

# Conceptual analysis of sexual dimorphism as per ayurveda classical reference

<sup>1</sup>Dr. Neelam Sagwan, <sup>2</sup>Dr. Sunil kumar, <sup>3</sup>Dr. Lahange Sandeep Madhukar

<sup>1</sup>M.D. Scholar, <sup>2</sup>Professor & Head, <sup>3</sup>Assistant Professor  
P. G. Department of Sharir Rachana Nia, Jaipur

**Abstract:** *Ayurveda* the most ancient science forms the base for many other sciences is incredible. Our *Acharyas* had deep insight pertaining to *Garbha Sharir*, which is the same as that of the modern science. Many factors mentioned in *Ayurveda* towards the study of development of foetus and genetics including fertilization and sex determination, *Ayurveda* considered two basic factors in the development of human beings i.e. *Shukra* and *Shonita* it represents that of sperm and ovum in modern medical science and which are responsible for the fertilization. In these contexts *Charaka* clearly stated that dominance of *Shonita* during conception resulting procreation of female child and dominance of *Shukra* (sperm) leads to male child. The sex of an individual is determined by the X and Y chromosome. Sexual dimorphism, i.e. the distinct recognition of only two sexes per species, is the phenotypic expression of a multi-stage procedure at chromosomal, gonadal, hormonal and behavioural level. Two methods of sex determination by the presence or absence of sex chromosomes have been found. One is Protenor method and other Lygaeus method. In this method the primary signal for sexual development is the X: A ratio and not the presence of Y chromosome. In this method the primary signal for sex determination is chromosome composition and the presence of Y. An attempt is made to bring out similarities between both the sciences.

**Keywords:** *Shukra*, *Shonita*, Sexual dimorphism

## Introduction:

The sages of ancient India gave the vision of many scientific facts about human body such discoveries are the fundamental aspects for the basis of other sciences in present scenario. Many factors mentioned in *Ayurveda* towards the study of development of foetus and genetics including fertilization and sex determination, *Ayurveda* considered two basic factors in the development of human beings i.e. *Shukra* and *Shonita* it represents that of sperm and ovum in modern medical science and which are responsible for the fertilization. In these contexts *Charaka* clearly stated that dominance of *Shonita* during conception resulting procreation of female child and dominance of *Shukra* (sperm) leads to male child. The sex of an individual is determined by the X and Y chromosome.

Sexual dimorphism, i.e. the distinct recognition of only two sexes per species, is the phenotypic expression of a multi-stage procedure at chromosomal, gonadal, hormonal and behavioural level. Chromosomal--genetic sexual dimorphism refers to the presence of two identical (XX) or two different (XY) chromosomes in females and males, respectively. This is due to the distinct content of the X and Y-chromosomes in both genes and regulatory sequences, SRY (sex determining region Y) being the key regulator Hormones (Anti Mullerian Hormone (AMH), testosterone, InsI3) secreted by the foetal testis (gonadal sexual dimorphism), impede Müller duct development, masculinize Wolff duct derivatives and are involved in testicular descent (hormonal sexual dimorphism). Steroid hormone receptors detected in the nervous system, link androgens with behavioural sexual dimorphism. Furthermore, sex chromosome genes directly affect brain sexual dimorphism and this may precede gonadal differentiation<sup>1</sup>. As one must have knowledge of fundamental basics for which this study is undertaken.

