



An Approach To Fetal Growth In Ayurveda With Its Applied Aspects

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Abstract

In Ayurveda the whole concept of fetal growth is included under the heading of Garbha. Here the essential factors of conception, time of conception followed by formation and its subsequent development to form an individual is stressed. The term 'Garbha' include zygote, embryo or fetus. Ayurvedic classics have lucidly elaborated the concept of garbha as well as the influencing factors for its growth and development starting from sukra-sonita samyoga. Fetal development includes continuous process of maturation of structure discussed under three period of gestation i.e. Germinal, Embryonic and Fetal period. The classics enriched with formation and subsequent development are highlighted under the term 'vridhhi'. Different factors are considered for fetal growth like excellence of the factors responsible for production of fetus viz. Sadabhava (six factors for embryogenesis), Adoption of proper diet & regimen by the mother during pregnancy, Availability of nourishment through upasneha & upasveda, Kala (proper time) & Swabhava samsiddhi (instinctive or natural tendencies). Sadabhava in other way exhibit genetic influences by Matrija & Pitrija bhavas while Satmya & Rasaja bhavas come from maternal diet & regimen. Satva & Atma are the individual factors that come to garbha (fetus) itself. This concept of sadabhava highlights the development of a complete human being. Here Mahabhuta plays an important role in embryogenesis with the help of functions such as separation or segregation of cell mass, influences of different hormones, nourishment passing through chorionic villi in early part and later through umbilical cord, followed by stabilization and structural development of body parts, as well as symmetrical and chronological increase of all these structures are attribute to the functions of Vayu, Teja, Apa, Prithvi and Akash respectively. In applied aspects Garbhasosha, Nagodara, Upasushka etc are mentioned. Upasushka emphasised with intrauterine growth retardation (IUGR) while jataharini include intra-uterine growth retardation (IUGR) and intra-uterine death (IUD). The present work highlights all these concept of fetal growth interpreting with different aspects of embryology while morbidity stressed through teratology.

Keywords : Garbha, Fetal growth.

INTRODUCTION

The science enriched with description of development of body parts in lucid manner. Growth and development are the normal biological phenomenon of all living beings. Growth and development are the process by which human body gets formed. The process of growth starts from the time of conception and continues until the child grows into a fully mature adult. Growth is defined as increase in size of an individual due to increase in cell number and cell size (auxetic) and increase accumulation of intercellular substance (accretionary). While development is a continuous process from birth to maturity. In normal child they progress together, and are interdependent. Differentiation is a complicated process by which the group

of cell assume special characteristics and assigned with specific function. Basically it is a process by which tissues and organs are laid down in the embryo in a sequential and integrated system. Fetal growth is facilitated by genetic, placental & maternal factors.

In Ayurveda the process of development are mentioned in different context. The classics enriched with formation and subsequent development which are highlighted under the term *vridhhi*. Concept of *vridhhi* are available in two aspect. One in fetal life i.e “*Garbha vridhikara bhava*” and the other in later life i.e “*Sharir vridhikara bhava*” as well as “*Purush vridhikara bhava*”. Different factors are considered for fetal growth like excellence of the factors responsible for production of fetus viz. *Sadabhava* (six factors for embryogenesis), Adoption of proper diet & regimen by the mother during pregnancy, Availability of nourishment through *upasneha* & *upasveda*, *Kala* (proper time) & *Swabhava samsiddhi* (instinctive or natural tendencies). Here *Mahabhuta* plays an important role in embryogenesis with the help of function such as *Vibhajana* (division), *Pachana* (metabolism), *Kledana* (moistening), *Samhanana* (solidification) & *Vivardhana* takes place in *Garbha* by *Vayu*, *Teja*, *Apa*, *Prithvi* and *Akash* respectively. This process continues throughout the whole period of life which exhibited in different physiological process.

AIM AND OBJECTIVES

- Analysis of fetal growth mentioned in Ayurveda.
- Applied aspect assessed through *Garbhavyapad* and *Jataharini*.

MATERIALS AND METHODS

- Literary information of *Brihatrayee*, *Laghutrayee*, *Harita samhita*, *Kashyap samhita* and Modern anatomical books, recent publications, electronic database has taken as sources.
- Morbidity of fetal growth analysed through *Garbhavyapad* inter-relating with *IUGR* and *IUD*.

REVIEW AND DISCUSSION

Garbha And Garbhotpadaka Samagri

In Ayurveda detailed description of *Garbha* are available in different context. First it mentioned regarding formation of *garbha*. Here it says union of *sukra* and *sonita* along with descend of soul forms *garbha* in uterus.^[1] This is identical with the process of fertilization where first unit of human being i.e *zygote* develops from fusion of *spermatozoon* and *ovum* in *ampulla* where two haploid becomes diploid. The concept of being is soul or *jiva* which obviously associate in fertilization.

