to restore normal epigenetic status. Research also indicates that diseases caused by epigenetic changes may be treatable and preventable. Epigenetic programming is possible by following the rules of *Garbha Samskara* in order to have a healthy progeny [4].

II. MATERIALS AND METHODS

Brihat-trayee and their commentaries, especially from *Sushruta Samhita Sharirsthana*, as it was perceived that clandestine concepts of Genetics are exemplified in it. This study also evaluated supporting texts from contemporary science, as well as references from the internet and journals.

III. REVIEW OF LITERATURE

A. *Garbha*

It is the union of the male and female seeds in the uterus, where the soul congregates with them intimately, along with the eight *prakriti* (elementary principles) and sixteen *Vikaras*. Only when the embryo has fully developed hands, feet, tongue, nose, ears, buttocks, and other organs is it described as a body.

The Ancient Wisdom of Embryology in the *Garbha Upanishad*

The body is fivefold in nature (the five elements), existing in the five, relying on the six supports (food tastes), linked with the six qualities, [consisting of] seven dhatus (tissues), three impurities, having two *yonis* (sexes), and [nourished by] four types of food.

When ready, [the embryo] is in a mixed (semi-fluid) state after [a day] and night; after seven days, it becomes a bubble; after a fortnight, a solid mass; and after a month, it hardens. It grows the head in two months and the feet in three months.

The belly and hips are formed in the fourth month; the backbone is formed in the fifth month; and the nose, eyes, and ears are formed in the sixth month. [The embryo] develops the *jiva* (conscious self) in the seventh month, and by the eighth month, it is complete in every way.

The *Ayurvedic* Concept of Embryology

Garbha Sambhav Samagri [5]

Garbha Sambhav Samagri are some pivotal considerations that are attributed to the formation of *Garbha*.

Ritu, *Kshetra*, *Ambu*, and *Beeja* are among the characters, as is *Panchmahabhuta*.

- 1) *Ritu* describes the normal female menstrual cycle, indicating the best time for conception. It is significant because it serves two functions: ovum release and fertilization. *Ritukala* is regarded as the ideal time for conception.
- 2) The *Ambu* term refers to the nourishment obtained by the *Garbha* from the ovum and sperm. Fertilization, implantation, fetal organogenesis, and placenta formation are all affected by the redeemed nutrition.
- 3) The term "*beeja*" refers to genetic material such as chromosomes, DNA, and genes. It is capable of producing new generations. They are extremely important in the conception and subsequent development of *Garbha*. Infertility results from any *Beeja* abnormality.
- 4) *Kshetra* represents *Garbhashaya*, which refers to the mother's reproductive system, specifically the uterus. It is a *Garbha*-inhabited location. Also, the location of *Garbha*'s development.

Sadbhava are the parts of the *Garbha* that come from the father, mother, *Rasa*, *Atma*, and *Satmya*. Soft organs such as the heart, liver, and spleen come from the mother; hard segments such as bone, nail, and teeth come from the father; physical development and strength come from *Rasa*; sensory and motor organs, knowledge, wisdom, lifespan, pleasure, and so on come from *Atma*; and energy, health, and strength come from *Satyamaja*.

IV. MASANUMASIK GARBHA VRIDHI

Garbha (embryo) is formed when *Shukra* and *Shonita* fuse in the uterus along with the entry of *Atma* (soul). *Garbha* becomes a fetus when it undergoes cell division and begins to differentiate. This process of transforming an embryo into a mature fetus takes nearly nine months.

