9

Reproductive System

Reproduction

i. *Definition* : Reproduction is the process by which an individual produces its offspring.

ii. *Importance of reproduction :*
   a. To maintain own species in the world
   b. To increase the number for existance.

iii. *Types of reproduction* : It is of two types-
   a. *Asexual reproduction* : It occurs by simple division of unicellular organism.
   b. *Sexual reproduction* : It occurs by sexual contact of male and female. It occurs in higher animals.

Chromosome

i. *Definition* : Chromosomes are deeply stained thread like structures within the nucleus of each animal cell.

ii. *Chromosomes number* : 46 or 23 pairs
   a. Autosomes : 22 pairs
   b. Sexchromosomes : 1 pair (XX or XY).

iii. *Structure of chromosome* : Each choromosome is composed of a double helix of DNA along with histone and non-histone proteins. The DNA-protein complex exists as a highly coiled or folded structure.
   a. The *non-histone* proteins are DNA and RNA polymerases, gene regulatory proteins and HMG (high mobility group) proteins.
   b. The *histones* are the most abundant group of basic proteins which help packaging of chromosomal DNA. There are five histone proteins according to the concentration of arginine and lysine residues : H_1,H_2A, H_2B, H_3, and H_4.

iv. *Function* : Chromosomes act as carries of units of inheritance in the form of genes of nuclear DNA. Genes are borne by the chromosomes in linear series as parts of specific DNA molecules.

Sex

Man kind is divided into two sexes, the males and the females. What are the criteria by which this classification is made ?

There are four criteria :

i. Chromosomal (or genetic) sex
ii. Gonadal sex
iii. Phenotype sex
iv. Psychological sex.

Genetic (chromosomal) sex : If the chromosomal pattern is XX, the subject, no matter what is the outward appearance, is genetically a female. Conversely if the chromosomal pattern is XY, the subject is male (irrespective of the outer appearance). Hence XX and XY are female and male genotypes respectively.

Gonadal sex : Testes and ovaries are the male and the female gonads respectively. Therefore, when testes are present, the subject is gonadally, a male. Similarly, presence of the ovaries means that the subject is gonadally, a female.

Phenotype sex : By the accessory sex organs (penis, epididymis, vas, seminal vesicles and the prostate in the male and fallopian tube, uterus, vagina and vulva in the female) gender sex or the sex phenotype is determined. Thus female phenotype will have female accessory sex organs and the male phenotype will have male accessory sex organs.

Psychological sex : Psychological sex is the sex which the individual believes that he or she belongs to. Thus, if a girl from her infancy, is mistaken as a boy and is reared up among the boys and she thinks that she is a boy, her psychological sex is male.

In vast majority of cases, there is no confusion in sex characteristics, that is, in a male, the genetic, gonadal, phenotype and the psychological sex are all male; so is the case with the female. Rarely however, anomalous situation arises. Thus, someone may have a male genotype pattern of sex (XY) and yet the appearance from outwards (the external genitalia, the dress) may be of the female type and the subject believes that he is female.

Two terms are commonly used :

i. Sex determination
ii. Sex differentiation.

Sex determination

By the term sex determination, it is meant how the genetic sex patterns are made. Sex differentiation means the development of gonads, accessory sex organs and the psychological aspects of sex. Thus, sex determination occurs during the fertilization of the ovum. On the other hand, in the early weeks of intrauterine life, the gonadal and gender sex of the fetus are not differentiated. After a few weeks of intrauterine life, a fetal gonadal and gender sex differentiation (that is, outward sex differentiating features like the development of testes, penis, prostate etc. in males or ovary, uterus, vagina, vulva etc. in the female) occur.

Mechanism of sex determination : Human beings have 46 (23 pairs of) chromosomes of which 44 are autosomes and the rest two are sex chromosome. These two sex chromosomes in case of the female are XX, wheres in case of male, are XY. Therefore, the male and the female chromosomal pattern can be written as 44+XY(=46) and 44+XX (=46) respectively.

Owing to the reduction cell division (meiosis) a gamet (a spermatozoon or an unfertilized ovum) will contain 22 autosomes+1 sex chromosme. In case of an ovum it has to be (obviously) always 22+X, or 22+Y. Now during fertilization, one such spermatozoon and one such ovum unite to form a zygote. Therefore from the ovum the zygote is always getting 22 +X but from the spermatozoon it may get either 22+X or 22+Y.

When fertilization occurs, therefore, the zygotes chromosomal pattern (Karyotype) can be 44+XX or 44 + XY, and the genotype of the genetic sex of the zygote will be female (44+XX) or male (44+XY) respectively. Thus the spermatozon (not the ovum) is the sex determining factor.

Clinical determination of the sex in a given person

In some critical situation, it may be necessary (despite the outward apperance) to determine the sex of a given individual. For example, a so called woman athleteís phenotype may be female but genotype of a male and in the eyes of law the athlete is a male (and thus not eligible to compete in events exclusively meant for the females).

i. ***Genotype*** : In the epithelial cells of the female buccal cavity or vagina or leucocytes of the female, the nucleus may contain a chromatin mass which stains deeply with creayl violet, and has a diameter of about 1 mm. This is called Barr body. Presence of Barr body in the above mentioned cells indicates that the subject is genetically a female.

(In reality, Barr body says, there are at least XY chromosomes and more. Hence Barr body may also be seen in a Klinefelters syndrome).

ii. ***H-Y antigen-It's role in gonadal sex*** : On the chromosome a protein has been found out and is called H-Y antigen. It is now understood, that H-Y antigen is the key factor. If H-Y antigen is present, only then testis will develop in the fetus otherwise not. Thus, even in a fetus with a genothpe XY, if the H-Y antigen is missing there will be no formation of testis.

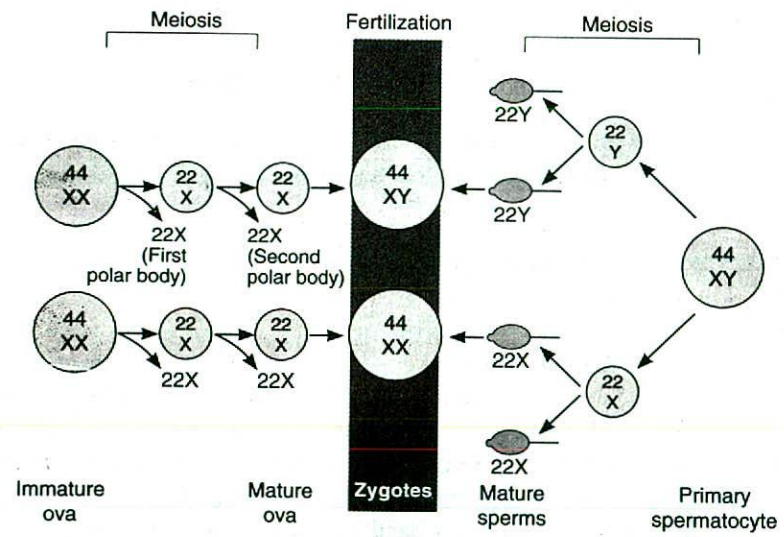

Fig. 9-1. Basis of genetic sex determination. In the two-stage meiotic division in the female, only one cell survives as the mature ovum. In the male, the meiotic division results in the formation of four sperms., two containing the X and two the Y chrosome. Fertilization thus produces a male zygote with 22 pairs of autosomes plus an X and a Y or a female zyggote with 22 pairs of autossomes and two X chromosomes.

Sex differentiation

Gonadal development : As stated earlier, when the Y chromosome and the H-Y antigen are present testes develop.

For the normal ovaries to be formed the fetus must have XX pattern.

Before the 6th week there is no gonadal development. Testes begin to be formed at the 7th week. Beginning of ovarian development occurs at the 9th week.

Phenotype Sex : In the early weeks, the embryo has two sets of ducts, viz, i. Mullerian duct and ii. Wolffian duct systems.

If on and from 8th week, the embryo does not get exposure to the effects of the embryonic testis i.e. if the fetal testes do not start to develop, as in XX genotype, the Mullerian system survives and the Wolffian ducts degenerate. On the other hand, if the embryo begins to be exposed to the effects of its own testes, on and from 8th week, the Wolffian system develops and the Mullerian ducts degenerate.

From the Wolffian ducts, the male accessory sex organs develop. From the Mullerian ducts the female accessory sex organs grow.

This means, that the natural tendency for the fetus is to develop female phenotype. Only when the testes are present, the accessory sex organs develop to form penis, prostate, seminal vesicles ctc. Thus, If in a genotype XY, the testis be removed around 7th week of intrauterine life, the new born will have fallopian tube, uterus, vagina and vulva, although its genotype will remain XY.

Mechanism of action of testis :

1. The embryonic testis produces a polypeptide hormone called, Mullerian duct inhibiting factor, which causes degeneration of the Mullerian duct.

2. On and from the 8th week, the embryonic testis begins to produce testosterone which directly causes development of the following structures.
   a. Seminal vesicle
   b. Vas deference
   c. Epididymis.

In some other structures of the accessory sex organs, testosterone is converted into dihydrotestosterons by an enzyme called 5th reductase. It is the dihydrotestosterone (and not the testosterone) that causes development of the rest of the accessory male sex organs, like : a. prostate, and b. penis. Therefore, testosterone ultimately speaking (i.e, directly or via dihydrotestosterone) causes development of all accessory male sex organs.

Although these growths start in embryonic life, they (i.e, the growth) again reappear with a gusto in the pubertal period. Some males have smaller size penis, while others have big size penis. It is possible that the smallness or bigness of the size of the penis due to the presence of too few or too many receptors for dihydrotestosterone and is no index of the sexual virility.

Brain and the sex differentiation : There are some anatomical and functional differences in between males and females in certain areas of the brain. Thus, in the embryonic life, when the fetal hypothalamus receives exposure to androgen (from its own testes) that is, in male fetus, it undergoes some changes due to which two important changes (in function) occur as follows :

i. When today's fetus becomes post pubertal boy, the pituitary gonadotropins are secreted constantly. Absence of androgenic exposure of the fetal hypothalamus causes it (i.e. the hypothalamus) to stimulate the anterior pituitary in a cyclic way. Therefore, in females, pituitary gonadotropins are secreted cyclically, so ovarian cyale and the menstrual cycles occur cyclically.

ii. If androgenic exposure occurs, on attaining post pubertal stage, the subject develops an attraction for females.

Some histological changes also occur (as a result of androgenic exposure of the fetal hypothalamus). These include some changes of the organelles within the cells of the hypothalamus.

Primary sex organ

It may be defined as the sex gland which are responsible for gametogenesis & controls the development & activity of accessory sex organ.

i. In male : Testes .
ii. In Female : Ovary.

Function of primary sex organ

1. Exocrine : Production of gamates (gamato genesis)
2. Endocrine : Production of hormone.
3. Controls the develop ment and activity of accessory sex organs.