## Ayurvedic Review:

- According to *Ayurveda Garbha lingam* or sex is the contribution of *Shukra Dhatu* and *Artava*. It is the predominance of '*Shukra*' and '*Artava*' particularly at the time of '*Shukra Artava Samyoga*' (time of fertilization), which determines the sexuality according to Indian thoughts. *Acharya Charaka*<sup>2</sup> and *Sushruta*<sup>3</sup> both have recognised the three different types of sexes, viz., '*Puman*' (male), '*Stri*' (female) and '*Napumsaka*'. He has also mentioned the factors playing role behind these three states of sexes. In his view, it is the predominance of *Shukra* lead to the formation of a male child, predominance of *Artava* leads to the formation of female child and their equality in strength leads to the formation of a *Napumsaka*. There is another concept mentioned by *Acharya Charaka* in this regard, he says that if the pregnant woman who uses her left lateral body parts for doing all the activities, who becomes desirous of male companionship, who dreams about females, whose drinking, eating habits are more feminine, there is elevation on the left lateral part of her abdomen, the shape of the abdomen is not rounded and lactation first appears in the left breast, such pregnant woman gives birth to a female child. When the female exhibits the opposite signs then she gives birth to a male child<sup>4</sup>. *Sharnghdharma* says that besides role of *Shukra* and *Artava*, the will of god is responsible for formation of sex<sup>5</sup>. *Yogaratanakara* besides giving the importance of predominance of *Shukra* and *Artava*, has mentioned that from *Dakshina-nadi* the male child is born and from *Vama-nadi* the female<sup>6</sup>. The description pertaining to difference in sex given by '*Varier*' is very interesting and scientific. Communicating his view, he states that the role of right and left testes and ovaries in giving rise to the birth of male and female child. The right testes and left ovary have been attributed to possess the male and female predominant characteristics, respectively. The germ cells taking origin from right testes is likely to produce the male child because of possessing masculine characteristics. Similarly, the

ovum springing out from the left ovary is likely to give rise the female child because of predominance of feminine characteristics in it<sup>7</sup>. *Bhavamishra*, gives a new view regarding birth of a male and female child and has recognised the way of insemination and the role of three distinct 'Nadees' is giving rise the male and female offspring. In his view, there are 'Sameerana', 'Chandramasi' and 'Gauri' three distinct 'Nadees' in a genital organ of a woman. The discharge of 'Virya' (semen) gets waste, if happens to fall in the mouth of the *Sameerana*; if it happens to fall in the mouth of *Chandramasi*, a second prominent *Nadi*, the woman gets satisfied with little duration of orgasm and gives birth to a female child; if it happens to fall in the mouth of *Gauri Nadi*, a prominent one characterised to give birth to male<sup>8</sup>.

The explanation put forth by 'Daruvahi' in favour of birth to a male and female child in context of statements given by *Vagbhata* in his *Sharir* First chapter, gives birth to a new hypothesis. This hypothesis is purely based on suppositions extended for the evolution of the whole of the creation, which has resulted with the union of 'Saumya' (category of *Apya* elements) and 'Agneya' *Tatvas* (category of *Agni* elements). The same principle is applied here with the birth of male and female child, where 'Shukra' and 'Artava', both represent the 'Saumya' and 'Agneya' *Tatvas*. The hypothesis stands that the predominance of earlier gives birth to a male child, while the predominance of latter gives birth to a female child. Linked with this supposition, 'Daruvahi' states that during the course of perfect orgasm, if a male happens to discharge *Shukra* (semen) prior to counterpart, the result will lead to a powerful, strong and steady male child; and if female happens to discharge before her counterpart, it leads to a beautiful female child with stout and steady built<sup>9</sup>.

### Modern review:

#### SYSTEM OF SEX CHROMOSOMES<sup>10</sup>:

A sex determination system is a biological system that determines the development of sexual characteristics in an organism. When the presence of a chromosome that was involved in the determination of sex was noted, it was called the X chromosome. To differentiate it from the other chromosomes (which were not involved in the process of sex determination), it was also named the allosome. Another chromosome, structurally different from the X, but also involved in sex determination process was subsequently detected. It has been named the 'Y' chromosome. In mammals, including humans, a normal female has two X chromosomes and a normal male has one X and one Y chromosome. The gametes of a female will have only the X chromosome. Therefore, females belong to the homozygotic sex. The gametes of the male will be in two groups: one group with the X chromosome and the other with the Y chromosome. Males belong to the heterozygotic sex.

#### METHODS OF SEX DETERMINATION:

It is not only the presence of the sex chromosome that determines the sex, but also sometimes, its absence too. Two methods of sex determination by the presence or absence of sex chromosomes have been found.