Month	Sushruta	Charak	Vagbhatta
FIRST	first month product of conception is in the shape of <i>Kalala</i>	In the first month <i>Atma</i> possessing all the qualities, getting mixed up or vitiated by all the <i>Dhatus (Bhutas)</i> attains the shape resembling the <i>Sleshma</i> in which all the body parts though present are not conspicuous	In the first month, during the first seven days, the embryo becomes a <i>Kalala (Astaang Hridaya)</i> In the first month there will be formation of <i>Kalala (Astaang Sangraha)</i>
SECOND	Second month <i>Tridosha and Panchamahabhta</i> processed in <i>Kalala</i> the foetus was solid shape, the shape of foetus decide sex of progeny. If as <i>Peshi-rupa</i> (elongated muscles/spindle shape) then female, if <i>Arbuda</i> shape (tumour shape) then <i>Napumsak</i> will be born	Second month of gestation, shape of the <i>Garbha</i> decides the sex determination of child. <i>Garbha</i> takes a compact form in the shape of a <i>Pinda, Peshi</i> or <i>Arbud</i> . The <i>Pinda</i> shaped <i>Garbha</i> leads to the production of a male child, the <i>Peshi</i> shaped to an enough one	During the second month, from the <i>Kalala</i> state (jelly mass) are produced the <i>Ghana</i> (hard mass), <i>Peshi</i> (muscle) and <i>Arbuda</i> (ant-hill) to be born as a male, female or eunuch (hermaphrodite) respectively (<i>Astaang Hridaya</i> and <i>Astaang Sangraha</i>)
THIRD	In the third month, five buds develop, one each of the arms, legs and head; even the differentiation of major and minor manifests minutely	In the third month <i>Sarva Indriya, Sarva Angavayava</i> manifests them simultaneously	During the third months, the five parts of the body become manifest, the head, two legs, two arms, and also all minor parts. Simultaneously with the head etc; the knowledge of pleasure and pain also (<i>Astaang Hridaya</i>) In the third month there will be five branching in the foetus, such as the two for the legs, two for the arms and one for the head. (<i>Astaang Sangraha</i>)
FOURTH	In the fourth month <i>Anga, Pratyanga Vibhaga</i> (demarcation of organs) is more prominent. The <i>Chetana Dhatu</i> also gets manifested because the <i>Hridaya</i> (heart) becomes obvious. Seat of <i>Chetana (Atma)</i> is <i>Hridaya</i> . The woman now possesses two hearts and is known as <i>Dauhridini</i> . If these desires are ignored, the lady would deliver the child <i>Kubja, Kuni, Khanja, Jada, Vaman</i> and	<i>Garbha</i> gets stabilised. Therefore, at that time, pregnant women specifically get excessive heaviness in her body	In the fourth month, all the parts become manifest (<i>Astaang Hridaya</i>) During the fourth month, all the major and minor parts of the body become clearer and the foetus become stable (<i>Astaang Sangraha</i>)

	<i>Vikritaksa</i> . Hence, whatever she desires should be provided to her, if desires are fulfilled, she delivers powerful and long lived son		
FIFTH	in the fifth month, mind becomes clearly manifest	In comparison with previous months, the pregnant women grow excessively thinner because growth (<i>Upachaya</i>) of <i>Mamsa</i> , <i>Shonita</i> in foetus more prevalent in this month. Therefore at that time, pregnant woman specifically gets excessive in her body	In the fifth month, the <i>Chetana</i> (consciousness). <i>Astaang Hridaya</i> Mind becomes well active due to increased <i>Maansa</i> and <i>Shonita</i> during the fifth month <i>Astaang Sangraha</i>
SIXTH	In the sixth the intellect	In comparison with other months, there is excessive increase in <i>Bala</i> , <i>Varna</i> of the <i>Garbha</i> during the sixth month of gestation. Therefore, at that time the pregnant women loss her <i>Bala</i> and <i>Varna</i> considerably	In the sixth month, the tendons, veins, hair, strength, colour, nails and skin (become manifest (<i>Astaang Hridaya</i>) In the sixth month, hairs on the head and on the body, nails, bones, tendons, etc. become patent and there will be increase of strength and colour (<i>Astaang Sangraha</i>)
SEVENTH	In the seventh month differentiation of all the major and minor parts becomes clearer	There is an allround development of the <i>Garbha</i> during the seventh month. Therefore, a <i>Garbhini</i> (pregnant woman) becomes exceedingly deficient in all aspects of her health	In the seventh month, it (foetus) is developed in all its part and nourished well (<i>Astaang Hridaya</i> and <i>Astaang Sangraha</i>)
EIGHT	In the eight month, <i>Ojas</i> becomes unstable; if <i>Garbha</i> born in this month does not survive firstly because of the absence of ' <i>Ojas</i> ' and secondly because of the „ <i>Nirritih</i> “ (demons).so the demons should be offered oblation of rice cooked along the meat,	In eight month of pregnancy is fatal period because <i>Garbhaja Ojas</i> which becomes unsteady.	Eight month of pregnancy is foetal period of <i>Garbha</i> and <i>Garbhini</i> . During the eight month, <i>Ojas</i> travel between the mother and the child alternately; because of this, they become fatigued or contented respectively; the child born during this month does not survive, and life of the woman is also doubtful, because of the absence of the <i>Ojas</i> (<i>Astaang Hridaya</i>) <i>Ojas</i> is unstable and moves