Fetal development includes continuous process of maturation of structure discussed under three period of gestation i.e. *Germinal*, *Embryonic* and *Fetal* period. The changes that occurs in all these periods are included under *Garbhavikash* or *Garbhadhan*. Thus *Garbhotpadak samagri* or (essential factor for conception), *Bhutavyapar* (role of *mahabhuta* in embryogenesis), *Sadabhava* (role of *sadabhava* in embryogenesis) as well as *Masanumasik garbhavikas* (monthwise development of fetus) includes under the heading of process of development of foetus.

Susruta stressed four factors i.e *Ritu*, *Kshetra*, *Ambu* and *Bija* are essential for conception known as ‘*Garbhotpada samagri*’^[2] *Ritu* emphasised with reproductive period of female in general and ovulation in particular. Further ‘*Ritu*’ specially highlighted for two purpose i.e ‘*beejatsarga*’ (release of *ovum*) and ‘*garbhadhan*’ (fertilization). Ovulation is the key period necessary for above two functions. *Ritukala* is mentioned as best period of conception. Characteristics mentioned under *ritumati* for example: *pinaprassana badanam*, *praklinna atmamukha dwijam* analyse the status of ovulation. Normally these are exhalation of mind occur due to β endorphin. Similarly increase mucosal secretion by higher level of estrogen while quivering of arm, breast, pelvis and hip are also the influences of this hormone. In broader sense, *ritu* exhibit best phase of reproductive age. In woman fertility peaks in mid-20 years of age after which declines with more dramatic drop at around 35 years.^[3] The prevalence of infertility increases 55% at the age of 45 years. It is interesting to observe that male age also shows significant impact on reproduction. Decline testosterone, decrease libido, difficulty in achieving ejaculation are seen in advancing ages whose morbidity influences fertilization.

Kshetra emphasises for area or a sphere of action. Status of health of woman in general and reproductive system of mother particularly uterus makes specific identity of *kshetra*. Abnormal condition of

reproductive system influences infertility where cause related to ovary, fallopian tube, uterus, cervix (for example: pin hole cervix) shows their influences.

Ambu in context of embryogenesis is the nourishment perceived by zygote. In broader sense, it may also indicate nutrition meant for ovum and spermatozoa. Fertilization, conception, implantation, fetal organogenesis and placentation are the critical stages potentially affected by nutrition during the periconceptual period. Reactive oxygen species (ROS) and homocysteine (tHcy) plasma level are the factors involved in respective mechanism. Micronutrient and their deficiency definitely affect ovulatory or uterine infertility. Study reveals spermatogenesis affected by deficiency of zinc, vitamin C, calcium, vitamin E etc. all these can be emphasise as *ambu* which is essential for healthy state of ovum and spermatozoa which may later develop normal progeny.

Beeja broadly indicate genetic material i.e chromosome, DNA, mRNA and gene plays key role in conception and subsequent development. Abnormality of chromosome and genetic material induces infertility. For example: Turner's syndrome (45, XO), Klinefelter syndrome (47, XXY), Monosomy (45, X) and premature ovarian failure can be mentioned here. Gene mutation mostly autosomal recessive disorder also hampers fertilization.

Mechanism Of Development Of Fetus

In context of the mechanism for development of the foetus Susruta stressed three terminology viz: *Parasparaupakara*, *Parasparanupraveshat* and *Parasparanugrahat*.^[4] The term *Parasparaupakara* emphasise mutual beneficial which is essential for contact and fusion of gamete i.e. second stage of fertilization. In this stage capacitation & acrosome reaction has taken place. In capacitation two hormone i.e *fertilizin* or oocyte and *anti-fertilizin* or spermatazoa causes immunological reaction which is defined as species specific interaction & essential for further process of fertilization. *Parasparanupraveshat* highlights mutual or homozygous inter relation where corona radiata of ovum pierce by head of spermatozoa by releasing hyaluronidase. Subsequently development follows through overcome the barrier around the oocyte, binding of sperm head with glycoproteins i.e ZP₁, ZP₂ and ZP₃ which digest the zona pellucida around the sperm head. *Parasparanugrahat* emphasize the third stage of spermatogenesis i.e capacitation which is only possible when the liberated spermatozoa gets deposited in the internal os has to reach the ampulla of the fallopian tube. Here the movement is facilitated through *Prostaglandin* of semen which induces contraction of uterine muscle. Further ascend of the spermatozoa gradually decrease in number by the abrupt constriction at the cervix and uterine osteum. Only 300 – 500 spermatozoa reaches the site of fertilization. While transportation of oocyte through pelvic osteum occurs by ciliary action and rhythmic contraction of fallopian tube. Out of 300 – 500 spermatozoa only 1 able to unite with the oocyte and the rest of them disintegrates in the cells of corona radiate. Here it is observed that positive chemotaxis also plays a pivot role in union of ovum and spermatozoa.