1. Protenor method
2. Lygaeus method
1. Protenor method: This method has been so named because of its discovery in the protenor bugs and grasshoppers. The female is homogametic sex with two X chromosomes and the male is the heterogametic sex with one X chromosome. Sex is determined not by the presence of the X chromosome, but by the ratio of the sex chromosomes to the autosomes. The ratio of X:A is 1:1. A normal male has one X chromosome and two sets of autosomes. The ratio of X:A is 1:2. A ratio greater than 1:1 will result in extreme female characteristics, an organism with XXX and AA is an example for greater than 1:1 and will be a metafemale. A ratio less than 1:2 will result in extreme male characteristics, an organism with X and AAA is an example for less than 1:2 and will be a metamale. A ratio of 1:1 will produce the female phenotype, an organism with XXX and AAA will have 1:1 ratio and will be a triploid female. In this method the primary signal for sexual development is the X:A ratio and not the presence of Y chromosome.
2. Lygaeus method: Lygaeus is another variety of bug. In this method, sex is determined by the presence of a specific chromosome. This specific chromosome is the Y chromosome. This method of sex determination is seen in most mammals including humans. The primary signal for sex determination is chromosome composition and the presence of Y.

#### SEX DETERMINATION IN HUMANS

Sex determination in humans depends on the Y chromosome. It has been seen the individuals with a Y chromosome (XY,XXY) develop male characteristics and individuals without a Y (XO,XX,XXX) develop female characteristics. X:A ratio (sex chromosome:autosome ratio) does not have any role to play. To understand the phenomenon, it is necessary to first study certain genetic steps which happen during development and the female sexual model.

- A gene called Dose Sensitive Sex Reversal (DSS) gene is found on X chromosome at position Xp 21. It suppresses the Male Pathways Genes (MPGs).
- The tissue which is to develop into a gonad is bipotential in the early embryo. In other words, this tissue has the capability to either become a male gonad or a female gonad.
- If the Male Pathway Genes become active, they direct the bipotential gonadal primordium to develop into a testis.
- Female Pathway Genes (FPGs) are also present, these genes direct the bipotential gonadal primordium to develop into an ovary.
- Like how the dose sensitive sex reversal (DSS) gene represses male pathways genes (MPGs), there are also other gene which repress the FPGs.

What happens in an embryo with XX composition?

We know that a normal human female has two X chromosomes. However, early in development, one of the two chromosomes is made inactive and genetically inert. The other X chromosome which is active has a DSS gene on Xp21. This DSS gene represses the MPGs. A little later in development, FPGs are activated and they direct the bipotential gonad to become an ovary. Subsequent to ovarian development, some other genes which permanently repress the MPGs are triggered. Ovarian development and permanent repression of MPGs result in female sexual development and the individual becomes a female.

What happens in an embryo with XY composition?

The embryo has an X and a Y chromosome. In the short arm of the Y chromosome, next to the terminal zone (called the Ypter) is a gene area called the sex determining Region on the Y (SRY gene). The SRY gene inactivates the DSS gene. Absence of inhibition by the DSS results in MPGs becoming active. MPGs act on the bipotential gonad and direct it to become a testis. As testis develops, various cells of the testis including the sertoli cells are formed. By the sixth week of development, Sertoli cells produce the Mullerian Inhibiting Factor (MIF or the antiMullerian hormone gene) that acts on the Mullerian ducts and their further development (MIF actually acts on the FPGs which promote Mullerian development). Since Mullerian (paramesonephric) ducts give rise to the female genital organs, the presence of MIF stops such development. In addition, interstitial cells of the testis produce testosterone which promotes and enhances development of the mesonephric (Wolffian) duct system resulting in male genital organs. It can be clearly seen that the primary signal for male development is from the SRY gene and so, from the Y chromosome.

