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## Epigenetics in Relation to Ayurveda

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### Abstract

Epigenetics has transformed the way we think about genomes. It is the study of changes in organism caused by modification of gene expression rather than alteration of the genetic code itself. It works through chemical tags added to chromosomes that in effect switch genes on or off. Several life style factors are identified that might modify epigenetic patterns, such as diet, obesity, physical activity, environmental pollutants, psychological stress etc. Ayurveda is the science of life. Hence, a lot of importance is given to diet, exercise, and mode of living and moral character of a person. It teaches us, how to live a healthy and peaceful life. It's preaching starts from preconception and runs whole of the life of a person. How lifestyle and diet of a pregnant woman affects the health, disease and survival of the fetus in womb it is beautifully mentioned here. These references directly indicate that science of epigenetics is playing role there. By following dinchrya, rituchrya, yoga and sadvritta we can modify the negative outcome of our genetic constitution in our life period through the epigenetics. How Ayurveda describes the science of epigenetics in its own terms and how we can modify the gene expression by following guidelines mentioned in Ayurvedic texts for healthy living that is thoroughly discussed in this paper.

**Key words-** *Epigenetics, Beeja, Mahabhuta, Shad bhva, Prakriti*

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**Introduction-**

The word epigenetics means things imposed on top of genetics. The study of modifications to DNA that promote changes in gene expression without altering the DNA sequence. It refers to external modifications to DNA that turn genes “On” or “off”. These modifications do not change the DNA sequence, but instead they affect how cells “read” genes.

*Examples of epigenetics-*

1. DNA methylation- Epigenetic changes alter the physical structure of DNA as in DNA methylation. The addition of a methyl group or a ‘chemical cap’ to part of the DNA molecule, which prevents certain genes from being expressed.
2. Histone modifications- Histones are proteins that DNA wraps around (without histones DNA would be too long to fit inside cells). If histones squeeze DNA tightly, the DNA can’t be read by the cells. The modifications that relax the histones can make the DNA accessible to protein that read genes.
3. Non - coding RNA- Messenger RNA (mRNA), which carries the genetic information from DNA and is used as a template for protein synthesis. RNA takes that information into the cytoplasm, where the cell uses it to construct specific proteins, RNA synthesis is transcription, and protein synthesis is translation. A non – coding RNA (nc RNA) is a functional RNA molecule that is transcribed from DNA but not translated into proteins. In general, nc RNA ‘s function to regulate gene expression at the transcriptional and post transcriptional level.

“Our DNA is not our destiny” Dietary and life style conditions affected the genetic expression of not only the individual but also their children. It is through epigenetics that environmental factors like diet, stress and pre-natal behavior can make an imprint on genes that are passed from one generation to the next. During embryonic development this epigenetic information get laid on chromatin. Most epigenetic changes that occur in sperm and egg cells get erased, when the two combine to form a fertilized egg, in the process called reprogramming. This reprogramming allows the cells of the fetus to start from scratch and make their own epigenetic changes. When conception occurs it is just a group of few undifferentiated embryonic stem cells, chromatin does not have epigenetic marks/switches on it. It is only when cells begin to divide and receive signals & information from surrounding cells that epigenetic marks begin to accumulate and genes begin to turn on and off. Each cell type expresses only those genes required for its specific function. This modification is determined by the interplay between enzymes which are controlled by epigenetic signal pathway that respond to changes in the cell’s local environment. Perturbations of these signaling pathways can predisposed to the development of diseases such as Cancer, Alzheimer and Schizophrenia. Scientist think some of the epigenetic changes in parent’s sperm and egg cells may avoid the reprogramming process and

make it through to the next generation. If this is true, things like the food a person eats before they conceive could affect their future child.