Another two terminology are mentioned i.e *rasa nimitta* and *maruta adhmana nimitta*.^[39] The terminology *rasa nimitta* emphasises nutrition coming from maternal diet which passes through placenta via umbilical cord to the fetus. For the growth and development of fetus, maternal nutrition plays a significant role. Even Acharya Caraka mentioned that nutrition taken by mother finally divided in 3 parts viz: 1) nutrition to mother herself 2) formation of breast milk 3) development of the fetus. While *maruta adhmana nimitta* emphasises increase in body part specifically in its size and shape under the influence of *vayu*. In early part of embryo two sac forms i.e 1) amnion and 2) entodermal cavity or yolk sac or archenteron. Later the archenteron divided into two parts i.e extra-embryonic and intra-embryonic parts where the Intra-embryonic part contains three gut i.e foregut, midgut and hindgut. While Extra-embryonic part contains extra embryonic coelom. Here umbilical cord is formed by fusion of primary mesoderm, allantosis, extra-embryonic part of yolk sac with vitelo intestinal duct, extra embryonic coelom, umbilical arteries and umbilical veins. On 15th day further here development occurs in the embryonic area and these are as below: 1) changes in the surface of ectoderm looking towards amnion-- primitive streak, primitive node, neural groove. 2) changes in the surface of ectoderm in relation to entoderm-- head process, neuro-enteric canal 3) secondary mesoderm-- pericardial bar, pericardial sac 4) secondary mesoderm 5) changes in the paraxial mesoderm-- sclerotome and myotome 6) changes in the intermediate cell mass—structures of uro-genital system develops 7) changes in the lateral cell plate—pleuro-pericardial canal and 8) Notochord. This

development take place within 1st to 2nd month of gestation and the concept of dilatation by vayu i.e maruta adhmaana nimitta thus clearly highlighted.

While 'jyotisthanam'^[5] is another terminology associated with process of development of the fetus can be emphasised in the following way: during fetal circulation, Left umbilical vein in the umbilical cord from placenta enters the visceral surface of liver and then reaches the inferior venacava (IVC) by 3 ways- 1) It connects the left branch of portal vein and then via ductus venosus reaches hepatic vein. 2) It circulate through the liver along with portal blood and then drains to hepatic vein. 3) It enters the liver substances directly and drains to hepatic vein. This concept can be interpreted with Susruta's view of 'jyotisthanam'.

Garbha develops from a single cell zygote to a body consisting of all body parts. Subsequent cell division upto the stage of morula followed by implantation (after 96 hours), embryo develops in the uterus and takes the name of fetus after 8 weeks. These concept of fusion of two haploid to form a diploid and its subsequent development is discussed under 'Garbhavakranti'. Charaka described this procedure of 'Garbhavakranti' under the heading of 'Khuddika garbhavakranti' and 'Mahati garbhavakranti' which highlights microscopic and macroscopic changes respectively.

FACTORS FOR EMBRYOGENESIS

Mahabhuta as a Source of Embryogenesis

All the scholars emphasis the concept of panchamahabhuta in growth, development and differentiation. Panchamahabhuta plays most important role after the formation of Garbha as well as its subsequent development. The role continues from birth onwards and until death. Mahabhuta plays an important role in embryogenesis with the help of function such as Vibhajana (division), Pachana (metabolism), Kledana (moistening), Samhanana (solidification) & Vivardhana takes place in Garbha by Vayu, Teja, Apa, Prithvi and Akash respectively.[6] The function of mahabhuta as stressed by scholars can be interpreted with different stages of embryogenesis stated in table 1.

Mahabhuta	Stages of Embryogenesis
Vayu	<ol style="list-style-type: none"> 1) Karyokynesis 2) Descent of zygote into the uterine cavity. 3) Differentiation of trophoblast into cytotrophoblast & syncytiotrophoblast. 4) Differentiation of embryologist into hypoblast & epiblast (formation of bilaminar disc). 5) Formation of trilaminar disc 6) Formation of yolk sac, amnion 7) Differentiation of sclerotome and myotome, pericardial bar leading to formation of musculoskeletal and cardiovascular system.
Teja	<ol style="list-style-type: none"> 1) Proteolytic action of trophoblast for embedding 2) Disappearance of zona pellucida assisted by trypsin like enzymes.
Apa	<ol style="list-style-type: none"> 1) Nourishment & protection of inner cell mass or embryoblast by trophoblast. 2) Action of decidual cells which contain glycogen and lipid facilitates the fertilized ovum to get embedded in the wall of the uterus 3) Uteroplacental circulation- in this process the nutrition comes from uterus to the placenta. 4) Fetoplacental circulation- in this process the nutrition goes from placenta to the fetus via umbilical cord. 5) Different subsequent formation of fluid in the serous cavity as well as in joints. For eg: synovial fluid.
Prithivi	<ol style="list-style-type: none"> 1) Maintains the grouping & compactness of cells under division. 2) Gives shape to all structures formed during the time of growth and development. 3) Forms bones and skeleton which gives the shape of the fetus. 4) Structural increase of all tissue and organ.
Akash	<ol style="list-style-type: none"> 1) Blastocoele formation. 2) Amniotic cavity formation. 3) Yolk sac formation, Vitellointestinal duct, allantosis and Extra embryonic coelom. 4) Trophoblastic lacunae which will later form intervillous space. 5) Formation of foregut, midgut & hindgut.

