UG-4th sem Paso

Sex Determination (UNIT-5) ①

Chromonomal Sex determination

There are several ways chromosomes can determine the sex of an embryo.

- In mammals, the presence of a either a second x chromosome or a y chromosome determines whether the embryo will be female (xx) or male.
- In Birds, the male has two similar sex chromosomes (ZZ) and the female has the unmatched pair (ZW).
- In flies, the y chromosome plays no role in sex determination, but the no. of x ch. determine the sexual phenotype.
- In other insects (especially hymenopterans such as bees, wasps, ants), fertilized, diploid eggs develop into female, and unfertilized haploid eggs become males.

Mammalian pattern of sex Determination :⇒

Mammalian sex determination is governed by the gonad forming genes and by the hormonal-mones elaborated by the gonads.

- Primary sex determination is the determination of the gonads – the egg forming ovaries or sperm forming testes.
- secondary sex determination is the determination of the male or female phenotype by the hormones produced by the gonads.

• Gonadal Sex determination:

- In human sex determination is of XX- XY type.
- Genes on the sex chromosomes determine whether the gonads of the embryo will develop into normal testis or ovaries.
- In human embryo gonad primordium region remains in undifferentiated 'indifferent' state for about 5 wks. During this time the embryo develops both Mullerian duets and Wolffian duct.

↓

upto 6 wks. Embryo contain pairs of rudimentary gonads (bipotential gonads) which are neither those of female nor those of male. But which are capable of developing into either testes or ovaries.

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At about 6 wks. —

i) The presence of Y-chr. (XY embryo) triggers the embryonic bipotential gonad into male Pathway and testis is formed.

ii) In absence of Y en. (XX embryo), the gonad will produce into ovaries about 12th wks.

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After testis formation two signals induce the male specific development:

i) Testosterone: Regulates male secondary characters.

ii) Mullerian inhibiting substances (MIS): Degradation of Mullerian duct.

iii) In absence of MIS, the uterus and fallopian tube are formed.