*Examples –*

1. Epidemiological evidence has shown an association between prenatal malnutrition (IUGR) and a higher risk of developing metabolic disease in adult life. An inadequate intrauterine milieu, affects both growth and development, leading to a permanent programming of endocrine and metabolic functions, programming may be due to epigenetic modifications of genes, implicated in the regulation of key metabolic mechanisms such as insulin signaling, immune responses, adipokine function, lipid metabolism and food intake. Liver is one of the main target organs of programming undergoing structural, functional and epigenetic changes following the exposure to a sub optimal intrauterine environment. However detrimental consequences of developmental programming arise if the fetus is born in an environment with normal or even increased nutrient supply. The mismatch between pre and post natal environment may predispose the offspring to the development of cardio - metabolic diseases in adulthood.
2. Delivery by elective cesarean section also has shown an increased risk of certain diseases such as asthma, Type – I diabetes, obesity, celiac disease and cancer.
3. The early emotional environment can lead to long lasting epigenetic changes. Traumatic experiences affect metabolism in the long term and those changes are hereditary (much at the level of micro RNA in sperm ) there is a significant association of reported childhood ,maltreatment and the later diagnosis of adolescent and adulthood schizophrenia, borderline personality disorders, post-traumatic stress disorder and major depression.
4. An epigenetic change that silences a tumor suppressor gene such as gene that keeps the growth of the cell in check could lead to uncontrolled cellular growth. The epigenetic change that turns off genes that help to repair damaged DNA, leading to an increase in DNA damage, which in turn increases cancer risk.

**Discussion-**

1. Recent discoveries in epigenetics shows how nature (genes) and nurture (the environment) works in concert. The only thing we know for sure is that we are a product of dynamic interaction between nature and nurture. Nothing about us is written in stone, therefore as long as we breathe, we are a work in progress, constantly changing. Epigenetic modifications are dynamic and potentially reversible processes.
2. An individual adult health is heavily influenced by early prenatal physiological factors affecting the mother such as food, pollution and radiation.

3. The unborn child will adjust as best it can to the external environment, he/she is going to encounter upon birth by way of epigenetics changes.
4. At least parts of the changed genetics code can be passed on to future generations.
5. Genes don't make you who you are, gene expression does. Gene expression varies depending on the life you live.
6. Our social lives, our interaction with others and ourselves can change our genes expression.
7. Three simple steps to control genetics-
  - Eat healthy
  - Exercise regularly
  - Don't suffer silently of stress, anxiety and depression.

Epigenetics starts its role since ovulation and spermatogenesis and works throughout life of a person. It is affected by diet, physical activity and psychological health of a person. Ayurveda is science of life, it believes in maintenance of health as its prime principle. Life starts from ovulation/spermatogenesis. Thus, guidelines for diet and conduct also starts from menstrual care i.e ritucharya, so that healthy ovum is produced in that cycle. If the woman conceives in that cycle after following preconception rituals mentioned in Ayurveda, she has to follow antenatal guidelines regarding diet and conduct for proper formation and development of fetus in womb. After delivery post delivery guidelines in the form of sutika paricharya are there. For whole of his life a person has to follow ahaar vidhi (dietary rules) dincharya (daily activities) and ritucharya (seasonal changes in diet and activity) to stay healthy. That is epigenetics in today's term. Definitely if these rules are followed by someone, it will cause healthy gene expression during embryogenesis and mask the genetic expression of hereditary disorders in later life. Some of these adaptations in genetics may transfer to the next progeny. By improving our own genetic expression we are improving our next generations too.

Ayurveda believes in incarnation of soul. That is why, it is said that at the time of union of sperm and ovum soul with four subtle bhutas and with the speed of mind (mana) transmigrate from one body to the other on the basis of past deeds . Whole universe along with our body is made up of five essential elements called mahabhutas (vayu, teja, jala and prithvi, akaash).

“पुरुषोऽयं लोकसंमितः” इत्युवाच भगवान पुनर्वसुरात्रेयः १ यावन्तो हि लोके (मूर्तिमन्तो) भाव विशेषस्तावन्तः पुरुषे यावन्तः पुरुषो तावन्तो लोके; (च शा ५/३)

A person is equal to universe, whatever formed entities are in the universe, the same are in the person and vice versa.