Sex hormones

Sex hormones exert effects on reproductive function. In both sexes, the gonads secretes sex hormones.

i. *Androgens* are the steroid sex hormones that are masculinizing in their action.
ii. *Testosterone :* Secreted from testes.
ii. *Estrogens* are those that are feminizing. The ovaries secrete large amounts of estrogens.
iii. *Progesterone* : Secreted from ovaries, a steroid that has special functions in preparing the uterus for pregnancy.
iv. *Relaxin :* A polypeptide hormone, secreted from ovaries particularly during pregnancy, which loosens the ligaments of the pubic symphysis and softens the cervix, facilitating delivery of the fetus.
v. *Inhibin B* : A polypeptide that inhibits FSH secretion in both sexes.
vi. Aterior pituitary gonadotropins, FSH, and LH : The secretory and gametogenic functions of the gonads are both dependent upon them.

In males, gonadotropin secretion is noncyclic; but in postpubertal females an orderly, sequential secretion of gonadotropins is necessary for the occurrence of menstruation, pregnancy, and lactation.

(Q. 00. Name the sex hormones?) *(Ref. Ganong 22th Edition; P-411)*

Q. 00. **What are the gonadotropin? Where are they formed? Discuss their function & regulation of secretion.**

Ans.

i. Gonadotropins are gonad stimulaing hormones. They are FSH, and LH.
ii. *Secreted from* :
   a. FSH, and LH : anterior pituitary.
   b. Human chorionic gonadotropin : Placenta.
iii. *Function* : The secretory and gametogenic functions of the gonads are both dependent upon gonadotropin.
iv. *Regulation of secretion :* The sex hormone and inhibin B feed back to inhibit gonadotropin secretion.
   a. In males : gonadotropin secretion is noncyclic.
   b. *In postpubertal females* : an orderly, sequential secretion of gonadotropins is necessary for the occurrence of menstruation, pregnancy, and lactation.

(Q. Name the gonadotropins) *(Ref. Ganong 21th Edition; page-415)*

Inhibin

The hormone inhibin is a glycoprotein, like both LH and FSH, having a molecular weight between 10,000 and 30,000.

Source and function :

a. *Sertoli cells of testis* : Inhibin has a strong direct effect on the anterior pituitary gland in inhibiting the secretion of FSH

and possibly a slight effect on the hypothalamus in inhibiting secretion of GnRH.

Its potent inhibitory feedback effect on the anterior pituitary gland provides an important *negative feedback mechanism for control of spermatogenesis*, operating sirnultaneously with and in parallel to the negative feedback mechanism for *control of testosterone secretion.*

(Ref. Guyton & Hall-11th Edition; page 1007)

ii. *Luteal cells* : Secrete small amounts of the hormone inhibin. Inhibin inhibits secretion by the anterior pituitary gland, especially FSH secretion. As a result, both FSH and LH in the blood fall to low concentrations, and loss of these hormones finally causes the corpus luteum to degenerate completely, a process called *involution of the corpus luteum.*

Final involution normally occurs at the end of almost exactly 12 days of corpus luteum life, which is around the 26th day of the normal female sexual cycle, 2 days before menstruation begins. At this time, sudden cessation of secretion of estrogen, progesterone, and inhibin by the corpus luteum removes the feedback inhibition of the anterior pituitary gland, allowing it again to begin secreting increasing amounts of FSH and LH. The FSH and LH initiate growth of new follicles, to begin a new ovarian cycle. And the paucity of secretion of progesterone and estrogen at this time also leads to menstruation by the uterus.

(Ref. Guyton & Hall-11th Edition; page 1015)

Puberty

i. *Definition* : The onset of reproductive life is called puberty. It is the time when the endocrine and gametogenic functions of the gonads have first developed to the point where reproduction is possible.

ii. *Age of onset* : It occurs about two year earlier in female.
   a. In girls, it starts in 8-13 yrs.
   b. In boys, it starts in 9-14 yrs.

(Ref. Ganong 22th edition; page 418)

iii. *Factors influce the onset of puberty* : The onset of puberty is greatly influenced by :
   a. Heriditary factor
   b. Environmental factor
   c. Nutritional status
   d. Hormonal factor.

iv. *Probable mechenisms initiating puberty are* :
   a. Withdrawl of central inhibition of GnRH release.
   b. Release of sufficient amounts of pituitary gonadotropins under the influence of hypothalamic GnRH.

v. *Gross changes at puberty* :
   a. Enlargement of testes and genitalia (boys).
   b. Breast bud enlargement ii girls.
   c. Pubic and axillary hair growth.
   d. Begining of meanstruation i.e mnarche in girls.
   e. Change of voice etc.

Precocious puberty

i. Definition : Development of menarche (girls) or secondary sex characteristics (boys) before the age of 9 years is premature, and called precocious puberty.

ii. *Characteristics* :
   a. Premature breast and pubic hair development
   b. Puberty starts too early, but otherwise normal pubertal pattern (gametogenesis is possible).

iii. Cause :
   a. Most frequently caused by hypothalamic disease i.e. withdrawal of inhibition of GnRH release.

Precocious pseudopuberty

Early development of secondary sexual characteristics without gametogenesis due to abnormal exposure of immature male to androgen, or females to estrogen is called precocious puberty.

Delayed puberty

Failure of testicular development by the age of 20 or menarche has fail to occur by the age of 17 is termed as delayed puberty.

Some important terms :

i. ***Thelarche*** : the devdlopment of bresat.

ii. ***Pubarche*** : The development of axillary and pubic hair.

iii. ***Menarche*** : The first menstrual peroid.

iv. ***Adrenarche*** : An increase in the secretion of adrenal androgens at the time of puberty.

(Ref. Ganong 22th Edition; page 419)

Clinical

Klinefelter's syndrome

Klinefelter's syndrome is the most common sex *chromosomal disorder*. The people have genitalia of normal male.

i. *Incidence* : 1 in 1000 males.

ii. *Characteristics* :
   a. *Karyotype* : 47 XXY
      Total 47 chromosome instead of the normal 46; extra chromosome is X chromosome.
   b. *Phenotype* : Male often with gynaecomastia i.e. enlargement of male breast.

iii. *Features* :
   a. Gonads : Small testes
   b. Poorly developed secondary sexual charac- teristics
   c. Infertility
   d. Mental retardation.

Turner's syndrome.

Turner's syndrome is a sex chromosome monosomy *(chromosomal disorder)* in which indivi duals have an X

chromosome only and no second X or Y chromosome.

i. *Incidence* : It occurs in 1 in 2500 females.

ii. *Characteristics* :
   a. *Karyotype* : 45 XO
      Total 45 chromosome instead of the normal 46; deficit of a X or Y chromosome.
   b. *Gonads* : rudimentary or absent
   c. *Phenotype* : female.

iii. *Features* :
   a. The affected person develops female external genitalia
   b. Short stature
   c. Webbed neck
   d. Increase carrying angle
   e. Loss of secondary sexual characteristics
   f. Primary ammenorrhoea
   d. Coarctation of aorta.

Trisomy X *(triple X syndrome).*

Trisomy X is a sex chromosomal disorder.

i. *Incidence* : occurs 1 in 12000 females.

ii. *Characteristics* :
   a. Karyotype : 47 XXX
      Total 47 chromosome instead of the normal 46; 1 extra X chromosome.
   b. Phenotype : female
   c. Usually asymptomatic; but in 20% cases mild mental retardation.

Double Y syndrome.

Double Y syndrome is a sex chromosomal disorder.

i. *Incidence* : Occurs in 1 in 800 males.

ii. *Characteristics* :
   a. Karyotype : 45 XYY
      Total 47 chromosome instead of the normal 46; excess of a Y chromosome.
   b. Phenotype : male

iii. *Features include* :
   a. Tall stature
   b. Fertile
   c. Minor mental and psychiatric illness
   d. High incidence of criminal activities.

Down's syndrome *(Trisomy 21)*

Down syndrome is the most common *autosomal disorder*. Cells bear extra copy of chromosome because of nondisjunction either in the first or second meiotic division- hence called *trisomy 21.*

i. *Incidence* : occurs 1 in 700 live births.

ii. *Characteristics* :
   a. Karyotype : 47 + 21
      Total 47 chromosomc instead of the normal 46; there is an extra chromosome 21.

iii. *Features* :
   a. Flat facies
   b. Slanting eyes
   c. Low set ears
   d. Epicanthic fold
   e. Simian crease (single palmer crease)
   f. Short stubby tingers
   g. Hypotonia
   h. Variable mental retardation
   i. IQ less than 50
   j. Congenital heart disease
   k. Love music.

True hermaphroditism.

Nondisjunction may occur during the early mitotic divisions after fertilization- which results in the production of *mosaic* (patient with two different cell lines with different chromosome complements).

True hermaphroditism is the condition in which an individual have both the testes and ovaries and is probably due to XX/XY mosaicism.

i. *Characteristics* :
   a. Karyotype : 46 XX/XY mosaic
   b. Phenotype : Male or ambiguous
   c. Gonads : Testes and ovaries.

Q. 00. **What are the hormonal abnormalities in sexual differentiation?**

Ans. Abnormalities in the action of androgens, Mullerian regression factor (MRF), and testosterone during developmental period may cause following disorders :

i. Female hermaphroditism
ii. Male hermaphroditism
iii. Testicular feminizing syndrome.

A pseudoherrmaphrodite is an individual with the genetic constitution and gonads of one sex and the genitalia of the other sex.

Female hermaphroditism : Development of male external genitalia in genetic female is called female hermaphroditism.

1. *Characteristics* :
   a. Karyotype : 46 XX (i.e. genetic female)
   b. Phenotype : Female with male external genitalia.
   b. Gonads : ovary.
2. *Cause* : Genetic female exposed to androgens during the 8^{th} - 13^{th} weeks of gestation

Male hermaphroditism : Development of female external genitalia in genetic male is called male hermaphroditism.

1. *Characteristics* :
   a. Karyotype : 46 XY (i.e. genetic male)
   b. Phenotype : Male with female external genitalia.

c. Gonads : Testes.

2. *Causes* :
   a. Androgen resistance
   b. Defective embryonic testes.

Testicular feminizing syndrome : It is a condition due to defective androgen receptor in which rhe external genitalia are female, but the vagina ends blindly because there are no female internal genitalia.

Important criteria are :

a. Karyotype : 46 XY
b. Phenotype : Ambiguous or infantile female
c. Gonads : Testes
d. Features :
   - Breast enlargement at puberty
   - No menstruation.

Male Reproductive System

Male Sex Organs

A. *Primary sex organ :* Testes

Functions : Testis acts as a mixed gland. It performs both exocrine and endocrine functions.

i. Exocrine : Spermatogenesis (Production of spermatozoa.
ii. Endocrine : Production of Testosterone.

B. *Accessory sex organs :*

1. Penis with Scrotum.
2. Prostate.
3. Seminal vesicle.
4. Urethra.
5. Epididymis.
6. Vas deference.
7. Ejaculatory duct.
8. Bulbo-urethral gland.