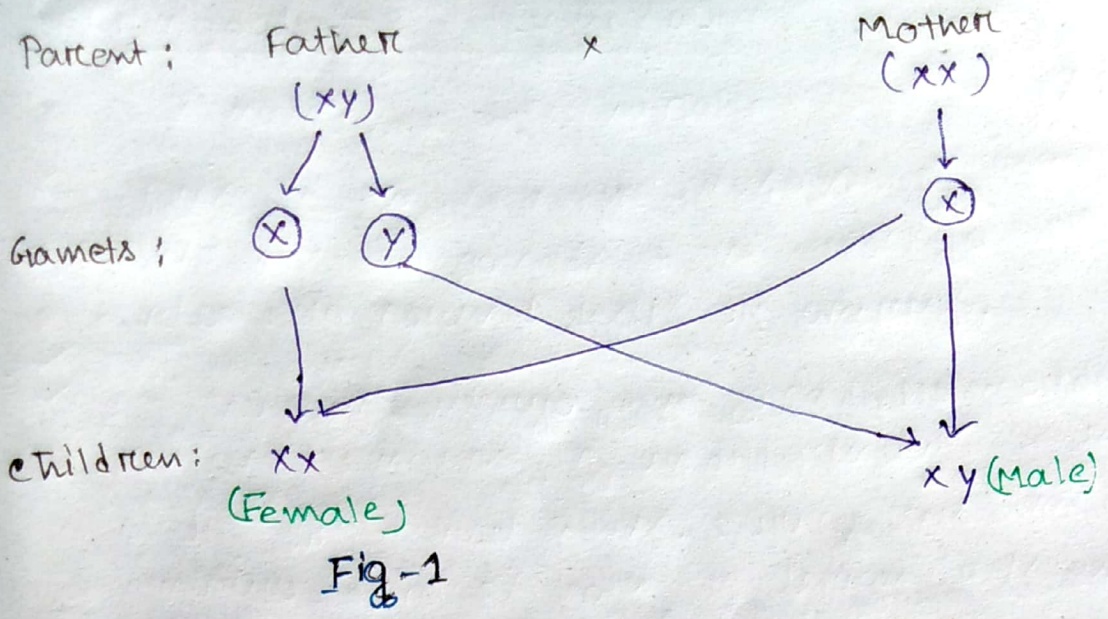


Fig-1

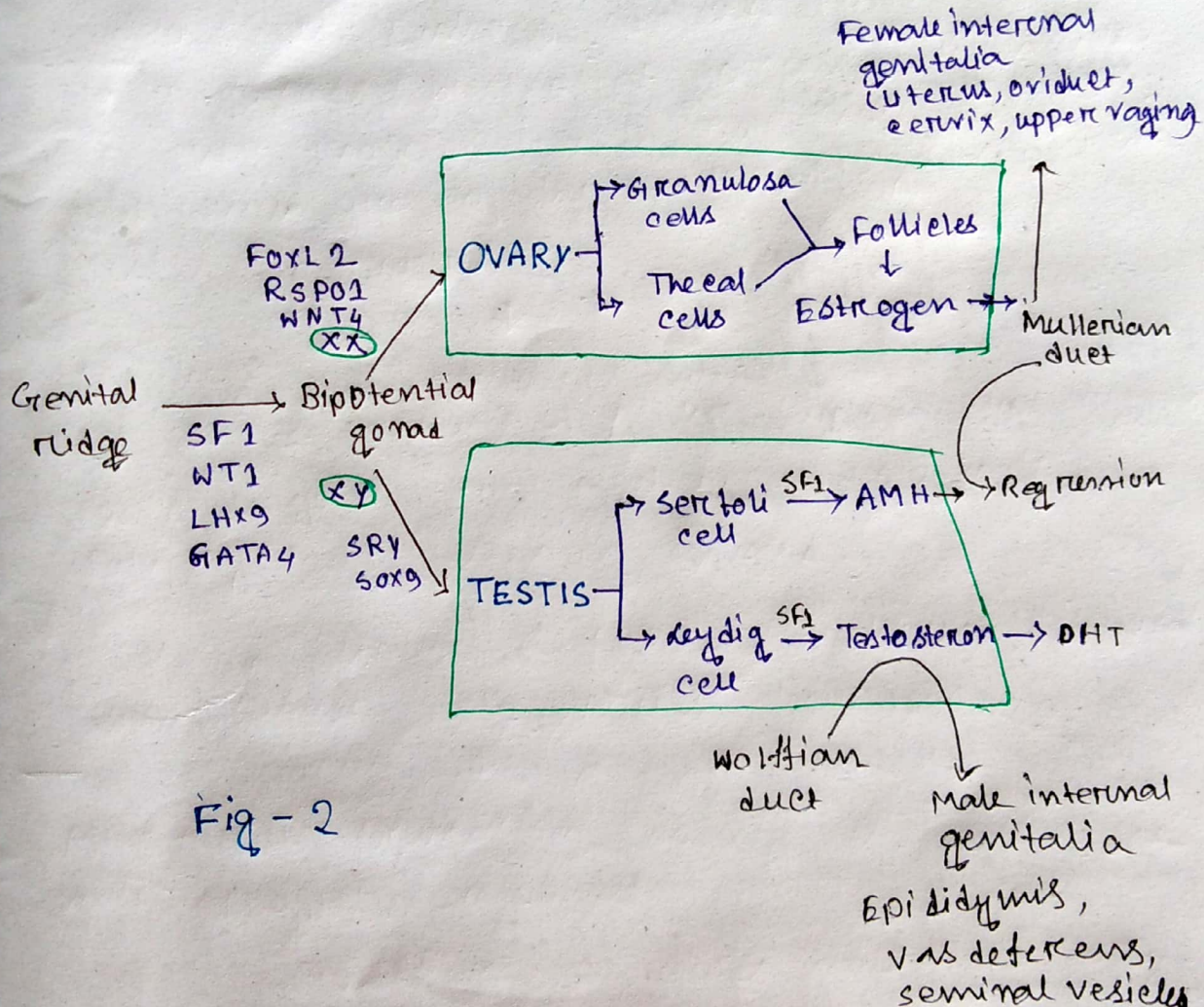


Fig - 2

MECHANISM OF SEX DETERMINATION IN HUMAN

SRY gene: (y chromosome sex determinant)

- In human SRY is the key gene that switches the bipotential genital ridge towards testis determination.
- SRY gene resides in the short arm of Y ch.
- The SRY protein is a transcriptional factor and contain HMG
- It's role may be to activate genes encoding other factor like Sox9, SF1, whose absence in XY male is feminized.