Table 1: functions of mahabhuta in different stages of fetal growth

All the components in human body are developed from panchamahabhuta. It is difficult to interpret any one particular structure developed from a specific mahabhuta. However, according to their characteristics, mode of action as well as chances of morbidity help to categorise it from different sources of origin. For eg: vision is perceived by eye and obviously it is the location of alochak pitta. The light passing through pupil like reflection by cornea and iris, formation of image by lens in retina. And subsequently carries the visual impulse which goes from ganglionic layer of retina through the optic pathway, optic chiasma, lateral geniculate body, optic radiation and then visual cortex. And thereby analysing the colour, shape and size of stimulus are the whole aspect of vision. In all these aspect perception and alteration of photo energy are seen and can be understood under the influence of vision which can be categorised under the function of agneya mahabhuta.

A.Garbhakara Bhava or Sadbhava as a Source of Embryogenesis:

Although conjugation of sperm and ovum is necessary in formation of embryo but various other features are also responsible for that. Thus, the formation of Garbha is said to be from sadbhavas viz: Matrija, Pitrija, Atmaja, Satmyaja, Rasaja and Sattvaja bhavas. Each and every factors has its own contribution in Garbha formation. Comprehensive description of sadbhava is found only in Carak samhita. Caraka said that neither of these factors individually are capable to develop the fetus.

From the description of sadabhava, it is clear that matrija and pitrija factors are mostly responsible for morphological/structural/anatomical development. So, any defect in maternal and paternal factors, will lead to congenital abnormalities. For example: mother suffering from rubella during pregnancy causes blindness, advanced maternal age (more than 35 years) may lead to abnormality in chromosomal number like trisomy 21 while advanced paternal age leads to autosomal dominant diseases. While other factors viz: atmaja and sattvaja are responsible for psychological development. This includes the mental or psychosomatic condition of the parents, region in which they lives and specifically emotional status of mother during pregnancy. Rasaja and satmyaja factor has its role in maintenance and growth of the body. The first four factors are given nourishment by the last two factors i.e rasaja and satmyaja as stated by Cakrapani. Here the term 'rasa' is meant for balanced ahar rasa which the pregnant mother used to achieve by following the monthwise dietetic regimens.

The concept of sadbhava described above plays a very significant role in the development of an individual in total. Basically these are the conglomeration of factors assigned with organogenesis/functional/psychological and social phenomena which develops to a fetus succeeding to later life a complete human being. Any deficiency or abnormality of any of these factors will lead to defects endowed with respective factor.

B.Masanumasik Garbhavikas

Monthwise development of fetus screened lucidly by our ancestors. Brihatrayi, Kashyap and Harita samhita explore the process vividly in different context. However, an analysis of this concept from modern perspectives is essential, rendering easy penetration to the subject and make more acceptable to the scientific world which are discussed in table 2.

