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Concept of *Beeja, Beejabhaga* and *Beejabhagaavayava*in Genetic Disorders and Genetic Predisposition: A Review Article

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ABSTRACT: Present generation is anxious about lifestyle disorders and ways to lead a healthy wellbeing. Modern science emphasis the role of genetic factors in physical appearance, mental characteristics and disease formation of individuals. Even though physical structure, appearance and behavior of every individual is different, there are some common traits transferred from parents to offspring. This transmission is explained in terms of genetics. Ancient *Ayurvedic Acharyas* understands and explains this in terms of *Beeja, beejabhaga and beejabhagavayava.* The formation and development of embryo is given much importance in *Ayurvedic* science. The concept of genetics is spread all over the *samhita* especially in *shaareerasthaana* in a hidden form. Understanding the concept behind each topic is a matter of interest and it put light on the view of genetics. *Ayurvedic* science not only gives importance to anatomical, physiological and pathological aspects of genetics but also emphasize the measures to prevent it. The genetics in *Ayurveda* is hence given much importance as the occurrences of genetic disorders are increasing day by day. Hence this study focuses to understand the role of *Beeja*, *Beejabhaga*and *Beejabhagaavayava* in genetic disorders and genetic predisposition.

KEYWORDS: *Beeja, Beejabhaga, Beejabhagavayava, garbhotpathisamagri,ritukshetra and ambu,shadbhava, garbhopaghatakarabhava*

1. INTRODUCTION

Genetics is the study of heredity. Heredity is a biological process where a parent passes certain genes on to their children which in turn express specific traits. Genes may also carry the risk of certain diseases that may pass on from parents to their offspring. Genetic diseases occur as a result of mutation or an anomaly in genome of an individual. Genetic predisposition is the augmented probability for developing a particular disease based on individual's genetic makeup. Development of theory of genetics was associated with the development of theory of evolution and Gregormendal's experiments on inheritance and genetics of sweet pea plants[1.] Even though physical structure, appearance and behavior of every individual is different, there are some common traits transferred from parents to offspring. This transmission is explained in terms of genetics.Modern science pays emphasize on the role of genetic factors in physical, mental characteristics and disease formation of individuals. We can also get the similar explanation about genetics from *Ayurvedic* literature like *Samhita* which were written second BC onwards.

Ancient *Ayurvedic Acharyas* understands and explains this in terms of *Beeja, beejabhaga and beejabhagavayava.*The explanation about *beeja*, the role of *beeja* in the formation of *garbha*(foetus) and hereditary diseases are explained in *samhitas.* The concept of *Beejabhaga* and *Beejabhagaavayava* are explained in *shareerasthana* of *charakasamhita*[2]. *Acharya charaka* clearly mentions that the characteristics

of parents will be transmitted to their offspring. This type of transmission of characters is known as anuvamshiki. The factors responsible for inheritance are *Beeja*, *Beejabhaga* and *Beejabhagaavayava.Beeja* means both the gametes. This *beeja* is the collection of functional units representing the structures and features of all parts and organs of an individual. This functional unit which is capable of formation of an offspring resembling the parent is called *beejabhaga*. Still minute fragments of *beejabhaga* are *beejabhagaavayava*[3]. In short *beejabhagaavayava*is the fundamental unit of inherence.

In view of this, the formation and development of embryo is given much importance in *Ayurvedic* science. Understanding the concept behind each topic is a matter of interest and it put light on the view of genetics. *Ayurvedic* science not only gives importance to anatomical, physiological and pathological aspects of genetics but also emphasize the measures to prevent it. The genetics in *Ayurveda* is hence given much importance as the occurrences of genetic disorders are increasing day by day

The detailed study of *Ayurvedic* literature shows informations and interpretation which enlights the different views of genetics. The concept of genetics and epigenetics has been explained in different *ayurvedic* classics in various contests with respect to *garghotpattisaamagri*, *matrujapitrujabhaava*, role of *beejabeejabhaaga* in various diseases, ritumaticharya, *garbhineecharya*, *shadbhaava*, *atulyagotreeyashaareera* etc. The explanation about *beeja*, role of *beeja* in the formation of *garbha* and hereditary diseases are explained in many of the *samhita'*s. But the beejabhaaga and beejabhaagaavayava are the unique concepts explained in *shaareerasthana*of*Charakasamhitaa*.