Sox9 gene: (Autosomal testis determining gene)

- It is found essential fore testis formation, as well as organogenesis in male genital system.
- It may act as sex reversal gene.
- Human who has an extra copy of Sox9 develops as male, even though have no SRY gene
- The Sox9 protein binds to a promoter site on the Amh gene and induce male pathway.

⇒ SRY is found in mammals but Sox9 is found throughout all vertebrates. So, Sox9 may be older and more central sex determination gene.

SF-1: (The link btn SRY and male development pathway)

- SF-1 (Steroidogenic factor-1) is directly or indirectly activated by SRY.
- SF-1 factor activates the gene encoding the enzyme that makes testosterone hormone.

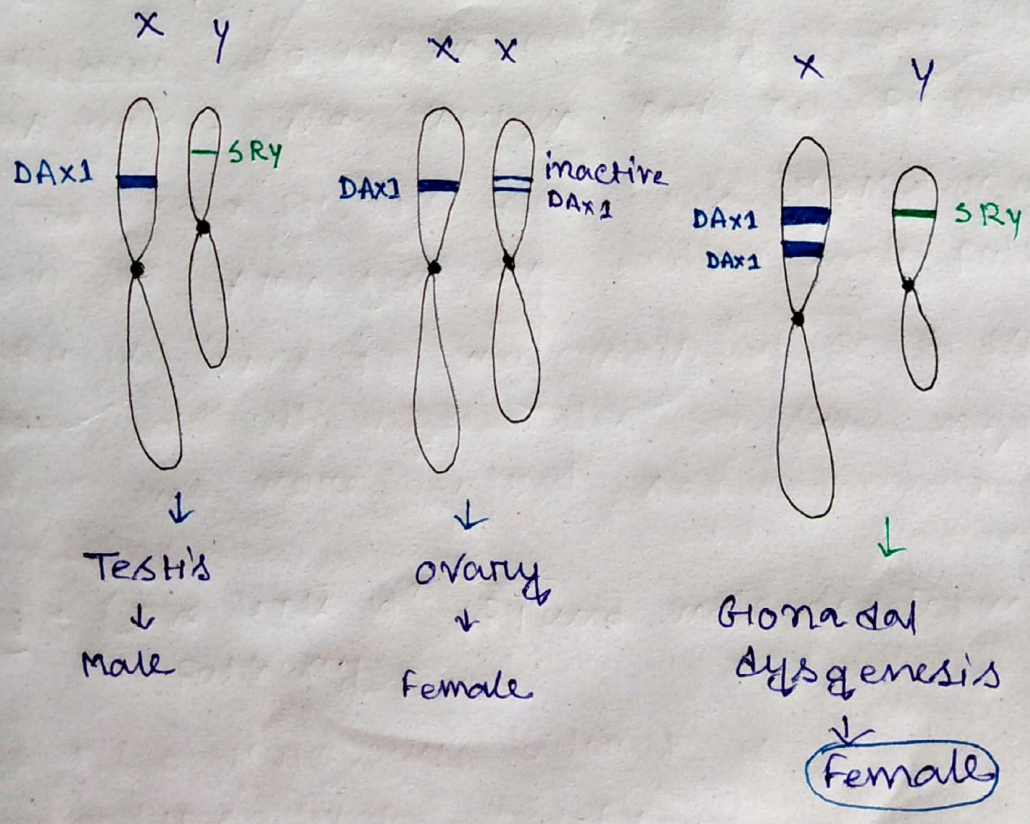
Fgf-9 gene : (Fibroblast growth factor 9)

It works with SRY and SOX9 and induce maleness.

1. It causes the proliferation and differentiation of sertoli cell.
2. It acts to bring mesonephric cell into the gonads.

DAX1 gene : (Potential testis suppressing gene on X ch.)

1. It is also a sex reversal gene, a potential ovary determining gene on the X ch. of human.
2. DAX-1 protein antagonize the function of SRY factor and down regulates the expression of SF1.



WNT4 : (Potential ovary determining gene on autosome) (6)

It is a Paracrine factor that represses male development in female gonad. It's target is the gene encoding TAF II 105. In transgenic XX female that lack WNT4, ovary do not form ....
It's cell express testis specific markers inducing testosteron producing enzyme and AMH.