1 st month	Caraka's opinion of 'Embryo' taking the form of jelly like ^[7] ; and Susruta and Vagbhata I & II's concept of kalala ^[8,9] can be emphasised with morula containing cell mass and fluid which develops from embryoblast approximately 72 hours (3 days) after fertilization. As the blastocyst develops further it gives rise to 3 layered germ disc which contains endoderm, mesoderm and ectoderm. Developing buds of different structures arise from these layers. But these buds are not well manifested for differentiation and recognition. This stage can be correlated to Charaka's description where he emphasized that organs developed in this period are both manifested and latent. Harita's concept on 10 th day kalala becomes budbuda ^[10] which can be interpreted with formation of extra embryonic and intra embryonic part along with germ disc. This happens after the process of embedding which gets completed on 9 th day. Thus Harita's concept
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	during this month can be considered rational.
2 nd month	According to all Acharyas during this month the garbha becomes a solid mass. ^[8,9,11,12,13,14] As per modern science the embryo develops further and its parts become more recognisable. The embryo attains a definite form and gets more condensed due to rapid proliferation of tissue. This stage can be incorporated with 'Ghanavastha'. Again gonadal ridges, urorectal septum and genital tubercles become definable during this month. But sex differentiation of embryo is not possible. As such pinda, pesi or arbuda difficult to justify which probably considered observing the abortive mass in this month.
3 rd month	In this month all the scholars are agreed with development of body parts along with sense organ. ^[8,9,15,16,17,18] From embryological point of view arm, finger, feet and toe are fully formed. External ears are also developing along with reproductive organ though difficult to distinguish the gender from ultrasound. At the end of this month all the organs continue to mature. This is identical with description of Susruta and Vagbhata I with minuteness of structure stressed by Vagbhata I as the baby length becomes 10 cm.
4 th month	During this month according to all Acharyas garbha attains sthirata or stability. ^[8,19,20,21,22] Susruta & Bhawa misra opines that as chetana dhatu, i.e Atma, is present in hridaya the consciousness manifest and heart beat starts. As per modern science also movements of the fetus being felt by mother which is termed as 'quivering' and heart beats becomes audible by stethoscope in 4 th month. Hence it can be interpreted with the views of Acharyas. But the vivid description of dauhridavastha are not explainable for modern science. Although a complex change in hormonal functions during pregnancy may be considered as responsible. Moreover at the end of first trimester toxemia develops in some women, which exhibits the identical feature of dauhridini. Harita says lanugo appears in this month ^[23] while modern science also have same view.
5 th month	According to Acharyas, 'mana' becomes developed during this month. ^[21,22,24,25] Ayurveda believes that the knowledge or perception, is the result of interaction between Mana and Indriya (sensory and motor organs). Since by 5 th month auditory reflexes and peripheral reflexes develops to some extent, the acharyas have mentioned to enlightenment of Mana. Charaka said that in this month, in comparison to other, there is an excessive increase of flesh and blood of the fetus. ^[26] Modern embryologist opines that formation of blood from bone marrow starts in 3 rd month. However blood forming function is completely taken over by marrow in the last part of 5 th month or early 6 th month. So Charaka's view that rakta and mamsa increases in this month, seems to be rational.
6 th month	Susruta and Bhavamisra stated that intellect of the fetus gets developed during this month. ^[24,25] According to modern science, development of cerebrum becomes completed in this month. The centre of intellect lies in cerebrum. Therefore Susruta's version that intellect of the fetus gets developed during this month can be considered rational. In 6 th month layers of skin developed completely though skin appears in 2 nd month of intrauterine life. So charaka's statement that bala and varna of embryo ^[27] becomes more recognisable also seems to be correct. Vagbhata I said that all the hard substances such as body hairs, nails, bones, ligaments, blood vessels etc. along with strength and complexion appears in this month. ^[21] Center for primary ossification for almost all bones also appear. The eyelids and eyebrows are well developed and the lanugo darkens. So Vagbhata I's concept about growth of the fetus in 6 th month seems to be rational. In 6 th month the specific sensory receptor meissner and pacini body gets developed in 24 th weeks of gestation. Thalamocortical pathways important for perception of sensory impulses, reach the somatosensory cortex around 23 rd week correlating with the development of synapses in the cortical plate. All these can be incorporated with total functional aspect of skin. These highlight the development of twaka as specified by Vagbhata II. ^[22]
	According to all Acharyas during this month all the major and minor body parts become

7 th month	prominent. ^[22,24,25,28] Vagbhata I stated that during this month all the doshas and dhatus are brought to their mature state (both structure and function). ^[21] Garbha becomes viable if she delivers in this month. The modern embryologists opines that in this month the eyelids themselves separate and the pupillary membrane disappears. The testes with the vaginal sac descend into the scrotum. The wrinkles on the skin starts to disappear. And all the systems like cardiovascular, respiratory, gastrointestinal and urogenital are able to function properly. The fetus born at the end of this month is able to survive. So the ayurvedic acharyas opinion regarding development of fetus in this month is quite correct.
8 th month	According to all Acharyas during this month the ojas become unstable. ^[24,29,30] No explanation can be given in this context. However, Rh-incompatibility may trigger such situation leading to mortality of fetus and even mother too. Harita's concept of function of jatharagni ^[31] can be understood with the functional status of Gastro intestinal tract.
9 th month	Caraka said that child survives well if delivered during 9th and 10th months as it accounts full term delivery while Susruta and Bhawamisra says the same with reference of 9th, 10th, 11th and 12th months. ^[24,32,33] As the 9 th month begins, the fetus may deliver at any time. By this statement it can be said that the ancient scholars were not confirmed about the time of delivery. However Caraka's opinion appear to be more logical as modern embryologists also consider duration of intra uterine life as 280 days or 9 th month \pm 7 days.

Table 2: Masanumasik garbhavikas with modern correlation

I. SPECIFIC FACTORS FOR FETAL GROWTH

It is observed that the science considered some specific factors for growth and development. It commences from formation of zygote upto complete development of the fetus. It is very clearly said that normalcy of garbhakara bhava or sadabhava along with intake of proper diet & regimen by the pregnant woman influenced by the time factor where the nutrition comes through two mechanisms i.e upasneha and upasveda; the fetus grows with the influence of above factors along with natural instincts in the mother's womb.[34]

While in modern science the maternal, paternal, hereditary, environmental, and nutritional etiological characters are the factors which are responsible for formation and development of the fetus.[51]