#### ROLE OF Y CHROMOSOME:

In humans, the Y chromosome has a significant role to play in sexual development. It has already been noted that the Y chromosome gives the primary signal in male development. Female development is more of a routine and regular process and its primary signal is chromosome composition (autosomes plus X) itself. The significance of Y can be better understood by studying two syndromes, namely the Klinefelter syndrome and Turner syndrome. Individuals with Klinefelter syndrome have normal number of autosomes, two X chromosomes and a Y chromosome. So the total composition is 47 and the sex chromosome pattern is XXY. These individuals develop male sexual characteristics though very often they are sterile. Few female sexual characteristics like enlarged breasts may show out. The overall picture indicates that the SRY gene has acted. DSS has been inhibited and MPGs are allowed to act. Individuals with Turner syndrome have normal number of autosomes, one X chromosome and Y chromosome. These individuals are females externally and develop female characteristics though they may have rudimentary or underdeveloped ovaries. Absence of SRY (sex determining region Y) and presence of one active X has resulted in the development of female characters and DSS inhibition on MPGs. Both these syndromes are evidences of the significance of Y chromosome. However, both developmental processes are not normal because of the imbalance and genetic factors.

#### Discussion:

The knowledge which our ancient seers is scientific and forms the basis of other sciences. We can find detailed description of *Garbha Sharir* in our classics. *Garbha Sharir* which deals with the developmental events that takes place during the Intra uterine life, which is nothing but Embryology of Modern Science. *Garbha* is defined as the union of *Shukra* and *Shonita* along with *Atma*. Modern science also explains that union of ovum and sperm (fertilisation) is the basic event necessary for it to be called a embryo later after consequent stages the resultant fertilised product is called fetus. Here *Shukra* and *Shonita* can be taken as sperm and ovum respectively. In our classics it is described that predominance of *Shukra* in the fertilized product gives birth to a male child, predominance of *Shonita* results in birth of a female child and predominance of both results in *Napumsaka*. As said in the earlier part of discussion that *Shukra* and *Shonita* are sperm and ovum respectively. Sperm contains XY chromosome and ovum contains XX chromosome. The different concept mentioned in our classics were we find that if the pregnant woman uses her left lateral body parts for doing all the activities, who becomes desirous of male companionship, who dreams about females, whose drinking, eating habits are more feminine, there is elevation on the left lateral part of her abdomen, the shape of the abdomen is not rounded and lactation first appears in the left breast, such pregnant woman gives birth to a female child. When the female exhibits the opposite signs then she gives birth to a male child, from this concept we assume that by doing so FPGs are activated, resulting in birth of

female child and vice versa. During the sexual development the genetic factor(s) that determine(s) sex as influencing only the fate of the gonad. A maleness factor produces testes (Primary Sex Determination). These organs secrete hormones which cause male Secondary Sexual Differentiation. In absence of the maleness factor, by default the gonad becomes an ovary, and the absence of testicular hormones leads to female secondary differentiation. In this article a new paradigm is proposed, to accommodate recent findings. Sexual dimorphism precedes gonadal development, in a Pregonadal Stage. Furthermore, female development is not by default-both male (Y) and female (X) sex-chromosomal primary sex-determining mechanisms probably exist. The human/mammalian male Y-chromosomal sex-determining gene is now known (SRY), and a candidate for a non-inactivated, X-linked, female determining factor, is under study. However, the proximate gonad-determining genes are probably on autosomes. Pathways between the primary factors and the proximate gonad-determining genes are indirect and complex. A hypothetical gene Z has been proposed, that inhibits the testis determiner and is itself the target of suppression by SRY. Candidates for proximate testis and ovary-determining factors and for Z also exist. The "default" concept has also been superseded with respect to secondary sexual differentiation. Absence of testicular hormones does not produce a normal female phenotype; ovarian genes and hormones are necessary. Finally, sex-chromosomal sex-determining genes influence the development not only of non-gonadal organs of secondary sexual development, but also of organs outside of the reproductive system<sup>11</sup>.

### Conclusion:

Ayurveda a traditional life sciences, explains about the concept of sexual dimorphism in different ways which has similarities with the contemporary science. This shows that how well the embryological concepts were known to our *Acharyas*. But due to more advancement in medical technologies very detailed descriptions are seen in the modern science. We can predict that our *Acharyas* also had done repeated researches on these topics only then they were able to establish the concepts, they might even had done research on these concepts at higher level but we do not have such collections in our classics. By analyzing the Review of the concerned topic it is concluded that there is similarities between both the sciences about the concept of Sexual Dimorphism. *Shukra* is considered as sperm having XY chromosome and *Shonita* is considered as Ovum containing XX chromosome.

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