गर्भस्य चत्वारि चतुर्विधानि भूतानि मातापितृसंभवानि १ आहार जान्यात्मकृतानि चैव सर्वस्य सर्वाणि भवन्ति देहे १

( च शा २/२६)

During embryogenesis four mahabhutas (vayu, teja, jala, prithvi) from four sources of origin i.e mother (through ovum), father (through sperm), ahara ras (nutrition derived from maternal diet for supplying nourishment to the embryo) and atma (soul encircling due to deeds of previous life) participate in the formation of embryo. Then all four bhutas with four sources of origin constitutes 16 in number. The born child then reflects the bhutik (physical) characteristics as per relative predominance of maternal, paternal, soul or nutritional factors.

अस्ति खलु सत्त्वमौपपादुकं; यज्जीवं स्पृक्शरीरेणाभिसंबध्नाति 1 (च शा ३/१३)

Mana (Mind) being constantly associated with soul establishes link with the present body. Soul takes birth only due to association with mind, once dissociated soul attains salvation. Mana has three types of emotions satva, raja and tama and preponderance of these in mana leads to psychological constitution of born child. Mana is also influenced by its previous abode and have some of characters of previous birth which depends upon the previous life deeds.

At the time of embryogenesis six essential factors are required-

1. Matrija (Maternal)
2. Pitrija (Paternal)
3. Atmaja (Soul)
4. Satmyaja (Palatability)
5. Rasaja (Nutrition)
6. Satvaja (Psyche)

Matrija Bhavas-

मांसशोणितमेदोमज्जहृन्नाभियकृत्प्लीहान्त्रगुदप्रभृतीनि मृदूनि मातृजानि 1

Muscles, blood, fat, bone marrow, heart, umbilicus, liver, pancreas, intestines, rectum etc. are made from maternal factors.

Pitrija Bhavas-

गर्भस्य केशश्मश्रुलोमास्थिनखदन्तशिरास्त्रायुधमनीरेतः प्रभृतिनि स्थिराणि पितृजानि 1

Hair, beard and moustache, hair of body, bones, nails, teeth, veins, tendons, arteries and semen are made up of paternal factors.

Atmaja Bhavas-

इंद्रियाणि ज्ञानं विज्ञानमायुः सुखदुःखादिकं च आत्मजानि 1

Five sense organs, knowledge, memory or retention power, happiness, sorrows etc. are related to soul.

Satmyaja Bhavas-

वीर्यमारोग्यं बलवर्णौ मेधा च सात्म्यजानि 1

Normal seed, freedom from diseases, strength or energy, normal complexion, intelligence etc. are related to palatability.

Rasaja Bhavas-

शरीरोपचयो बलं वर्णः स्थितिर्हानिश्च रसजानि 1 (सु शा ३/३३)

Growth of body, strength, complexion, health or unhealthy state etc. are related to nutrition.

Satvaja Bhava-

‘सात्विकं’ शौचमास्तिक्यं शुक्लधर्मरूचिर्मतिः 1 (अ ह शा ३/७)

Piousness, belief in existence of God, cleanliness, interest in religion and intellect are mind related satvaja bhava.

‘राजसं’ बहुभाषित्वं मानकुहम्भमत्सरम् 1 (अ ह शा ३/७)

Talkativeness, arrogance, anger, ego and jealousy are the features of mind related to rajasa bhavas.

‘तामसं’ भयमज्ञानं निद्राऽऽलस्यं विषादिता 1 (अ ह शा ३/७)

सत्त्वविशेषकराणि पुनर्मातापितृसत्त्वान्यन्तर्वद्वयाः श्रुतयश्चाभीक्षणं स्वोचितं कर्म भवति पूर्वाभ्यासश्चेति 1

(अ सं शा १/६६)

Dejection, ignorance, sleep, laziness are the features of mind related to tamasa bhava.