2.GARBHOTPATTIKARASAMAGRI(factors essential for conception)

*Attainment of a good progeny is compared with the germination of a high yielding seed. Four important factors are responsible for this including Beeja(*seed or sperm and ovum),*Ritu*(season or ovulatory phase), *Kshetra* (field or reproductive system) *and ambu(*water or nourishment*).Garbha*is formed by the union of *shuddhashukra* and *shuddhaartava*(good quality sperm and ovum) associated with *atma*[4]. *Charaka* not only explains about the factors responsible for inheritance but he also explains how abnormality in these factors leads to abnormality in the offspring. He explained, in the *beeja*there is a representative for each and every organ. If a particular part of *beeja* become *upatapta*(vitiated), there will be some abnormality in the organ formed. *Charaka* explained this concept with the help of different consequences.

2.1 Beeja

It is the *garbhasayabeejabhaga* in the *beeja* of mother which is responsible for the formation of *garbhasaya* in a female child. When this *beejabhaga* is excessively vitiated, then she gives birth to a *vandhya* (sterile child). When the *beejabhagavayava*in the *beeja* of the mother which is responsible for the formation of uterus is vitiated then she gives birth to a *pootipraja(*child dies after delivery due to congenital abnormality).The direct cause for female genital tract congenital anomaly is not known. These abnormalities can occur due to the abnormality of genes. The primordial analge of the female reproductive tract is the mullerianducts.Studies show 2%- 3% prevalence for the defects in fusion of mullerian duct and an average 20% of women with congenital uterine abnormality which affect the fertility[5]. Other researches show that the women can conceive but it is difficult to sustain the normal pregnancy.

When the *beejabhagaavayava* which is responsible for the formation of *garbhasaya* and also the *beejabhaga* which is responsible for the production of organs that characterize a female is excessively vitiated, then she gives birth to a child who is not a complete female but having feminine characteristics in abundance[3,4]. Such a type of child is known as varta.Varta will be with predominance of feminine characteristics but not a complete female.Similar explanation is given about abnormalities in a male child. If it is the *beejabhaga* responsible for the formation of *shukra* is vitiated then the offspring born will be a *vandhya*. The *beejabhaagavayava* responsible for the formation of *shukra* is vitiated then the offspring will be a *pootipraja.* In case both the *beejabhaga* responsible for the production of *shukra* and a part of *beejabhaaga*

forming the organs characterizing a male are vitiated then the offspring will be a *trinaputrika*. *Trinaputrika* is one who is not a complete male but will have predominance of masculine characteristics.

Sushruta explained different types of napumsaka[6]. *Charakaacharya* also described various types of genetic sexual abnormalities like *dvireta, pavanendriya, samskaaravaahi, narashanda, naareeeshanda, vakree, eershyaabhirati and vaatikashanda*[7]. These sexual abnormities are found to be due to abnormality at genetic level.These can be considered with chromosomal abnormalities like hermaphroditism with 46-XX karyotype[8]. In true gonadal intersex or hermaphroditism both ovarian and testicular tissue will be present in individual. For them sex chromosome have male and female masacism. Most often chromosome compliment is 44XX and also exist evidence of Chromosomal material on one of the autosomes. This individual may have uncertain external genitalia with sizable penis and are there for reared as males. They may develop breast during puberty and menstruate. In rare condition they produce sperm. They have male external genitalia but the chromosomal constitution and reproductive organs of female. 44-XX ambiguous female external genitalia but chromosomal constitution and reproductive organs of a male. Though the testicles may be absent or malformed. Also we can consider the chromosomal abnormality like turners syndrome X0 and klinefelter syndrome XXY. Turners and klinefelter have male and female genitalia respectively with retarded development of sexual characteristics (*dvireta, pavanendriyasamskaravaah*ietc).

2.2 Role of *beeja,beejabhaga,beejabhagaavayava* in few diseases.

Acharya had a very clear idea about the hereditary diseases also. Some diseases like *prameha,arsha, jatyandha* and *kushta* may occur due to vitiation of beeja[9,10].But even though the parent is affected with these diseases, sometimes it may not be transformed in to off spring. Charaka clarifies, if the parent is affected with *kushta* (skin disease) but the part of the beeja forming the skin of the offspring is not affected, then offspring born will be having a healthy skin. But if thepart of beeja forming the skin is affected then the offspring also will have skin disease[11]. This may happen because gene expression is influenced by genes.

3.CONCEPT OF RITU KSHETRA AND AMBU[12]

3.1Ritucan be considered as the reproductive period

The man or women who is too young (bala) too aged (vriddha) affected with chronic diseases are prohibited from production of off spring[13]. Researches show that young maternal age is a risk of prematurity, major congenital malformations and perinatal mortality. Advanced maternal age also has the risk of certain chromosomal abnormalities. Down syndrome (trisomy 21) is an example of such chromosomal abnormality due to advanced maternal age. As the paternal age advances, there will be decline in semen quality due to DNA damage by DNA fragmentation and increased susceptibility to denaturation.