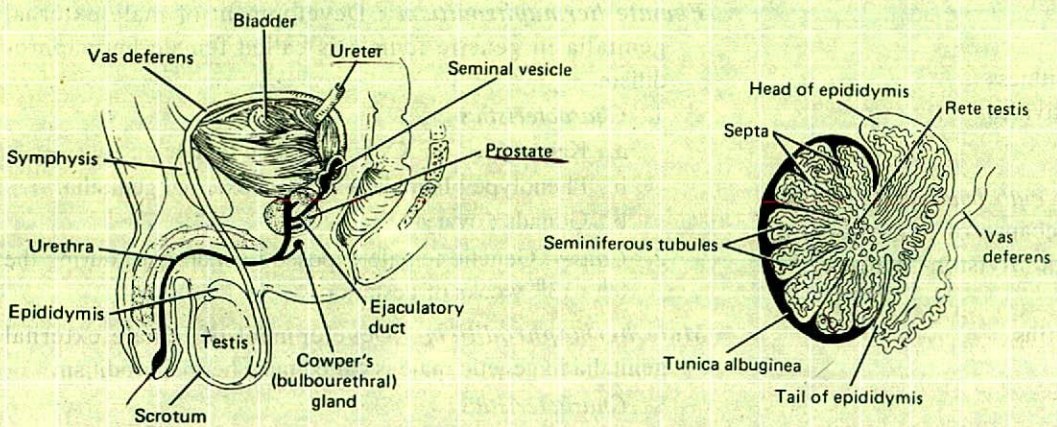

Fig. 9 -2. *Left : Male Reproductine System; Right : Duct system of the testis.*

Testes

Structure of testes : The testes are made up of loops of Seminiferous tubules, in the walls of which the spermatozoa are formed from the primitive germ cells (Spermato -genesis). Both ends of each loop drain into a network of ducts in the head of the epididymis. From there Spermatozoa pass through the tail of the epididymics into the vas deferens. They enter through the ejaculatory ducts into the urethra in the body of the prostate at the time of ejaculation.

Between the tubules in the testes are nests of cells containing lipid granules, the interstitial cells of Leyding which secrets testosterone into the blood stream.

The spermatic arteries to the testes are tortous, and blood in them runs porallel but in the opposite direction to blood in the pampiniform plexus of spermatic veins. This anatomic arrangement may persist countercurrent exchange of heat and testosterone.

Blood Testes Barrier

The walls of the seminiferous tubules are lined by primitive germ cells and by sertoli cells -large, complex glycogen-containing cells that stretch from the basal lamina of the tubule to the lumen. Tight junction between adjacent sertoli cells near the basal lamina form a *blood-testis barrier* that prevents many large molecules from passing from the interstitial tissue and the part of the tubule near the basal lamina (basal compartment) to the resion near the tubular lumen (adluminal corpartment) and the lumen. How ever steroids penetrate this barrier with ease and there is evidence that some proteins pass from the sertoli cells to the leyding cells and vice versa in a paracricu fashion. In addtion, maturing germ cells must pass through the barrier as they move to the lumen. This appears to occur without disruption of the barrier by progressive break down of the tight junctions above the germ cells, with concomitant formatrom of new tight junction below them.

The fluid in the lumen of the seminiferous tubules is quite different from plasma; it contains very little protein and glucose but is reach in androgens, estrogens, K^+, inositol, and glutamic and aspartic acids. Maintenance of its composition presumably depends on the blood testes-barrier. The barrier also protects the germ cells from blood-born noxious agents, prevents antigenic products of germ cell division and maturation from entering the circulation and generating an

autoimmune response, and may help establish an osmotic gradient that fascilitates movement of fluid into the tubular lumen.

Secondary sexual characteristic of male

1. *External genitalia* : Penis increase in length and width, scrotum become pigmented and rugose.
2. *Internal genitalia* : Seminal vesicles enlarge and secrete and begin to form fructose. Prostate & bulbourethral gland enlarge and secrete.
3. *Voice* : Larynx enlarges; vocal cord increase in length and thickness, and voice becomes deeper.
4. *Hair growth :*
   i. Beard appears. Hair line on scalp recedes anterolaterally.
   ii. Pubic hair grows with male (triangle with apex up) pattern.
   iii. Hair appears in axilla, on chest and arround the anus. Genera body hair increase.
5. *Mental changes* : *More agressive, active attitude,* interest in opposite sexdevelops.
6. *Body conformation* : Shoulder broden, muscle enlarge.
7. *Skin* : Sebaceous gland secretion thickens and increases (predisposing to acne).

(Ref. Ganong 22th edition, Page-430).

Male Hormonal system

Male hormonal system consists of three hierarchies of hormones as follows :

1. Hypothalamic hormone :
   a. Gonadotropin-releasing hormone (Gn RH), Previously also called luteinizing hormone releasing hormone.
2. Anterior pituitary hormones :
   a. Luteinizing hormone (LH) : Luteinizing hormone is the primary stimulus for the secretion of testosterone by the testes.
   b. Follicle stimulating hormone (FSH) : FSH mainly stimulates spermatogenesis.
3. Hormones of the testes :
   a. Testosterone (Secrects from interstitial cells of leyding)
   b. Inhibin (Secrects from the sertoli cells)

Reproductive function of male

1. Spermatogenesis, which means simply the formation of sperm.
2. Performance of the male sexual act.
3. Regulation of male reproductive functions by the various hormones.

(Ref. Guyton & Hall-11th edition; page 996)

Function of male reproductive hormones

1. Spermatogenesis, which means simply the formation of sperm.
2. Performance of the male sexual act.
3. Regulation of male reproductive functions by the various hormones.

Associated with these reproductive functions are the effects of the male sex hormones on the accessory sexual organs, cellular metabolism, growth, and other functions of the body.

(Ref. Guyton & Hall-11th edition; page 996)

Spermatozoa

Spermatozoa consists of-

i. Head
ii. Neck
iii. Body
iv. Tail.

Head : Oval in shape. The head is a condensed nucleus about 40 % DNA and rich in arginine. The nucleus is covered in its anterior-twothird by acrosome. The acrosome is formed by golgi apparatus and can liberate a chemical substance, hialuronic acid which enables the sperm to pierce the zona pellucida of ovum.

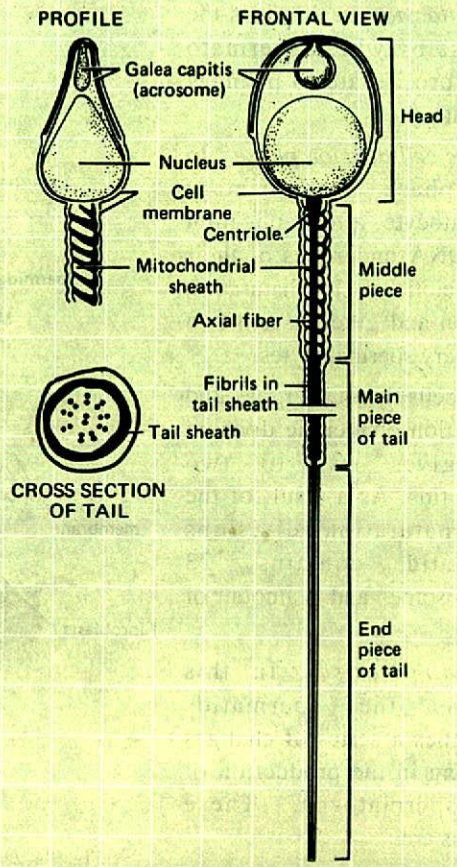

Fig. 9-3. *Structure of the human spermatozoan.*

Neck : Short, connecting the head with body. In the neck the axial filaments consist of three bundles of fibrils which connect the three basal granules.

Body : It is cylindrical in form and is the engine room of spermatozoon. In which cisternae mitrocondrialis are found.

Tail : It has three major component -

a. A central skeleton constructed of 11 microtubules, collec- tively called axoneme.
b. A thin cell membrane covering the axoneme.
c. A collection of mitrochondria surrounding the axoneme.

Gametogenesis

Gametogenesis is the process in which both male and female germ cells undergoes a number of chromosomal and morphological changes in the preparation for fertilization.

(Ref. Lang Man 5th Page 16)

Spermatogenesis

Spermatogenesis is the maturation process from primitive germ cell to mature gamate in male.

(Ref. Lang Man 5th Page 17)

Stages of spermatogenesis : Spermatogenesis has three different stages :

i. *Spermatocytogenesis :* It is the process by which spermato gonia proliferate to primary spermatocyte.

ii. *Meiosis cell division phase :* In this phase the primary spermatocyte, after replication their DNA undergoes of their first meiotic or, 1st maturation division and gives rise to two secondary spermatocytes.

These cells then undergoes 2nd maturation or meiotic division and gives rise to two spermatids. As a result of the two maturation divisions spermatid contains 23 chromosomes and n amount of DNA.

iii. *Spermiogenesis :* In this process the spermatids undergoes a series of changes resulting in the production of the spermatozoa. These changes are :

a. Formation of acrosome.
b. Condensation of nucleus.
c. Formation of neck, middle piece & tail.
d. Sheding of most of the cytoplasm.

(Ref. Lang Man 5th page 14-15)

Hormonal regulation of spermatogenesis :

1. *Testosterone :* Secreted by the Leyding cells located in the interstitium of testis, is essential for growth and division of germinal cells in forming sperm.
2. *Lutenizing hormone (LH) :* Secreted by anterior pituitary gland and stimulate the Leydig cell to secrete testosterone.
3. *Follicle stimulating hormone (FSH) :* Secreted by the anterior pituitary gland, stimu-late the sertoli cells and without this stimulation the conversion of the spermatids to sperm (the process of spermiogenesis) will not occur.
4. *Growth hormone :* Growth hormone specifically promotes the early division of spermatogonia and also maintain the metabolic function of testis.
5. *Estrogen :* Formed from testosterone by the Sertoli cells when they are stimulated by FSH, are probably essential for conversion of the spermatids to sperm (Process of spermioenesis) and helps in maturation of sperm.