By going through the various bhavas it can be interpreted that matrija and pitrija bhvas are responsible for organogenesis in embryo as per genetic constitution. Satmyaja bhavas reflect the use of palatable substances by mother the same would be palatable to the fetus. Rasaja bhvas are responsible for nutrition of fetus which depends upon the nutritional status of mother. Satmyaja and rasaja bhavas are responsible for healthy gene expression and normal organogenesis in fetus. Atmaja and satvaja bhavas are responsible for psychological development of fetus.

सत्त्ववैशेष्यकराणि पुनास्तेषां तेषां प्राणिनां मातापितृसत्त्वान्यन्तर्वद्व्याः श्रुतयश्चाभीक्षणं स्वोचितं च कर्म सत्त्वविशेषाभ्यासश्चेति 1 (च शा ८/१६)

Charaka has mentioned that psychological development of fetus depends upon the psychological status of the mother and father, the topics listened by the pregnant woman, influence of deeds of previous life and specific practice of mana. These factors are atmaja and satvaja and responsible for formation of nature and intellect of fetus along with the longevity in later life.

Due to these six variables constitution of bhutas differ and thus it determines the normal and abnormal development of fetus in utero along with development of physical and psychological traits in fetus. After birth the future life of that human being more or less depends upon constitutional development in utero with interplay of above mentioned six bhavas.

शुक्रशोणित संयोगे यो भावेद्दोष उत्कटः ,

प्रकृतिर्जायते तेन तस्या मे लक्षणं शृणु 1 (सु शा ४/६३)

सप्तविंशत्वं प्रतिपाद्य तस्या उत्पत्तौ हेतुमाह – शुक्रेत्यादि 1 यो भावेद्दोष उत्कट इति स्वभावस्थितो न प्रकुपितः 1 द्विविधा ह्युत्कटः वातादयः प्राकृता वैकृताश्च; तत्र प्राकृताः सप्तविधायाः प्रकृतेर्हेतुभूताः शरीरैकजन्मानः, वैकृताश्च गर्भव्याघातकाः 1 (डल्हण टीका)

At the time of union of sperm and ovum which dosha will become predominant that kind of constitution would be fetus will develop. Formation of seven kinds of prakriti or constitution depends upon sperm and ovum and predominance of naturally present dosha at the time of union. Dosha predominance will be natural or abnormal which depends upon the health status, behavior and psyche of the couple at that time. If there is abnormal vitiation of dosha it may lead to congenital abnormalities in the fetus. For this sake, rules and regulations followed by couple before and at the time of procreation are mentioned in detail.

Here the formation of prakriti means physical and psychological constitution of the person. Body is made up of five essential elements air, water, earth, fire and space. Among them Vayu (air), Agni (fire) and Jala (water) are representative of Vata, Pitta and Kapha and they are predominantly responsible for health and disease in the body. Other two factors Prithvi (earth) is base and akash (space) is empty space, are the work place of Vata, Pitta and Kapha. Thus, three types of constitutions are recognized i.e Vata, Pitta and Kapha. Despite it mana has major influence on the body and responsible for the formation of psychological constitution of the body. Psychological constitution (Mansik prakriti) is of further three types depending upon the psychological behaviour of person- Satva, Raja and Tama.

The science of epigenetics is so developed in Ayurveda that the effect of different dosha vitiating diet on fetus is also mentioned by Vagbhata. (A.S Sha 2/45), (A.H Sha 1/48).

When a pregnant woman consumes diet capable of vitiating vata continuously then vitiating vayu makes the fetus- idiot, deaf, dumb, having hoarse and nasal voice, lame, hump- backed, dwarf, possessing less or more number of body parts and other abnormalities like contracted pinna of the ear.

Pitta vitiating diet leads to baldness, premature greying of hair, absence of hair on face, tawn of colour of skin, nail and hair etc.

Kapha vitiating diet produces skin disorders, congenital presence of teeth, leukoderma and anemia.

When all the three dosha are vitiating diet is taken, it may cause mixed abnormalities.

During pregnancy, sometimes a woman desires some unusual things for whom she was not accustomed to in past. These are basically desires of the fetus expressed through mother, if not fulfilled may cause adverse psychological effect on mother that may directly affect the fetus by the epigenetics and may cause certain abnormalities in fetus or even fetal death.