3.2 Kshetra can be considered as male and female reproductive system. The production of healthy sperm and ovum depends on the health status of reproductive system. For the formation of good progeny Ayurveda highlights healthy shukra and artava. For attaining a healthy reproductive system there is explanation regarding ritumaticharya, diets and regimens include panchakarma therapy which is to be followed by both male and female. By following these diets and regimens there will be formation of healthy gametes.

3.3Ambu can be considered as the proper nourishment. For the Proper development of gametes require appropriate nourishment. The nourishment of sperm and ovum before fertilization is equally important as the nourishment after fertilization. Maternal and paternal nutrition before conception affect the health of the foetus. Exposure of male to certain lifestyle, environmental or occupational hazards, tobacco smoking etc may increase the risk of aneuploid spermatozoa. Hence Ayurveda gives importance for diet and regimens of both father and mother before fertilization. After fertilization Ayurveda explains the garbhineecharya which includes proper diets and regimens to be followed by pregnant lady with special emphasis on month wise dietary regimens. The pregnant lady is advised to take laghu, sheeta ,madhura rasa pradhanaahara which

maintains the proper digestion as well as metabolism of the mother, thus by nourishing the developing foetus, thereby ensures the proper growth and development of the foetus. Improper diets and regimens can lead to malformation of foetus.

Chromosomal abnormality can occur before conception as well as after conception also. Most of the chromosomal abnormality occurs as an accidental in egg cell or sperm cell. Some anomalies which occur after conception occur as a result of mosacism due to chromosome non disjunction a, anaphase lag and endoreplication, which effects on to only its daughter cells. Hence anomaly be present in a fraction of adult cells. Mammalian gametogenesis include mitotic and meiotic cell division. During this process there may be chances of DNA damage. The mammalian cells by the beneficial process of DNA repair, identifies the damaged DNA and corrects DNA molecules encoding its genome. According to the study by Marchetti et al, DNA damage is highly suspected in sperm during few weeks before fertilization[14]. in chromosomal abnormality in developing zygote.

This shows the importance of diet and regimens advised for both male and female partner for achieving a healthy progeny.

4. SATVAJA- DOUHRIDAVIMANANA, SATMYAJARASAJABHAVA

Among the six garbhotpadakabhavas, satvaja, rsasaja, satmyajabhaava also play important role for attaining healthy offspring. Certain organogenesis are assigned to each procreative factors. The deficit of any of this procreative part will result in anatomical physiological or psychological problems or occur as latent disorder Proper development of these bhaavaas also influenced by diets and regimens of the mother. This also shows the importance of garbhinicharya and maasaanumasika pathya krama. There is also concept of douhridaavastha in the month wise development of foetus. As the chethana dhatu become vyakta or developed, foetus desires different shabdasparsharupa rasa and gandha and express it's will through the mother[15]. For the proper growth and development of foetus these wishes may be indispensable.

5.MATRIJATI SHADBHAVA*(Maternal, paternal etc six factors)*

Detailed description about *Matrijatishadbhavagarbhotpadakabhavas* can be seen in *samhita. Garbhotpadakabhava* are the factors from which garbhaacquires its features[16].These are nothing but factors which can influence the genome of the foetus. These factors include *matrujabhava(*from ovum) *pitrujabhava*(from sperm*), aatmajabhava*(from soul), *rasajabhava*(nutrition from mothers food) *satvajabhava*(from mind) and *saatmyajabhava*(from wholesomeness).गर्भ is said to be produced by these *matrujaadi*six*garbhotpadakabhava*. Here we can consider matruja pitruja bhava, the traits transfered from mother and the father under genetic factors and others can be considerd as the epigenetic factors.

Atreya further explains that the offspring will be different from their parents according to the changes in the *beeja*. The affected part of the *beeja* will exhibit changes in the offspring also.Even if there is some changes in parents and such changes have not affected the *beeja,* then the offspring will not show these characteristics of parent.

6.EPIGENETIC FACTORS

Other than these genetic factors, epigenetics is also play a vital role in genetic and congenital abnormalities by influencing the gene expression. These changes may lasts for several generations. These epigenetic processes is predisposed by numerous factors like environmental factors, aging, diet and nutrition, chemicals, use of certain drugs and also influenced by the developmental factors in the intra uterine and childhood development.