(Ref. Guyton & Hall-11th edition; page 998)

Diagramatic representation of spermatogenesis : Spermato-

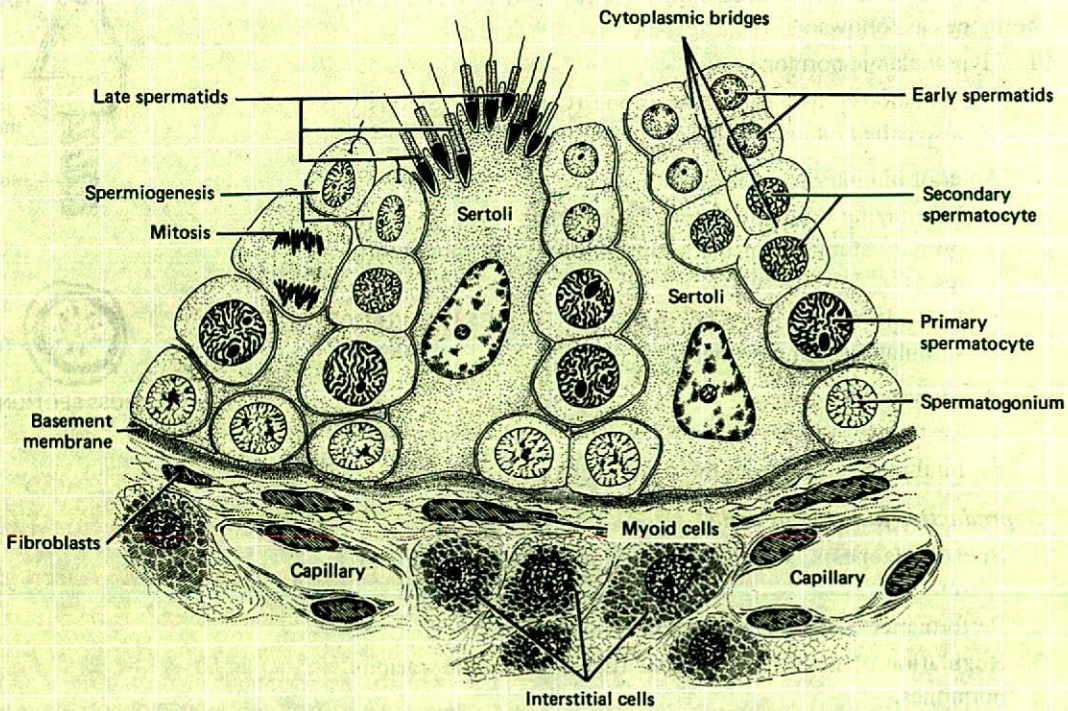

Fig. 9-4. *Diagramatic representation of spermatogenesis. Seminiferous epithelium-- mature germ cells remain connected by cytoplsmic brodges through the early spermatid stage and that these cells are closely invested by Sertoli cell cytoplasm as they move from the basal lamina to the lumen.*

gonia → Primary spermatocyte → 2ndary spermatocyte → Spermatid → Spermatozoa.

Diagramatic regulation of spermatogenesis

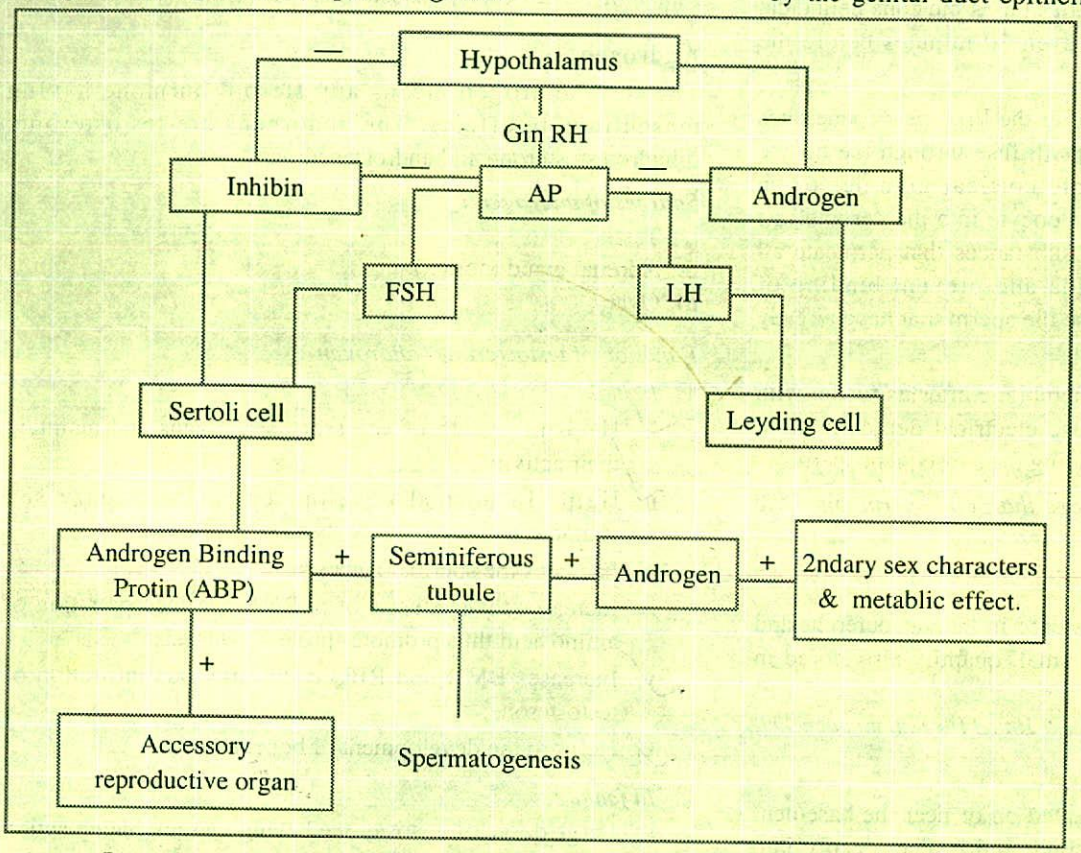

Fig : 9-4. *Digramatic Regulation of spermatogenesis.* *(Ref. Selkert 5th page 648)*

Maturation of sperm (in the epididymis) :

It is the process by which newly formed non-motile young un-fertile sperm become motile and get the capacity for fertilization.

Following formation in the seminiferous tubules, the sperm require several days to pass through the 6-meter-long tubule of epididymis. Sperm removed from the seminiferous tubules and from the early portion of the epididymis are completely non-motile and they can not fertilize the ovum. However, after the sperm have been in the epididymis for some 18 to 24 hours also become capable of fertilizing the ovum; if placed in the uterus.

The Sertoli cells and the epithelium of the epididymis secret a special nutrient fluid containing hormones (both testosterone and oestrogen), enzymes and special nutrients that may be important or even essential for sperm maturation.

(Ref. Guyton & Hall-11th edition; page 999)

Capacitation of sperma tozoa

It is the process by which the sperm develop capability to penitrate the granulosa cell that cover the ovum after deposited into the female genital tract.

Mechanism of capacitation : Although the sperma tozoa are said to be "mature" when they leave the epididymis, their activity is held in check by multiple inhibitory factors secre ted by the genital duct epithelia. Therefore, when they are first expelled in the semen, they are unable to perform their duties in fertilizing the ovum. However, on coming in contact with the fluids of the female genital tract, multiple changes occur that activate the sperm for the final processes of fertilization. These collective changes are called capacitation of the spermatozoa. This normally requires from 1 to 10 hours. Some changes that are believed to occur are the following.

1. The uterine and fallopian tube fluids away the various inhibitory factors that had suppressed sperm activity in the male genital ducts.
2. While the spermatozoa remained in the fluid of the male genital ducts, they were continually exposed to many floating vesicles from the seminiferous tubules containing large amounts of cholesterol. This cholesterol was continually donated to the cellular membrane covering the sperm acrosome, toughening this membrane and preventing release of its enzymes. After ejacu- lation, the sperm that are deposited in the vagina swim away from the cholesterol vesicles upward into the uterine fluid, and they gradually lose much of their excess cholesterol over the next few hours. In so doing, the membrane at the head of the sperm becomes much weaker.
3. The membrane of the sperm head also becomes much more permeable to calcium ions, so that calcium now enters the sperm in abundance and changes the activity of the flagellum, giving it a powerful whiplash motion in contrast to its previously weak undulating motion. In addition, the calcium ions probably cause changes in the intracellular membrane that covers the leading edge of the acrosome, making it possible for the acrosome to release its enzymes rapidly and easily as the sperm penetrates the granulosa cell mass surrounding the ovum and even more so as it attempts to penetrate the zona pellucida of the ovum itself.

Thus, multiple changes occur during capacitation. Without them, the sperm cannot make its way to the interior of the ovum to cause fertilization. *(Ref. Guyton & Hall-11th ed, page 1000)*

Q. **Why does only one sperm enter the oocyte?**

Ans. The reason is not entirely known, but some of the facts are the following.

1. *First,* only a few sperm ever get as far as the zona pellucida, so that it might be 10, 20 or even 30 minutes before the second sperm arrives.
2. *Second,* within a few minutes after the first sperm penetrates the zona pellucida, calcium ions diffuse through the oocyte membrane and cause multiple cortical granules to be released by exocytosis from the oocyte into the perivitelline space. These granules contain substances that permeate all portions of the zona pellucida and prevent binding of additional sperm and even cause the sperm that have already bound to fall off.
3. *Third,* changes in the oocyte membrane after its fusion with the sperm are believed to cause electrical depolarization; this, too, may play a role in fending off subsequent sperm.

At any *rate, almost never does more than one sperm enter the oocyte during fertilization.*

Storage of sperm

Following maturation sperms are stored in the vas deferens and the ampulla of vas deferens but a small quantity also stored in the epididymis.

(Ref. Guyton & Hall-11th edition; page 999)

Sertoli cells

Are quite few in numbers and situated on or near the basement membrane of the seminiferous tubule and project deeply into the lumen. They are also known as sustentacular cells, nurse cells, foot cells or branched cells. These cells have a large vesicular nucleus with a characteristic nucleus. The cells contain quite large amount of glycogen. The membranes of the sertoli cells are tightly adherent to each other at their bases, forming a barrier, called *blood-testis barrier.*

Function of cells of Sertoli :

1. It provide appropriate nutrients for the developing and newly formed sperm.
2. It provide a special fluid environment in which germinal cell develops.
3. It helps in convertion of spermatid to sperm (the process of spermiation).
4. Sertoli cell secretes-
   i. Mullerian inhibitory factor
   ii. Estradiol
   iii. Inhibin.

(Ref. Guyton & Hall-11th edition)

Interstitial cells of Leyding : The Leydig cells lie in the interstices between the seminiferous tubules and constitute about 20% of the mass of the adult testes. Leydig cells are almost non-existent during childhood, but they are numerous in the newborn male infant and also in the adult male after puberty.

Function : They secret testosterone.

Androgen

The term androgen means any steroid hormone having masculinizing effects. The andorgens are-testosterone, dihydrotestosterone and androstenedione.

Sources of androgen :

i. Testis
ii. Adrenal gland (cortex).
iii. Ovary

Function of testosterone (androgen)

1. *In male :*
   i. Helps in growth of accessory sex organs and maintain their activity.
   ii. Helps in normal development of secondary sex characters.
   iii. Facilates the spermatogenesis.
   iv. Increases the synthesis of m RNA and incorpo ration of amino acid thus promotes protein synthesis.
   v. Increases BMR and RBC count after administration of testosterone.
   vi. Helps in the development of bone, muscle.
2. *In female :*
   i. Large doses of testosterone having masculi nizing action like enlargement of clitoris, and growth of hair on the face.
   ii. Inhibit the pituitary function as in male.
3. *In male foetus :*
   i. It is responsible for the sex determination and development of male external genitalia.
   ii. Helps in the descent of testes during foetal life.