			between her body and of the foetus along with <i>rasa</i> . Some other says that death of the foetus (born during eight month) is due to influence of <i>Nivrtti (Astaang Sangraha)</i>
NINTH	Birth may take place in any one of the ninth, tenth, eleventh or twelfth months. Birth taking place apart from these months is abnormal	From the first day of the ninth month till the end of the tenth month is known as the period of <i>,Prasava-Kala</i> (period of parturition).	After even one day after eight month, is the time for the birth of the child; if it (foetus) is retained inside the abdomen for a year by <i>Vata</i> , leads to abnormalities (<i>Astaang Hridaya and Astaang Sangraha</i>)

V. SHADGARBHAKARA BHAVA

Matraja (maternal), *Pitraja* (paternal), *Atmaja* (soul), *Rasaja* (nutritional), *Satmyaja* (wholesomeness), and *Satvaja* (psych) [8] are the six procreative factors beautifully described by various *acharyas*.

- 1) *Matraja bhava*- in charge of the development of soft organs in offspring such as *Mamsa* and *Shonita, Meda, Majja, Hriday, Nabhi, Yakrit, Pleeha, Guda*, and so on.
- 2) *Pitraja bhava*- responsible for the creation of *Sthir* (hard) elements such as *Kesh, Shamashru, Loma, Asthi, Nakha, Danta, Sira, Snayu, Dhamani, Retah*, and so on.
- 3) *Atmaja Bhava*- *Buddhi* (wisdom), *Ayu* (longevity), *Atmagnanam, Vigyanam, Prana Prerna, Apana, Swara, Sukh, Dukh, Ichcha, Dwesha, Chetna, Dhriti, Smriti, Ahankara, Praytna, Mana, Indriya* (Sense organs), *Akriti, Varna of progeny*.
- 4) *Satmyaja bhava*- In children, determines *Arogyam, Analasyam, Aloluptvam, Indriya Prasadnam, Swra varna beej sampata, Praharsh, Viryam, Balam, Medha, Ayu, Ojas, Prabha, Uthanam, and Santosham*
- 5) *Rasaja bhava* -*Sharirashya abhinivritti, Pranandubandhta, Tripti, Pushti, Utsaham, Balam, Varnam, Sthiti, Hani, Aloyum, Buddhi, Vritti*.
- 6) *Satvaja bhava* is composed of spiritual, temperamental, and other qualities of progeny such as *Bhakti, Sheelam, Shoch, Shauryam, Krodham, Tandra, Utsaham, Taikshanyam, Mardavam, Gambhiryam, Anavasthitam, Tyagam*, and others^[9]

Role of *Shadbhavas* in Genesis ^[10]

Shadbhavas, which include *Matrija, Pitrija, Atmaja, Satmyaja, Rasaja, and Sattvaja Bhavas*, are in charge of the formation of *Angapratyangas* of *Garbha*, or organogenesis. These *shadbhavas* are not only in charge of the structural development of the foetus, but they also play an important role in the development of psychological, spiritual, and emotional factors. As a result, we can say that proper *Garbha* growth and development result from a combination of proper *shadbhavas*. Each of these *shad Garbhakara Bhavas* is tasked with developing a specific organogenesis, functional/psychological phenomenon in the upcoming baby during its intrauterine life.