Charaka explains the most important reason for the *beejadushti* as the unwholesome *aaharavihara* before and during conception[17]. This especially implies the importance of r*ajaswalacharya* and *garbhinicharya* in *ayurveda.* If the *aahara* and *vihara* are unwholesome it will vitiate the dosha which inturn will cause defect

in *beejahaga.*The vitiated *dosha* may not completely affect the beeja. If she conceives at this time the foetus gets damaged in one of the matrujabhava. Also there is explanation regarding the importance of ahara and vihara of the father, hence there is advice regarding diets and regimens including panchakarma therapy which is to be adapted by the male partner for a healthy progeny[18]. Moreover special importance is given to garbhinee charya, the food and regimen adopted by a pregnant lady in order to deliver a healthy child. This is emphasized by the concept of ritukshetraambu (garbhotpadakasamagris).

7.ATULYAGOTRA(Mutually different clan)

Studies shows that the consanguineous marriages are associated with increased risk of congenital malformation and autosomal recessive diseases with some increased postnatal mortality in the offspring of first cousin couples.Same principle has been expressed by Charakacharya in the AthulyagothreeyaShareera[19]. He advices, for the procreation of healthy child the male and female should be from different clans.

8.GARBHOPAGHATAKARABHAVAS (Teratogenic factors)

As per Ayurvedic literature, factors contraindicated to pregnant lady are teekshna, rooksha, ushnadravyas, travelling on vehicles, excess satiation, excess emaciation, sleeping in day, awakening in night, sitting in uneven places and should avoid fasting, grief, anger, visiting lonely places, cremation ground, prolonged stay near fire or hot sun etc[20].These may be advised mainly to ensure the proper nourishment of the foetus and to prevent, intra uterine growth retardation, Intra uterine death and abortion. Hence garbhopaghatakarabhavas can adversely affect maintenance of pregnancy and health of mother and foetus. Garbhasthapakadravya(engagement of foetus) are explained to counter act the effect of garbhopaghatakarabhavasand maintenance of the pregnancy[21].

Maternal, placental and foetal factors with genetic factors may affect the normal growth and development of foetus. Maternal factors include maternal size including height and weight, nutritional status, high environmental noise exposure, air pollution, cigarette smoking, alcohol, drugs, tobacco etc. Placental factors include size, microstructure (densities and architecture), umbilical blood flow, transporters and binding proteins, nutrient utilization and nutrient production. Fetal factors include the foetus genome, nutrient production etc. Studies illustrate over nutrition and malnutrition of mother diminishes placental – fetal blood flow and arrest fetal growth. Researches highlight hypo perfusion to brain and other vital parts may occur due to Sudden shock which impede flow of blood to the uterus and foetus.Researches also shows that antenatal distress can persist through the postnatal period and can lead to cognitive–emotional and behavioral problems in the child.

9.PRAKRITI

Expression of genotype is known as phenotype. This is expressed in Ayurveda in terms of prakrutiPrakriti is the unique characteristics of a person. Prakriti is determined at the time of union of shukra and artava by the predominance of dosha. This prakriti portrays the physical and mental characteristic of a person. Dominant and recessive part of these characteristics varies from person to person due to difference in combination of dosha. The factors which influence the prakruti are kalagarbhasayaprakriti, shukrashonitaprakriti, maaturaaharaprakriti etc.

Prakriti or Basic constitution is the changeless characteristic. Though influenced by many factors it remains constant from birth to death. Hence it is considered as genetically determined anatomical physiological and psychological constitution of an individual.

Understanding of Prakriti is useful for identifying the incidence of disease, strength of a person and disease, prognosis of disease and its treatment. Also the knowledge of Prakriti helps in the selection of drugs,

preventive measures such as diet, diurnal and seasonal regimens. Hence concept of Prakriti can be considered as one of the most primitive known concept of preventive and personalized or genomic medicine.

10.CONCLUSION

The descriptions so far mentioned proves that ancient Ayurvedic Acharya's had sound knowledge about the minute parts of the gametes which is now known as genetics. They had clear idea regarding the transmission of genetics materials from paternal and maternal side andthe effect of these factors in combination with lifestyle and environmental factors results in genetic disorders. Modern science also proves that the parent germ cell mutation or epigenetic factors influences the genotype and phenotype. Proper knowledge and care regarding the essential factors and factors influencingthe formation and normal growth of goodoffspringmay help to achieve a healthy progeny.Since from second BC, Ayurvedic Acharya's explained in various ways aboutthese genetic processesand also about the ways to prevent the factors influencing the gene expression with or without changing genotype. So here comes the need of evidence based research on these references for establishing its applicability. Understanding these concepts and following these regimens may help the future generation free of these anomalies.

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