Semen

It is the fluid, which is ejaculated during male sextual act is composed of the fluids from the vasdeference, prostate, seminal vesicle and from the mucous gland, especialy bulbourethral gland.

Characteristic of semen :

Colour	:	White, opalescent.
Specific gravity	:	1.028
PH	:	7.35 -7.50
Amount	:	2-4 ml/ejaculation.
Sperm count	:	Average 100 million/ml, with fewer than 20% abnormal forms.

Composition of semen :

I. Sperm : Average 100 million/ml, with fewer than 20% abnormal forms.

II. *Other components* :

i. From seminalvesicle contribute 60% of total volume
   a. Fructose (1.5-6.5 mg/ml)
   b. Phosphorylcholine
   c. Ergothioneine
   d. Ascorbic acid
   f. Flavins.
   g. Prostaglandins

ii. From prostate (Contribute 20%of total volume)
   a. Spermine
   b. Citric acid
   c. Cholesterol, phospholipids
   d. Fibrinolysin, fibrinogenase,
   e. Zinc
   f. Acid phosphatase
   g. Phosphate (PO_4^{-3})
   h. Bicarbonate (HCO_3^-) Buffer
   i. Hyaluronidase.

***Speed** : Human sperms move at a speed of about 3 mm/minute through the female genital tract. Sperms reach the uterine tubes 30-60 minutes after copulation.*

(Ref. Ganong 22th edition, Page 427)

Effect of sperm count on fertility : The usual quantity of semen ejaculated during each coitus averages about 3.5 milliters, and in each milliliter of semen is an average of about 120 million sperm, although even in normal males this can vary from 35 to 200 million. This means an average total of 400 million sperm are usually present in the several milliliters of each ejaculate. When the number of sperm in each milliliters falls below about 20 million, the person is likely to be infertile.

Thus even though only a single sperm is necessary to fertilize the ovum, for reasons not understood, the ejaculate usually must contain a tremendous number of sperm for only one sperm to fertilize the ovum.

(Ref. Guyton & Hall-11th edition; page 1001)

Prostatic fluid

The Prostate gland secreates a thin, milky, alkaline fluid which increases the volume of semen.

i. *Composition of prostatic fluid :* Citrateion, Calcium ion, Acid phosphate ion, a clotting enzyme, a profibrinolysin.

ii. *Function of prostatic fluid :*
   1. It adds the bulk of semen.
   2. Its alkalinity neutralizes the acidity of the vaginal fluid (P^H 3.5 to 4.0) and the fluid of vas deference enhances the motility and fertility of the sperm.

(Ref. Guyton & Hall-11th edition; page 999)

Seminal fluid

Seminal vesicles secrete a mucoid materials which increases the volume of semen.

i. *Composition of seminal fluid :* An abundance of fructose and other nutrient substance as well as large quantities of prostaglandin & fibrinogen.

ii. *Function of seminal fluid :*
   a. It adds greatly the bulk of semen about 60%.
   b. Fructoes and other nutrients provide nutrient to the ejaculated sperm until one of them fertilizes the ovum.
   c. Prostagladins aid fertilization by :
      1. Reacting with cervical mucus to make it more receptive to spermmovement.
      2. Causing reverse peristaltic contraction in the uterus and fallopian tubes to move the sperm toward the ovaries.

(Ref. Guyton & Hall-11th edition; page 999)

Sterility

Sterility means loss of reproductive capacity.

Cause of sterility :

i. Failure of erection of penis
ii. Failure to discharge sufficient quantity of semen
iii. Less sperm count (below 60 million in per ejaculation)
iv. Presence of more than 20% abnormal sperm in semen.
v. Impairment movement of sperm due to-
   a. Genital infection
   b. Malnutrition
   c. Acidic P^H
vi. Absence of hyaluronidase in the head acrosome.

Impotancy

Inability to perform sexual intercourse i,e. failure to erection of penis.

Cause of impotancy :

i. Malnutrition
ii. Mental unability
iii. Genital infection
iv. Excessive utilization.

Castration

Removal of testis is known as castration.

Effect of castration : The effects are variable in different subjects. Some effects are more pronounced than others. These changes are :

i. Seminal vesicle and prostate atrophy as its development and maintenance depend on the secretion of testosterone which is lacking.
ii. Loss of sexual desire and activities in most subject, those these persist in few.

iii. Falliny of hair occurs along with the tendency to baldness sparseness of beard and moustache and recession of convex hair margins of the pubis.
iv. Sometimes femine deposition of fat occurs.
v. No change in the size of penis.
vi. No change in the voice.
vii. Psychological upset in conveniences the subject greatly.

Eunuchism

It is a condition when a boy loses his testes prior to puberty. In which he continues to have infantile sexual characteristics through out life. The height of the adult eunuch is slightly greater than that of the adult man, although the bones are quite thin, the muscles are considerably weaker than normal man, the sexual organs and secondary sexual characterstics remain those of a child. The voice is child like, there is no loss of hair on head and the normal musculine hair distribution on the face and else where does not occur.

(Ref. Guyton & Hall-11th edition)

Adiposogenital syndrom

It is a condition in which severe obesity develops along with eunuchism. It is also called *Frohlich's syndrom* or *hypothalamic eunuchism.*

Damage of certain areas of the hypothalamus greatly decreases gonadotropic hormone secretion and stimulates feeding center, causing the person to greatly overeat. Consequently the person develops severe obesity along with enuchism. This phenomenon is called adiposogenital or Frohlich's syndrom.

(Ref. Guyton & Hall-11th edition)

Chryptorchidism

It means failure of a testis to descend from the abdomen into the scrotum. During late stages of gestation (about 3 weeks to 1 month before the birth of the baby) the testes descend from abdomen through the inguinal canal into the scrotum. Occasionally this descent does not occur at all or occurs incompletely, So that one or both testes remain in the abdomen, in the inguinal canal or elsewhere along the route of descent.

Condtion of chrytorchidism : In chryptorchidism, the testicle is incapable of forming sperm. Few degree higher temperature in the abdomen than the scrotum is enough to cause degeneration of the tubuler epithelium and consequently to cause sterility.

(Ref. Guyton & Hall-11th edition)

Male Sexual Act

Sources of male sexual stimulation : These are areas or events from where sexual stimulation arises :

1. Glans penis .
2. Adjacent to penis.
3. Anal epithelium, the scrotum and perineal structures etc.
4. Internal structures such as- Urethra, the bladder, prostate, seminal vesicles, testes and the vas deferens, when irritated.
5. Filling of the sexual organ with secretion.
6. Infection and inflammation of the sexual organs.
7. 'Aphrodisiac' drugs- comtharides etc.
8. Psychic elements- Sexual thinking or dreaming, visual stimuli etc.

(Ref. Guyton & Hall-11th edition; page 1001)

Stages of male sexual act : It is divided into following stages :

a. Erection
b. Lubrication
c. Emission & Ejaculation.

Erection : Erection is the 1st effect of male sexual act and the degree of erection is directly proportional to stimulation. It is a vascular phenomenon and is controlled by parasympathetic (S 2, 3, 4) With sufficient stimulation the helicine arteries dilates and engorment of the sinuses of the penis along with venous retardation also occcur.

Lubrication : During sexual stimulation the para sympathetic impulses, cause the bulbourethral and urathral glands to secrete mucous which lubricates female genitalia during copulations.

Emission & ejacualtion :

a. *Emission :* It is the process of secretion of semen into the urethra.
b. *Ejaculation proper :* It is the process of propulsion of semen out of the urethra by the contraction of urogenital muscles.

Emission and ejaculation are the culmination of male sexual act. When the sexual stimulus are extrimely intense, the sympathetic impulse (L_1 & L_2) pass to the genital organ to initiate emission and ejaculation.

(Ref. Guyton & Hall-11th edition; page 1002)

Clinical

Teratoma : Tumors of the germinal epithelial cell. Germinal cells are capable of differentiating in to many type of cell and so this tumour contain multiple tissues, such as placental tissue, hair, teeth, bone, skin and so forth.

(Ref. Guyton & Hall-11th edition; page 1009)

Gynaecomatia : Over growth of male breast is called Gynaecomatia. *Cause :* When teratoma in male contain significant amount of placental tissue, the tumour may secrete large quantities of chorionic gonodrtropin hormone and also oestrogen, which then cause overgrowth of breast.

(Ref. Guyton & Hall-11th edition; page 1009)

Clitmacteric : The decrease in male sexual function is called male climetric.

Symptoms : Occasionally it is associated with symptoms of

a. Hot flashes
b. Suffocation

c. Psychic disorders etc.

Characteristics :

a. Progressive loss in sexual function with reduction in morning erections and frequency of intercourse.
b. Testicular volume diminished
c. FSH and LH levels gradually rise.

(Ref. Guyton & Hall-11th edition; page 1008)

Q. Why spermatogenesis does not occurs before puberty?

Ans. Because before puberty hypothalamus remains dormant and does not secrete leutinizing hormone releasing factor (LHRF).

So, that anterior pituitary cannot secret LH and Leydig cell can not stimulated for secretion of androgen, as a result seminiferous tubule can not produce spermatogonia.

(Ref. Guyton & Hall-11th edition)

Effects of removal of testes before puberty

The following changes take place and all of are due to lack of testicular hormone :

i. Lack of development of accessory organs of reproduction e.g, penis, scrotum, seminal vesicle and prostate do not grow and remain infantile.
ii. Complete failure of reproductive cycle and permanet sterility.
iii. Lack of development of secondary sexual characters e.g. Lack of hair growth over face, trunk and axilla So, no beard or moustache and the pubic hairs become sparse and female type (outline become concave instead of convex).
iv. There is no change in the larynx, so the voice does not deepen.
v. Deposition of fat occurs and takes a femine deposition (Buttocks, Hip, Pubis, Breasts).
vi. Lack of muscular development i,e. these are less developed and flabby.
vii. Delay in union of epiphysis, incre- ase in the height (limbs are longer in proportion to trunk)
viii. Skin is pale and tansletile when exposed to suns rays.

Effect of removal of testes after puberty

The effects are variable in different subjects. Some effects are more pronounced than others.

These changes are :

i. Seminal vesicle and prostate atrophy as its development and maintenance depend on the secretion of testosterone which is lacking.
ii. Loss of sexual desire and activities in most subject, those these persist in few.
iii. Falling of hair occurs along with the tendency to baldness sparseness of beard and moustache and recession of convex hair margins of the pubis.
iv. Sometimes feminine deposition of fat occurs.
v. No change in the size of penis.
vi. No change in the voice.
vii. Psychological upset in conveniences the subject greatly.

Female Reproductive System

Female reproductive organs : The female reproductive organs are classified in to two groups :

A. *Primary sex organs :* Ovary
B. *Accessory sex organs :*
   1. External geni talia (valva)
   2. Vagina
   3. Uterus
   4. Uterine tube
   5. Bartholins gland.