Ayurvedic science believes in incarnation, so as the fetus develops and its mana and indriyas (mind) starts functioning it expresses the desires based upon the experiences of previous life. We usually observe that some persons are having exceptional talent or interests in certain fields though both his/her parents are not possessing this kind of talent or interest. Those previous life interests are expressed by fetus through

mother. By interpreting, these exceptional desires of mother the future interests of fetus post birth in later life can be predicted. For instance, if mother expresses the desire to wearing silk garments and ornaments during pregnancy then would be child will become handsome and fond of ornaments. If she shows desires to live in pious place the would be child may have religious nature etc.

So, respecting the pregnant woman's desires during pregnancy and maintaining her psychological health are responsible for good epigenetics.

मात्रादीनां खलु गर्भकराणां भावानां संपदस्तथा वृत्तस्य सौष्ठवान्मातृतश्चैवोपस्त्रेहोपस्वेदाभ्यां कालपरिणामात् स्वभावसंसिद्धेश्च कुक्षौ वृद्धिं प्राप्नोति 1 (च शा ४/२)

Charaka says that with normalcy of all six factors of conception and use of appropriate diet along with mode of life by pregnant woman the fetus obtaining its nourishment from rasa (supplied by mother) by the process of upsneha (diffusion) and upsweda (osmosis) and influenced by time factor along with its own nature or desires grows normally.

बीजात्मकर्माशयकालदोषैर्मातृस्तथाऽऽहारविहारदोषैः 1

कुर्वन्ति दोषा विविधानि दुष्टाः संस्थानवर्णेन्द्रियवैकृतानि 1 (च शा २/२९)

According to Charaka due to abnormalities of bija (sperm and ovum), atma karma (deeds of previous life), ashaya (reproductive organs), kala (time factor), dietetics along with mode of life of mother the vitiated doshas produce abnormalities of fetus, affecting its appearance, complexion and indriyas.

Here genetically predetermined factors are ovum and sperm, while deeds of previous life, status of reproductive organs of parents, time, diet and mode of life of mother are responsible for epigenetical changes.

Epigenetics don't stop after birth of baby alone. We can further modify the genetically predetermined state of body by following healthy life style in our life. It is in our hands to modify the unfavourable outcome of our genetic constitution in our life and refining our genetic traits for future generation. For this ayurvedic literature is full of guidelines to live healthy life by following Dincharya, Ritucharya and Sadvritta.

### Conclusion:

1. The science of epigenetics which is responsible for gene expression is evolving to newer heights now a days. Its elaborate practical description is available in Ayurvedic literature.
2. Six bhavas or six essential factors (maternal, paternal, soul, mind, palatability and nutritional factors) are responsible for physical and psychological development of fetus in utero. Among them maternal (Matrija) and paternal (pitrija) factors are responsible for genetic constitution of the fetus and soul (atmaja), mind (satvaja), palatability (satmyaja), nutrition (rasaja) play role in epigenetics.



3. Prakriti (Physical and psychological constitution) is formed at the time of union of egg and ovum according to doshik predominance which in turn depends upon mahabhuta predominance.
4. Along with six bhavas , maternal diet and mode of life have great impact on healthy gene expression in fetus, other factors are nature of fetus (determined by previous birth) and time factor (age and season etc.)
5. Maternal psychological state, mode of life and respect to her desires during pregnancy have great impact on epigenetics.
6. By following guidelines for pregnant women mentioned in Ayurveda we can modify epigenetics and get physically and psychologically healthy child.
7. We can further modify the genetically determined disease expression by keeping epigenetics in our control throughout our life. For this certain guidelines related to daily routines, seasonal variation in life style, dietary habits, good conduct, use of health and longevity producing drugs, biopurification, Yoga and meditation (for psychological peace) are mentioned in our ancient (Ayurvedic) texts.
8. By modifying epigenetics, we can induce permanent change in our genetics (positive or negative) depending upon our life style that may transmit to our progeny.

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