- a) The influence of '*Garbhakara bhava*' are discussed above.
- b) **Nourishment from maternal diet and regimen** plays a prime role for normal growth of the fetus. Each month of pregnancy has its distinguished requirements. A special dietary regimen and mode of conduct has been advocated for the garbhini in ayurvedic texts, right from conception till birth of baby, considering the different physiological changes taking place in the pregnant women along with the requirement of growing fetus. According to the month of gestation the nutrition requirement by fetus get vary as its morphological development occur continuously.
 - **In early period** of fetal life the conceptus is basically predominance of apa and prithvi mahabhuta. In the stages of nutrition specifically in first trimester as milk mentioned along with preparation of madhur skandha drugs. Milk which is mentioned in the first, second and third month by all classics is enriched of Lactose (carbohydrate) 4.9%, Fat 3.4%, Protein 3.3% and rest portion are mineral and vitamin.^[35]
 - **In second trimester** muscular tissue of fetus grows abundantly require more protein which is supplied by meat soup as stressed by Susruta. Vitamin B₆ & Vitamin D are advocated in this period where both are present in butter and are mentioned by Caraka. Towards the end of second trimester there are chances of paddle oedema or oedema in feet due to water accumulation. Use of Gokshur (a diuretic) in this month will prevent retention of water as well as its complication.
 - **In third trimester** the baby grows rapidly & hence both mother & baby should be properly nourished. The drugs of vidarigandhadi group are anabolic and diuretic prevents dehydration & suppress pitta & kapha. Due to their regular use in 7th month definitely help in maintaining normal status of both mother & baby. In the 8th month ghee is mentioned along with kshira and yavagu.

Ghee is basically enriched of Omega 3 fatty acid, DHA which is essential for the further growth of the baby. There most of the pregnant mother due to pressure of gravid uterus & effect of progesterone suffer from constipation. Asthapan vasti mentioned by susruta definitely helps in removing constipation. These drugs e.g. bala, atibala has got the effect of autonomic nervous system which in other way influences myometrium with regulating their function during labour.

In 9th month, Anubasan vasti is advocated which may benefit in susceptible pathogenic organism in vaginal canal & thereby prevent puerperal sepsis. These also help in softening of cervical os which help in normal labour. Influences of these anubasan vasti also seen in perineum which may be softened & thereby help in its relaxation during labour.

So the pregnant woman should follow these protocols and guidelines to achieve a healthy progeny. According to Ayurveda, all the desires of a pregnant women should be fulfilled otherwise it would have adverse effect on the growing fetus. Deficiency in maternal nutrition / nourishment affects fetal growth. For example: Deficiency of Iron, Folic acid, Vitamin B₁₂ and protein will cause hypoxemia which can lead to fetal death. Again low intake of folic acid and vitamin A in mother's diet causes abnormality like cleft palate.

- a) The term '*upasneha*' indicate mardayati which clearly specify moistening or lubrication. The process through which nutrition, fatty substance are highlighted in specific and other nutritive substance in general. Oxygen and other nutrients such as glucose, amino acids, fatty acids, minerals, vitamins and water osmose from the maternal blood through the cell layers of the chorionic villi into the villi capillaries, and from there nutrients are transported to the developing embryo. The liquid material i.e glycogen and lipid are formed from decidual cells and gives nutrition to the growing fetus via chorionic villi. These entire concept can be emphasised as upasneha. The term '*upasveda*' indicate moisture, sweat or vapour in general while heat in particular.

In this aspect, process of nourishment or garbha poshan can be discussed. The fetal nourishment takes place in 2 stage. First at the stage of Asangata angapratyanga avayaba/Sadasadbhuta angaavayaba i.e before apparent evidence or development of organ. Action of upasneha and upasveda are seen in this stage. In embryonic period before development of placenta, it gets nourishment through chorionic villi present all over embryonic surface. This process of nourishment is identical with upasneha when it is opinded nourishment come through hair follicles of embryo.

In this context of Upasneha and Upasveda, Indu opines that upasneha supplies snigdhatva to the fetus. As fetus is dominant by kapha naturally it requires more unctuous substance to replenish this kapha. This can be correlated with the process of nutrition in embryonic stage where the embryo used to store nutrient from decidual cells which contain glycogen and lipid and other necessary material for development of the fetus. While upasveda indicate simple osmosis.

- b) The factors i.e *Kala* and *Swabhava samsiddhi* are the two independent factors.

Kala as time duration may be incorporated in or with time period of gestation. Baby normally gets delivered in 9 months \pm 7 days where Charaka also considered that delivery may takes place in between 9 -10 months.

According to the period of gestation, changes takes place in embryo where in succeeding embryonic period formation of zygote followed by morula, blastocyst, trophoblast, embedding, appearance of primary mesoderm and syncytial lacunae are formed. In this period, primitive streak appears at 15th day, notochordal or head process is formed which become distinguished at 17th or 18th day, chorionic stem villi, cephalic flexure, optic vesicles appear. Three gut, gland, gonadal ridge and cerebral hemisphere are also formed. In fetal period, head flexion, lanugo, quickening, scalp hair etc. gets developed. All these occur under the influence of kala.

Susruta also mentioned the importance of kala where he says that as a fruit getting detached from its stalk due to time factor comes down naturally, similarly garbha in its appropriate time, getting detached from its nadi-nibandha, proceeds for labour due to its specific nature. Total five causes for onset of labour can be counted as- 1) nadi-nibandha mukti, 2) garbhavasa vairagya 3) garbha sampurnata 4) swabhava 5) kala prakarsa ^[36] Here 'kala prakarsa' indicate a specific period of gestation where changes occur in mother for onset of labour. It can be understood with estrogen inactivation due to sensitization of myometrium for the action of Pitocin which benefit myometrial stimulation.