Female Hormonal system

1. *A hypothalamic releasing hormone :*
   a. Gonadotropin releasing hormone (Gn RH), previously also called luteinizing hormone-releasing hormone.
2. The anterior pituitary hormones : Which are secreted in response to the releasing hormone GnRH from the hypothalamus.
   a. Follicle stimulating hormone (FSH)
   b. Luteinizing hormone (LH).
3. Ovarian hormones : Which are secreted by the ovaries in

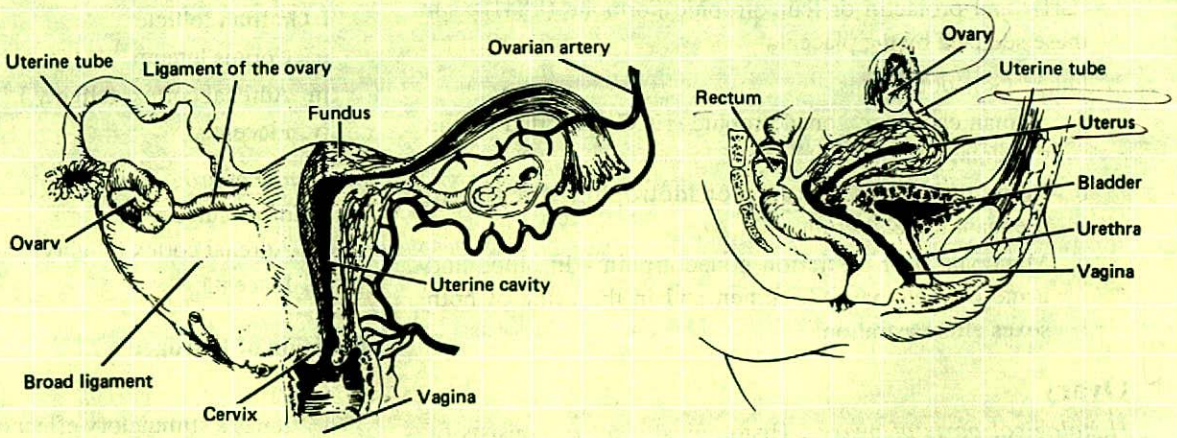

Fig. 9-5. *Female Reproductive System.*

response to the two hormones from the anterior pituitary gland.

a. Estrogen (secreted by the graafian follicles and corpus luteum).
b. Progesterose (Secreted by the corpus luteum)
c. Inhibin (Granulosa cells of the corpus luteum).

(Ref. Guyton & Hall-11th edition; page 1011)

Secondary sexsual character of female

i. Onset of menstrua tion.
ii. Enlargement of breast.
iii. Change in voice (high pitched low frequency)
iv. Maturation of female sex organs.
v. Appearance of pubic and axillary hair.
vi. Enlargement of pelvis in all diameter (Gynaecoid pelvis)
vii. Feminine distribution of subcutaneous fat.
viii. Attraction to the oposite sex.

Phases of reproduction in female

There are two phases :

1. Preparation of the female body for conception and gestation.
2. The period of gestation.

(Ref. Guyton & Hall-11th edition)

Q. **What is sex hormone? Do you think FSH & LH are sex hormone?**

Ans. Hormones which bring about the changes of sex character of male and female is called sex hormone.

Indirectly FSH and LH are sex hormone. Because these bring about the changes in the sex character through gonad. Actually these are gon adotropic hormone.

Gonadotrophic hormone

The Gonadotrphic hormones are so named, because they have profound actons on the gonads and sexual activities of both sex.

They include :

1. Follicle stimulating hormone (FSH), Luteininzing hormone (LH) and prolactin or leuteotrophic hormone (LTH)- all these seereted by the placenta.
2. Other Gonadotrophins -
   a. Human chorionic gonadotrophic (HCG) - secrted by the placenta.
   b. Pregnant mare's serum gonadotrophin -Presant in pregnant mare's serum.
   c. Manopausal or castration gonadotrphin - In blood and urine of menopaused women and in the urine of both sexes after castration.

Ovary

Histological parts of ovary : Histotogically ovary consists of two parts .

i. Cortex or Outer portion.
ii. Medulla or Inner portion.

Cortex : It contains :

1. Germinal epithelium
2. Tunica albicans.
3. Stroma
4. Follicles at various stages -
   a. Primary or primordial follicle
   b. Growing follicle and
   c. Mature graafian follicle.
5. Corpus luteum
6. Interstitial cells.

Medulla : *It contains :*

1. Loose connective tissue
2. Elastic tissue
3. Smooth muscle fibres
4. Blood vessels, lymphatics and nerve fibres.

Functions of the Ovary

It has both exocrine and endocrine function-

1. Exocrine function : Formation of mature ova.
2. Endocnine function : Secretion of four homones :
   a. Oestrogen - Secreted by the Graafian follicles.
   b. Progesterone - Secreted by the corpus luteum.
   c. Androgen.
   d. Relaxin.

Hormone of ovary

Hormones of the ovary are :

1. Estrogen
2. Progesterone
3. Androgen
4. Relaxin.

Source of estrogen and progesterone in female

a. *Source of estrogen :*
   i. Graffian follicle
   ii. Corpus luteum
   iii. Adrenal cortex (slighty)
   iv. Placenta.

b. *Source of progesterone :*
   i. Corpus luteum
   ii. Adrenal cortex (slighty)
   iv. Placenta.

Function of Estrogen

1. *On ovary :*
   i. It has a stimulatory effect on follicular growth.
   ii. It also causes development of gonad in female foetus.

2. *On Fallopian Tube :*
   i. It stimulate musculature and promotes the motility and contractility of the tube.
   ii. It stimulate the epithelium and increases the tubular secretion of the tube.
   iii. It increases the cilliary movement of the tube.
3. *On uterus :*
   i. It causes prolife rative phase of endometrium.
   ii. It increases the motility and sensitivity of myometrium to the oxytocin.
   iii. It increases the size of uterus 2 -3 folds.
4. *On vagina :*
   i. It enlarges the vagina to adult size.
   ii. It causes proliferation and stratification of vaginal epithelium .
5. *On breast :*
   i. Development of the stromal tissues of the breasts.
   ii. Growth of an extensive ductule system of the breasts.
   iii. Deposition of fat in the breasts.
6. *Other effect :*
   i. It causes development of female secondary sexsual character.
   ii. Estrogen increases the total body protein, which evidenced by a slight positive nitrogen balance.
   iii. It causes deposition of large quantities of fat in the subcutaneous tissues, breasts and buttock & thighs.
   iv. It causes the skin to become more vascular, soft and smooth.
   v. It increases the osteoblastic activity of bone and help in rapid growth of bone.
   vi. It stimulates the union between epiphysis and diaphysis.

(Ref. Guyton & Hall-11th edition; page 1017)

N.B. Estrogen mainly promote proliferation and growth of specific cells in the body and are responsible for development of most secondary sexual characteristics of the female.

(Ref. Guyton & Hall-11th edition; page 1016)

Function of Progesterone

1. *On uterus* :
   i. It causes secretory phase of endometriun and preparing the uterus for implantation.
   ii. It decreases the contractility of gravid uterus. Thus prevents expulsion of the implanted ovum.
   iii. It causes development of decidual cell in endometrium which provides nutrition to early embryo.
2. *On fallopian tube :* It increases the tubal secretion and provide nutrtion to zygot before its implantation.
3. *On breast :*
   i. It promote the proliferation of the lobule and alveoli of breast.
   ii. It prepared the breast for lactation.
4. *On Vagina :* It induces cellular proliferation and increased secretion of vaginal epithelium.
5. *On electrolyte balance :* Progesterone causes mild salts and water retention.
6. It has slight protein catabolic actvity.

(Ref. Guyton & Hall-11th edition; page 1018)

N.B. Progestins is concerned almost entirely with final preparation of the uterus for pregnancy and the breasts for lactation.

(Ref. Guyton & Hall-11th edition; page 1016)

Sources of testosterone in woman

1. Ovaries : Secret small quantities of testosterone as well as androstenedione and DHEA (Dehydro epiandrosterone).
2. Suprarenal gland (Zona reticularis of cortex) secrete DHEA and androsterone.

All these hormones enter the circulation. DHEA and androstenedione then enter into the liver (also other tissues) and converted into testosterone and also re-enter into the blood.

Actions of testosterone in woman :
   i. It may be the sex desire of women.
   ii. It causes appearance of pubic and axillary hairs.
   iii. It causes acne vulgaris.

Q. **What is ovulation? How does it occur?**

Ans. Ovulation is the process by which a mature ovum surrounded by cumulus oophorus cells is discharged from the graafian follicle by rupturing the wall of ovary.

Ovulation occurs 14 days before the onset of the first day of next menstruation. Shortly before ovulation the protruding outer wall of the follicle swells rapidly and in the center a small area called stigma protude like a nipple. The fluid begin to ooze from the follicle through the stigma and the follicle become smaller because of loss of fluid, then the stigma ruptures widely and the ovum evaginated into the abdomen.

(Ref. Guyton & Hall-11th edition; page 1014)

Initiation of Ovulation

Approximately two days before ovulation, the quantity of LH secreted by the anterior pituitary increases. This LH at first stimulate theca externa (capsule of the follicle. which form a proteolytic enzyme that cause dissolution and consequent weakening of the capsular wall, resulting in the further swelling of the entire follicle and degeneration of the stigma. Simultaneously, there is rapid proliferation of blood vessels into the follicle wall and secretion of prostaglandin by follicular tissue occur. These two effects in turn causes plasma

transudation into the follicle swelling.

Finally, the combined follicular swelling and simultaneous degeneration of stigma causes follicle rupture with discharge of ovum.

(Ref. Guyton & Hall-11th edition; page 1015)

Determination of ovulation time

It can be determined by -

A. *Direct method :*
   1. Observation of the ovary.
   2. Results of intercourse at different times of menstrual cycle.
   3. Ovulation pain : A slight pain felt on the side in which ovary has discharged the ovum.

B. *Indirect method :*
   1. Alteration of basal temperature : After ovulation temperature rise by 0.3°C-0.5°C.
   2. Estimation of urinary excretion of hormones : Excretion of oestrogen and pregnanediol in urine rises during and after ovulation respec-tively.
   3. Estimation of plasma gonadotropin level (FSH falls and LH high) and oestrogen level high.
   4. Use of ultra sound scanning.

Hormonal control of the maturation of ovum

Control of maturation of ovum : Early maturation is chiefly controlled by FSH, but for full maturation both FSH and L.H are necessary.