The combination of these procreative factors is required for healthy offspring. A lag in any of these procreative factors will result in physical, functional, or psychological defects. One factor cannot produce an embryo on its own.

a) *Matrija- Pitrija Bhava*

If the mother and father are the only responsible elements (factors) in the production of an embryo, all those couples who want to have children of a specific sex will have children of that sex; no couple will be childless or have children of an un-wanted sex. If the mother and father were solely responsible for the development of an embryo, no couple would be childless. Without the mother, placenta formation is impossible.

b) Atmaja Bhava

If only *Atma* is thought to be capable of creating another *Atma*, it could be encouraged to transfer its good qualities to the species of its choice, but this is not observed. Embryos are not produced solely through congenital, wholesome, or appropriate diet. If this were the case, only those couples who consumed a suitable diet rich in high-quality *rasa* would have had children. The *satva*, *Svabhava*, does not come from the outside world; otherwise, all the incidents of previous lives would not have gone unheard, unseen, and unknown. We can say that the mother, father, *Atma*, and other factors are not completely independent in their functioning.

c) Sattvaja Bhava

Only humans have the opportunity to live a conscious, wide awake, and controlled life. Humans have instincts and intelligence. All of this occurs as a result of the presence of *Manasa* (psyche). *Garbhini's Dauhrida Avastha* is an impromptu manifestation of the *sattvaja bhava*.

Ayurvedic scholars clearly stated that *Dauhridini's* repression of desires may influence the psychology of both the mother and the foetus. *Sattva*, through its syndication with soul during copulation, is thought to be an important factor in embryo development. As a result, we can say that the foetal *Sattva* is influenced by three factors.

- *Sattva* of parents - Genetic derivatives; *Garbhini Uparjita Karma* - Gestational derivatives.
- *Janmantara Visheshha Abhyasa*- Derivatives of the environment.

Everything a pregnant woman feels and thinks is communicated to her unborn child via neuro hormones, which are precursors to neuro hormones. When a pregnant mother experiences anxiety, stress, or fear, the stress hormones released in her bloodstream cross the placenta to the body of the foetus, activating the unborn child's endocrine system and influencing foetal brain development.

d) Satmyaja Bhava,

The distribution of uterine fluid, the chemical diversity, and their synergy create an environment conducive to embryo development. *Satmya* (habituation) is defined as doing things that are not harmful to the body despite being contrary to one's own constitution, habitat, time, caste, season, disease, exercise, water, day sleeps, and taste.

- *Kalatsatmya*: Different types of *Kala* (time) can be implicated as age of parents and time of copulation, according to *Acharyas*. The predominance of *doshas* in the body varies according to the age of the parents, for example, in old age, the predominant *dosha* is *vata*, in middle age, the predominant *dosha* is *pitta*, and in childhood, the predominant *dosha* is *kapha*. As mentioned by *Acharya Gangadhara*, these *doshas* affecting the entire body also *shukra* (sperm), *shonita* (ovum), and thus the foetus formed at different ages of the same parents have different constitutions.

Copulation time: Copulation is stipulated only in *anindya kala* for the attainment of a healthy child.

- *Deshsatmya*: A developing child's early environment, for example, can affect its genome through epigenetic means; tribal groups in India have a unique genetic makeup that has evolved in the natural setting over thousands of years, conferring special health problems and genetic abnormalities such as sickle cell anaemia. In terms of foetal growth, the intrauterine environment is also critical.

e) Rasaja Bhavas

Nutrition is an important intrauterine environmental factor that affects the expression of the foetal genome and may have long-term consequences. Changes in foetal nutrition and endocrine status may result in developmental adaptations that permanently impair the structure, physiology, and metabolism of the offspring, exposing individuals to metabolic, endocrine, and cardiovascular diseases in adulthood. A *Garbha* is a *Rasaja* (born of the finest form of digested food known as *rasa*) whose function is noticed after the development of a *Garbha*.

The *Rasaja Bhava* (emerging from *rasa*) or the characteristics visible in a *Garbha* are growth and development of the body and tissues, a constant supply of energy, nourishment, respiration, and so on.

VI. EPIGENETICS IN AYURVEDA

The term genetics is derived from the ancient Greek word "Genetikos," which means "genesis" or "origin" [11]. The study of genes, genetic variation, and heredity in living organisms is referred to as genetics [3]. Although genetics may appear to be a new topic in *Ayurveda*, ancient *Acharya Charaka* and *Sushruta* understood the principles of heredity and the nature of traits or characters very well.

They understood the fundamentals of genetics, such as the factors that determine a child's gender and a genetic defect in a childlike lameness. *Acharya Charaka* described the entire genetics in three genetic points: *Beej* (Germinal cell), *Beejbhag* (Chromosome), and *Beejbhagavyava* (Gene).