The term 'Swabhava samsiddhi' comprises of two words: swabhava and samsiddhi. 'Swabhava' indicate original or natural characteristics while 'samsiddhi' means perfection. Basically Swabhava is a natural tendency of fetus to grow continuously.

II. GARBHAPOSHAN

In aspect of fetal nourishment the whole process takes place in 2 stage:

- In the stage of *Asangata angapratyanga avayaba*^[37] / *Sadasadbhuta angaavayaba*^[38] i.e before apparent evidence or development of organ
- In the stage of *Sanjata angapratyanga avayaba* / *Vyaktibhavat*^[39] i.e after complete evidence of organ

Here the first stage is related to early part of development i.e germinal and embryonic period or upto third month of gestation where the body parts though present yet not explicit i.e sadasadbhuta angaavayaba. The subsequent development when the body parts are matured then nourishment through umbilical cord & placenta. This 2 stage of nourishment can be analysed with the subsequential essential structure of nourishment that means one in early embryonic via chorionic villi when placenta is not matured & the other is after maturation of placenta. These 2 stages has similarity with modern embryology. In embryonic period before development of placenta, it gets nourishment through chorionic villi present all over embryonic surface. This process of nourishment is identical with upasneha when it is opined nourishment come through hair follicles of embryo.

In fetal period when the placenta gets matured, it provides nourishment via umbilical cord which continues upto the time of delivery. This clearly indicate the stage of Sanjata angapratyanga avayaba / Vyaktibhavat where maturation of body followed by nourishment of apara through umbilical cord is stressed or highlighted.

In context of garbhaposhan mentioned by acharyas clarification of the two words 'Anga' and 'Pratyanga' are essential which are not merely use to mean limb or organ or structure. Basically they indicate Apra and Nabhinadi. The same idea has been clearly indicated by Vagbhata I.

III. GARBHAVYAPAD

The concept of fetal abnormality mentioned in Ayurveda are highlighted in 2 platform:

- Abnormality occur due to malnutrition or poor nutrition to the mother
- Teratological abnormalities

Abnormality occur due to malnutrition or poor nutrition to the mother

The abnormalities like Garbhasosha, Upavishtaka, Nagodara or Upasushka and Mrutagarbha occurs due to poor nutrition to the mother. This all conditions can be interpreted with IUGR where decrease in fetal movement and fetal growth rate occurs due to inadequate nutrition. However upavistaka is a stage where quickening of the fetus without decrease in size is understood.

Mrutagarbha can be interpreted with intra-uterine death (IUD) where maternal diet and regimen, anaemia, oligohydramnios etc are the most important factors. Deficiency of Iron, Folic acid, Vitamin B12 and protein will cause hypoxemia which can lead to fetal death.

Teratological abnormalities

Ayurveda is enriched with scattered references regarding this concept, commencing from abnormalities of chromosome, genetic materials as well as abnormality due to environmental causes. Specific factors like Beeja (ovum and sperm), Atmakarma (deeds of previous life), Ashaya (Uterus), Kala (time factor or abnormality of ritukala), Matu aharvihar (dietetics along with mode of life of mother) are mentioned[40] that influence fetal growth, affecting its appearance, complexion and sense organs and impart abnormalities of fetus in morbid conditions. Various congenital abnormalities due to morbid condition of Beeja, Beejabhaga and Beejabhaga avayava highlights the abnormalities caused by genetics and chromosomal factors.

The terminology Beeja indicate morbidity of Beeja, Beejabhaga, Beejabhaga avayava indicating abnormalities in chromosome, gene, DNA material which causes various sexual anomalies. Among them Varta indicate congenital abnormality of uterus due to involvement of Beejabhaga avayava. While involvement of Beejabhaga highlights absence of streakara bhava, this can be understood with primary and

secondary infertility involving chromosomal aberration[41] Vandhyaa occurs due to abnormality in Beejabhaga. Susruta however mentioned it as yoni vyapad which indicates female infertility caused primary amenorrhea due to congenital absence or distinct anomalies in uterus as well as ovary. Vandhya which indicate primary male infertility due to defect in Beejabhaga. Trinaputrika occurs due to abnormality in Beejabhaga and Beejabhaga avayava[42] This can be understood with Klinefelter syndrome and androgen insensitivity syndrome where mutation of AR gene occur leading to abnormality like masculine character and dominance of feminine character.[43,44]

Some psychosexual disorders along with abnormality in reproductive tissue are also mentioned in classics like klaibya, sanda, asekyā, dviretas, vakri and pavanendriya. These include both autosomal and sex chromosome abnormalities and exhibit morbidity in reproduction, impotency and infertility. Sahaja klaibya and Asekya indicate congenital impotency or erectile dysfunction. Genetic inheritances are seen in impotency where natural variation of DNA sequences is observed.[45,46] Dviretas occurs due to upatapta Beeja can be understood as Hermaphroditism where offspring will have characteristics of both the sexes.[47] *Atma karma* included in this category exhibits vulnerability of one's unknown chance for susceptibility of inheritance leading to hereditary defect. Atma karma means the deeds of previous life of both parents and child. The effects of the action of previous life are carried by the soul to his next life, which are the results of good or bad actions. Vulnerability of one's unknown chance for susceptibility of inheritance abnormalities are understood with the concept of Atma karma.