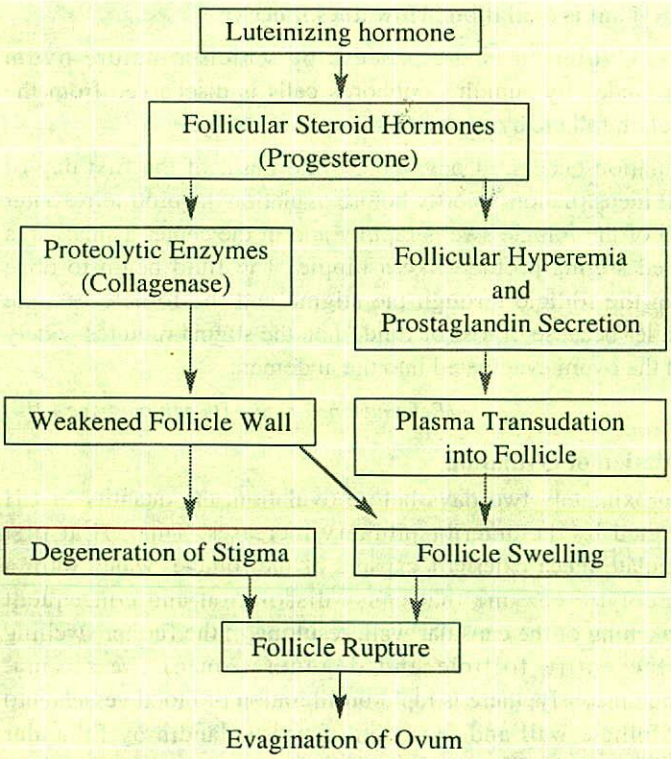

Fig. 9-6. *Postulated mechanism of ovulation.*

Ovulatory surge of LH & FSH

Approximatly 16 hours before ovulation, the rate of secretion of LH by the anterior pituitary increases 6-10 fold and that of FSH increases up to 2 - 3 fold. These two homone act synergistically to cause ovulation (but LH has some specific role). After ovulation the corpus luteum secrets oestrogen and progesterone that decreases the LH and FSH secretion. This phenomenon of sharp rise and fall of LH & FSH secretion is called ovulatory surge of LH & FSH.

(Ref. Guyton & Hall-11th edition; page 1014)

Ovultory surge of LH

Approximately 18 hours before ovulation, the rate of secretion of LH by the anterior pituitary increases markedly (6-10 fold). This causes the ovulation to occur . After ovulation the corpus luteum secretes estrogen and progesterone that decreases the LH secretion. This phenomenon of sharp rise and fall of LH secretion is called ovulatory surge of LH or LH surge.

(Ref. Guyton & Hall-11th edition; page 1014)

Ovarian cycle

The regular maturation of a group of primordial follicle and the periodic sheding of an ocyte, constitute a cyclic change in the ovary , is called ovarian cycle.

It has two phases :

a. *Follicular phase :* In this phase follicle ripen and discharge. At puberty, the rate of secretion of FSH and LH by anterior pituitary increases. The effect of this rapid proliferation of granulosa cell and many spindle cell from ovarian interstisium collect outside the granulosa, form a layer called theca. It has two sublayers. An outer theca externa highly vascular connective tissue layer and an inner theca interna, cellular layer. As development proceeds, irregular fluid filled spaces appear between the follicular cells, which coalesce to form antrum folliculi and the fluid is called liquor folliculi. The follicular cells surrounding the ocyte is known as cumulus oophorus and the rest situated peripherally around the liquor folliculi, called stratum granulosum. Then graafian follicle is formed and ovulation occurs.

b. *Luteal phase :* After ovulation, the remaining granulosa cell become vascularized, yellow in colour and form corpus luteum which then secrete estrogen and progesterone . Corpus luteum is of two types :
   i. Corpus luteum of menstruation.
   ii. Corpus luteum of pregnancy.

Regulation of Ovarian Cycle

Ovarian cycle is regulated by both hormonal and nervous control.

Hormonal regulation :

i. The anterior pituitary secretes FSH and LH FSH initiate the

growth of ovarian follicle and LH helps in final maturation of follicle and ovulation.

Theca cell of graafian follicle secrete large quantities of estrogen that stimulate anterior pituitary to secret LH and inhibit the secretion of FSH.

ii. After ovulation, corpus luteum secretes estrogen and progesterone which then inhibit FSH and LH secretion by feed back mechanism.

Nervous regulation : Hypothalamus secrete FSHRF and LHRF. These two factors act on ant. pituitary which then release FSH and LH. This two hormone inturn maintain normal ovarian cycle.

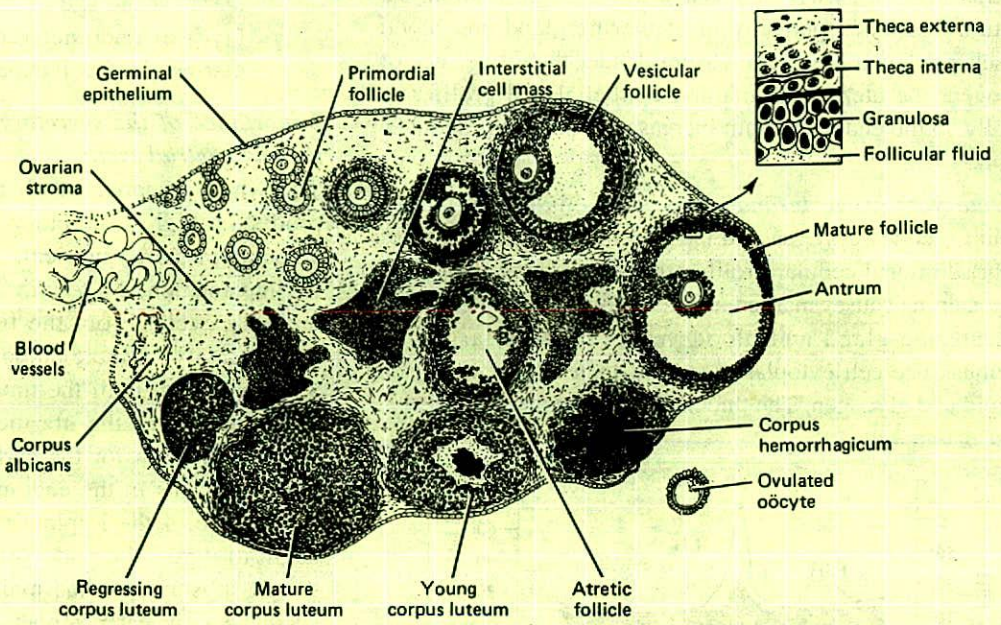

Fig. 9-7. *Diagram of mammalian ovary, showing the sequential development of a follicle, formation of a corpus luteum and in the centre, follicular atresia. A section of the wall of a mature follicle is enlarged at the upper right. The interstitial cell mass is not prominent in primates.*

Q. **What is anovulatory cycle? How this occur?**

Ans. Due to the lack of sufficient amount of luteinizing hormone (LH) sometime ovulation does not occurs in a menstrual cycle and this is known as anovulatory cycle.

If we inhibit the anterior pituitary gland by administration of high doses of progesterone and low doses of estrogen, which causes the decrease secretion of LH. as a result anovulatory cycle occur. It mainly occurs at the early stage of menarche, during menopause and by using contraceptive pills.

(Ref. Guyton & Hall-11th edition)

Effects of removal of ovaries after puberty

i. Uterus become almost infantile type.
ii. Vagina become smaller and vaginal epithelium become thin.
iii. The breast atrophyed and become pendulous.
iv. Atrophy of the valvar structure.
v. Pulic hair become thinner.
vi. Loss of reproductive funtion.
vii. Cessation of menstruation.

Histogical structure of uterus

Histologically uterus composed of three layers. it also contains glands vessels and lymphatics. The layers of uterus are -

1. *Perimetrium* : It is the outer serous coat.
2. *Myometrium* : It is the middle muscle coat. It is consists of interlacing bundles of smooth muscles segmented by fibrous tissue. It is divisible into 3 layers :
   a. Outer longitudinal fibres
   b. Intermediate oblique fibres, arranged in cross spiral fashion.
   c. Inner circular fibres.
3. *Endometrium* : Inside the myometrium is the mucous membrane, called endometrium. It contains glands. At the seeretory phase of menstrual cycle, it contains three layer -
   a. Basal layer
   b. Spongy layer
   c. Compact layer.

Menstrual cycle

The monthly rhythmic changes in the rates of secretion of female hormones and corresponding changes in ovaries and sexual organ as well is known as menstrual cycle. May be regared as periodic preparation for fertilization and pregnancy.

(Ref. Guyton & Hall-11th edition)

Signaficance of menstrual cycle :

i. Only one mature ovum is released from the ovary in each cycle so that one foetus is form.

ii. Prepared the endometrium for implantation.

Stages or phases of menstrual cycle :

1. *Proliferative or estrogenic phase :* After menstru- ation, the stratum basali, deeper portion of uterine gland and blood vessels remain at the endometrium. Under the influe -nce of estrogen, the uterine stroma and epithelial cell proliferate rapidly so the endomet- rium increases in thickness about 3-4 mm.
2. *Secretory or progesteronal phase* : In this phase, corpus luteum secretes estrogen and progesterone. Estrogen causes slight additional cellular proliferation of endometrium while progesterone causes marked swelling and secretory changes. The uterine gland and blood vessel become large and tortuous. The cell cytoplasm contain secretory granule rich in lipid and glycogen. The thickness become 5-6 mm.

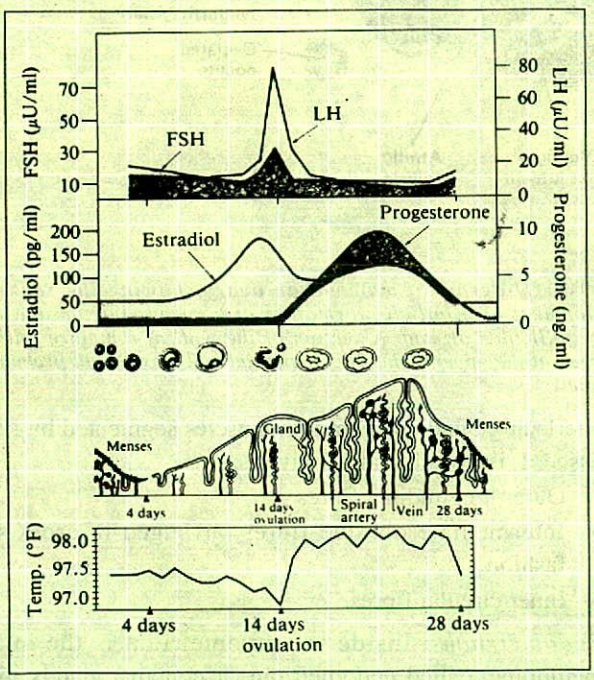

Fig. 9-8. *Variation in the plasma levels of FSH, LH, estradiol and progesterone with different phages of menstrual cycle.*

3. *Menstrual phase (Mechanism of menstrual bleeding)* : The menstrual bleeding occurs when the ovum fails to fertilize and blood estrogen and progesterone level falls due to the degeneration of corpus luteum .