He has explained that due to the *vikriti* of the couple's *bija*, *bijabhaga*, and *bijabhagavyava*, the child will have *vikriti* or *vyapada* depending on gender ^[12]. *Adibalapravritta* ^[13] diseases are groups of illnesses caused by defects in either the *Shukra* (male reproductive element) or *Shonita* (female reproductive element), which are the primary factors in humans.

There are six factors that can lead to the formation of an embryo and various body parts. The combination of all six procreative factors is critical for producing healthy offspring ^[14].

Any lag in these factors may have an abnormal effect on the psychological makeup of progeny.

Proper preconception and prenatal counselling, as well as good antenatal care and a suitable mode of conduct by mother and father, play an important role in achieving appropriate psychological health of progeny ^[15]. Indeed, it has been demonstrated that maternal psychosocial stress during intrauterine life is associated with significantly shorter leukocyte telomere length in young adulthood, which is a predictor of disease onset and mortality ^[8].

All of the soft structures of the foetus, such as the heart, spleen, intestine, rectum, muscles, blood, lipid, bone marrow, umbilicus, and so on, are derived from the mother, which is known as *Matrija bhava*. Similarly, all stable or hard parts of the foetus, such as hairs, veins, arteries, nails, bones, beard, sperm, and so on, are formed from the father, which is known as *Pitrija bhava*. As with the previously mentioned *Atmaja*, *Satmayaja*, *Satvaja*, and *Rasaja*

Bhavas also play a role in the development of a foetus in the uterus. *Ayurveda* Science had fundamentals.genetics knowledge since a very early age when there were no concepts such as chromosomes, genes, and so on.

Our *Acharayas* explained that genetic disorders are caused by a defect in the ovum or sperm of the parents (an accepted fact today), so they advised some ritualistic therapy and cleansing (*Shodhana*) of the male and female body before planning to have a child, as well as rejuvenation therapy to restore health and prevent the appearance of genetic disorders. Whatever our *Acharyas* have told us in our classics about genetics should be scientifically validated in order to provide better explanations worldwide ^[16,17].

VII. CONCLUSION

Ayurvedic embryology concepts for individual genesis are purely based on its fundamental principles of *Tridosha*, *Triguna*, and *Pancha-mahabhoota*, among others. The critical analysis of *Garbhasharir's* literature reveals two types of processes related to offspring genesis: independent and dependent. *Ayurveda* believes in the unique concept of soul as the source of life.

Thus, understanding the embryology concepts described by *Ayurveda* centuries ago necessitates a thorough understanding of the concepts that remain relevant in today's scientific world.

The study of changes in the organism caused by changes in gene expression is known as epigenetics. In this context, two important and fundamental concepts are genotype and phenotype. The current concept of foetal origins of adult diseases describes in utero programming, or adaptation to a range of adverse environmental conditions, which leads to an increased susceptibility to age-related diseases later in life. David Barker's keen observations became known as the "Barker hypothesis" or "Foetal Origins of Adult Diseases," which is based on the premise of "developmental plasticity." Similarly, the concept of *Shadbhavas* is mentioned in *Ayurveda*, which are defined as factors that are not only factors that bring similar new ones into this universe, but they are also carriers of organogenesis and other traits.

Satmyaja Bhava and *Rasaja Bhava* are profoundly influenced by the mother, whereas *Atmaja Bhava* is solely dependent on an individual (progeny), and *Satvaja Bhava* is dependent on *Satva* both parents, psychological state of the mother during pregnancy, and *Daiva* (one's own deeds of previous life). Early maternal behavior can alter the epigenetic state of the foetal DNA. Maternal stress and maternal-placental-foetal biological mediators of stress can have an impact on foetal development. Several studies have been initiated along this line, three of which have been completed.

Ayurveda is a complete and holistic health system. Science not only deals with the preventive but also the curative aspects of health because basic fundamental principles such as *Masanumasik Paricharya* and *Garbha Sanskar* are described in *Samhitas* and *Supraja Nirman* will be the new faces of modernity and a Healthy Society. In addition, planning documentation *Supraja* can be done using *Ayurvedic* principles.

To achieve the WHO goal of global public health coverage and reduce congenital flaws in newborns which is a major impediment to the goal of health progeny. As a result, thorough research of *Ayurvedic* fundamentals is required.principles in collaboration with modern sciences will improve the practical utility of Rich concepts, which will lead to healthy offspring

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