Abnormality due to Asaya can be understood with congenital abnormalities of fetus due to defects in female reproductive organs specially uterus. Structural deformity of uterus, ovary and fallopian tube may cause teratologic abnormalities. Infection like virus involved endometrium crosses utero-placental barrier, resulting abnormality in offspring. For eg: if mother gets affected by Rubella virus during pregnancy then the baby will suffer from blindness or deafness.

The word Kala can be understood as reproductive age of parents. Research studies shows that advanced age of both parents can be associated with congenital deformities of the child. For example : increased maternal age is strongly associated with chromosomal birth defects such as trisomies 13, 18, and 21.[48] Majority of Down's syndrome observed specifically in newborn of mother's above 40 years [44] ; and advance paternal age increased the risk of autosomal dominant diseases [49]

Due to intake of abnormal diet & regimen by mother various abnormalities occur in offspring. Maternal intake of certain diets mentioned in classics said to propagate fetal abnormalities. These types of diet aggravated dosic status of mother and thereby influences subsequent abnormality. For example- excess intake of vata predominant diet influences premature graying of hair, baldness, tawny color of skin, nail, and hair etc. Excess intake of kapha predominant diet influences different type of skin disorder, for example- kilasa and switra (Leucoderma). Different vitamin deficiency like vitamin B2 and vitamin B3 induce CHD (coronary heart diseases), low protein and zinc along with low BMI of mother induce the infant with gastroschisis. For eg: low intake of folic acid and vitamin A in mother's diet causes abnormality like cleft palate.[50]

Susruta also mentioned some birth defects specially due to non fulfillment of Dauhridini viz: Pangu, Kuni, Badhirya, Muka, Minmina, Vamana and Kubja. Pangu and Kuni indicates limb deformity caused by both genetic and environmental factors, where environmental factors include drug like Thalidomide causes Amelia and Meromelia, alcohol intake during pregnancy, certain specific infection of mother, exposure to certain chemicals which lead to congenital limb defect. Badhirya can be understood as congenital deafness, found in autosomal recessive and autosomal dominant due to mutation in gene. Muka indicate dumb or speech impairment since birth which influenced by both genetic and environmental factors like infection during prenatal period, exposure to toxins radiation etc. Fetal Alcohol Syndrome (FAS) cause a variety of difficulties, including speech and language disorders. Minmina indicates nasal twang in voice. Apart from the normal causes genetic variation also influence the nasal twang. Vamana indicates various types of Dwarfism influenced through growth hormone deficiency which may cause by mutation of specific gene damage to pituitary gland. Kubja indicate congenital Humpback, occur due to various causes like hereditary defect in bone growth, weaken bone and spina bifida.

IV. JATAHARINI

Jataharini is a unique feature mentioned by kashyap. Fetal mortality occur either in earlier part or in later part i.e after maturation of body part are enlisted in different jataharini. These are classified as 5 sadhya namely: Kalaratri, Stambhini, Andagni, Durdhara and Mohini. Among which Andagni and Durdhara indicate fetal death which occurs in early part while the other three indicate IUD or still birth. In yapya 2 namely: Nakini and Pisaci are enlisted which indicate still birth or repeated still birth. And in asadhya 4 namely: Vasya, Punyayoni, Indrayava and Badavamukhi which indicate repeated IUD, biovular and uniovular twin respectively.

Conclusion

The term 'GARBHA' include zygote, embryo or fetus. Garbhotpadaka samagri are the essential factors for embryogenesis while Garbha vriddhikara bhava are the specific factors of fetal growth. Influences of Mahabhuta and Sadabhava plays key role in embryogenesis which continues throughout life. For mechanism of fetal growth, rasa nimitta and maruta adhmaana nimitta can be understood. Two terminology i.e Upasneha and Upasveda; Upasneha emphasise for specific nutrition via chorionic villi in early embryonic period and Upasveda is understood with temperature required for development. A specific time duration for delivery can be understood with kala where baby comes out from the mother's womb with proper and healthy status is identification of swabhava samsiddhi. In applied aspect, fetal abnormalities due to deficiency or poor nutrition of pregnant mother leading to Garbhasosha, Upavistaka, Nagodara or Upasushka, Lina garbha understood with both symmetrical and asymmetrical IUGR and congenital abnormalities influenced through Beeja, Atmakarma, Asaya, Kala and Matu ahavihar. The science thus seems to include every aspect of embryology starting from fertilisation upto development. Process of nutrition, mode of action also highlighted in different references. Observation status of intrauterine period as well as advocacy of specific drugs, diet and regimen definitely highlights a new platform for inclusion of this concept in national health programme.

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