   Approximately two days before menstruation the quantity of estrogen and progesterone sharply decreases which causes involution of endometrium due to decreased hormonal stimulation. This involution causes release of vasoconstrictor material. Due to-

   i. Release of some vasoconstrictor substance .

   ii. Withdrawal of estrogen which is a vasodilator, the tortuous blood vessels become vasospastic and necrosis of endometrium occur. As a result blood sweeps into the vascular layer of endometrium and a haemorrhagic area will grow.

   Gradually the necrotic outer layer will separate from the uterus at the site of haemorrhage and all the superficial layer of endometrium along with blood vessels and uterine gland will expelled out by uterine contraction.

Importance of the secretory phase *(progestational phase)* ***of the endometrial cycle*** :

The whole purpose of all these endometrial changes is to produce a highly secretory endometrium that contains large amounts of stored nutrients to provide appropriate conditions for implantation of a *fertilized* ovum during the latter half of the monthly cycle. From the time a fertilized ovum enters the uterine cavity from the fallopian tube (which occurs 3 to 4 days after ovulation) until the time the ovum implants (7 to 9 days after ovulation), the uterine secretions, called *uterine milk*, provide nutrition for the early dividing ovum. Then, once the ovum implants in the endometrium, the trophoblastic cells on the surface of the implanting ovum (in the blastocyst stage) begin to digest the endometrium and absorb the endometrial stored substances, thus making great quantities of nutrients available to the early implanting embryo.

(Ref. Guyton & Hall-11th edition; page 1019)

Hormonal control of secretory phase *(progestational phase)* ***of the endometrial cycle*** :

During most of the latter half of the monthly cycle after ovulation has occurred, progesterone and estrogen together are secreted in large quantity by the corpus luteum. The estrogens cause slight additional cellular proliferation in the endometrium during this phase of the endometrial cycle, whereas progesterone causes marked swelling and secretory development of the endometrium. The glands increase in tortuosity an excess of secretory substances accumulates in the glandular epithelial cells. Also, the cytoplasm of the stromal cells increases; lipid and glycogen deposits increase greatly in the stromal cells; and the blood supply to the endometriurn further increases in proportion to the developing secretory activity, the blood vessels becoming highly tortuous. At the peak of the secretory phase, about 1 week after ovulation, the endometrium has a thickness of 5 to 6 millimeters.

(Ref. Guyton & Hall-11th edition)

Menstration

The cyclic discharge of blood, unfertilized ovum and certain other substances from uterus through vagina in the female reproductive life at an average interval of 28 days is called menstruation.

a. *Composition of menstrual blood* :
   i. Blood 30-70 ml.
   ii. Stratum compactum and spongiosum of endometrium.
   iii. Mucous

iv. Unfertilized ovum.
v. Leucocytes.
vi. Fibrinolysin.
vii. Some chemical substance like glycogen.

b. *Nature of menstrual blood* :
i. It is liquid, pale, reddish brown in colour.
ii. Its smell is fishy like.
iii. It is non clotting due to absence of clotting factor and presence of fibrinolysin which acts as anticoagulant.

Q. **Why menstruation does not occur during pregnancy?**

Ans. If fertilization does not occur, menstru-ation occurs at the 14 days after ovulation due to sudden fall of blood estrogen and progesterone level.

But if fertilization and implantation occur, the trophoblastic cell of the placenta secretes large quantities of chorionic gonadotropin which prevent the involution of corpus luteum. This corpus luteum secretes large quantites of estrogen and progesterone which continue the growth of endometrium and prevents the menstruation. So, menstruation does not occur during pregnacy.

Menarche : Means the onset of menstruation . It is at about 12 to 14 years.

Menopause

I. *Definition* : Cessation of menstrual cycles due to unresponsiveness of the ovaries, naturally occurring about the age of 45-55 years is called menopause.

II. *Characteristics* :
a. Estrogen deficiency
b. High levels of plasma FSH and LH
c. Features of estrogen deficiency
i. Hot flashes
ii. Vaginal dryness
iii. Breast atrophy
iv. Weight gain
v. Loss of libido.

Cornification : Changes of mucosa of vagina, uterus, and uterine tube is called cornfication,
These changes include-
i. Stratification
ii. Increase mitotic activity.
iii. Deposition of glycogen.

Amenorrhoea : It means the absence of menstruation.

Cause :
i. Before puberty
ii. After menopause
iii. During pregnacy
iv. Some time during lactation.

Dysmenorrhoea : It means painfull or difficult menstruation.

Reproductive period : It is the life of female between menarche and menopause.

Danger period : From 9 to 17th days of menstruation or roughly the middle week of menstruation. Because in this time there is chance of fertilization, if ovum comes in contact with mature sperm.

Viable period : It is the 7th month of pregnancy. In early stage of pregnancy the pulmonary circulation of foetus is less and is just adequate for providing nutrition, with further development, pulmonary circulation starts. At 7th month it is rich enough to supply adequate O_2 for the survival of the subjects. So, this stage is called viable period.

Primodial follicle : The primodial ova surrouded by a single layer of granulosa cells, is called primodial follicle.

(Ref. Guyton & Hall-11th edition)

Germinal epithelium : During foetal life outer surfacr of ovary covered by a layer of cells which embryologicaly derived from germinal ridge, is called germinal epithelium.

(Ref. Guyton & Hall-11th edition)

Ova count at different stage of life

At the 30th week of gestation the number of ova reaches about 7 million. But most of them degenerate. So that less than 2 million are present in the two ovaries at birth and only 300,000 to 400,000 at puberty. Then during all the reproductive years of women from about 13 to 46 years of age, about 400 of these follicle develope enough to expell their ova- one each month, the remainder degenerate. At the menopause, only a few primodial follicle remain in the ovaries, & even these degenerate soon after.

(Ref. Guyton & Hall-11th edition)

Ogenesis : In the female, the maturation process from primitive germ cell to mature gamate is known as ogenesis.

(Ref. Lang Man 5th page 17)

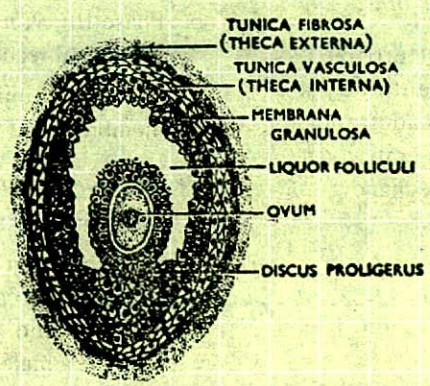

Fig. 9-9. *Vesicular or Graafian follicle*

Graafian Follicle

The compeletly developed primary ocyte surrounded by many layer of cells, containing vesicle is known as graafian follicle.

The graafian follicle comprises the following structure from outer to inner :

i. *Theca externa :* It is an outer fibrous layer which gradu ally merges with the ovarian stroma.

ii. *Theca interna or theca gland :* It is an inner cellular layer which is rich in blood vessel.

Function : It is the main source of oestrogen, the female sex hormone, that regulates the function of the reproductive organ.

iii. *Stratum granulosum cells.*

iv. *Cumulus oophorus :* The ovum together with surrounding granulosa cells is called the cumulus oophorus.

v. *Zona pellucida :* It is an acellular material consisting of mucopolysaccharide deposited on the surface of the ocyte.

(Ref. Lang Man 5th page 12)

Corpus Luteum

It is a folded and collapsed new ovarian structure formed from the remaining position of the graafian follicle after ovulation. It is a temporary endocrine gland.

Types : It is of two types -

i. Corpus luteum of menstruation.

ii. Corpus luteum of pregnancy.

Mechanism : During the first few hours after the expulsion of the ovum from the follicle, the remaining granulosa cells changes rapidly. Under the influence of LH yellow pigment grows in these cell and change into Luteal cell. These cell grow to a diameter two or more times as large as the granulosa cells and become filled with lipid inclusions. This process is called leutinization.

(Ref. Guyton & Hall-11th edition)

Corpus Luteum of menstration : If fertilization does not occurs corpus luteum reaches maximum development about 9 days after ovulation. It can easily recognised as a yellowish projection on the surface of the ovary. Subsequently the corpus luteum decrease in size through the degeneration of the luteal cell, which is known as corpus luteum of menstruation.

After the degeneration it forms a fibrotic mass known as corpus albicans.

Secretion :

i. Progesterone

ii. Estrogen

iii. Inhibin. *(Ref. Lang Man 5th 22)*

Corpus Luteum of pregnancy : If the ocyte is fertilized, degeneration of the corpus luteum is prevented by a gonadotropic hormone (human chorionic gonadotropin) secreted by the trophoblast of the developing embryo, it continues to grow and forms corpus luteum of pregnancy.

Secretion :

i. Progesterone

ii. Estrogen. *(Ref. Lang Man 5th 22-23)*

Stimulation of female sexual act

1. *Psychic stimulation :* Thinking of erotic thoughts etc.

2. *Local sexual stimulation :* Clitoris, nipple, vulva, vagina, and other perineal region and even the urinary tract.

(Ref. Guyton & Hall-11th edition; page 1023)

Stages of female sexual act

1. *Erection :* During sexual stimulation, the arteriols of the erectile tissue, located around the introitus and into the clitoris dilated, and this allows rapid accumulation of blood in the erectile tissue so that introitus tightens around the penis.

2. *Lubrication :* Bilateral Bartholin's glands located beneath the labia minora, vaginal epithelium and a small amount from the male urethral glands, cause secretion of mucus inside the introitus. This mucus is responsible for lubrication during sexual intercourses for satisfactory masaging sensation.

3. *Orgasm :* When local sexual stimulation as well as psychic stimulation reaches in maximum intensity, cause the female orgasm, called female climax. It is analogous to amission and ejaculation in the male. There occurs rhythmic contraction of the perianal muscle, motility of the uterine and fallopian tube and dilatation of the cervical canal, thus helps to promote fertilization of the ovum.

(Ref. Guyton & Hall-11th edition; page 1023)

Fertilization

i. *Definition* : Fertilization is the process by which male and female gametes fuse.

ii. *Sites* : Usually it occurs in the ampullary region of the uterine tube.

iii. *Phases* : The phases of fertilization include :

a. Phase-I : *Penetration of the corona radiata by sperm* : Of the 200-300 million spermatozoa deposited in the female genital tract in each ejaculation, only 300-500 reaches the site of fertilization. Only one of them is needed for fertilization, and it is thought that the others aid the fertilizing sperm in penetrating the barriers protecting the female gamete.

b. Phase-II : *Penetration of the zona pellucida* : By acrosomal reaction.

c. Phase-III : Fusion of the oocyte and sperm cell membranes.

iv. *Results of fertilization* :

a. Restoration of the diploid number (46) of chromosomes

b. Determination of the sex of the new individual. An X chromosome carrying sperm will produce a female (XX) embryo, and a Y chromosome carrying sperm will produce a male (XY) embryo.

c. Initiation of cleavage (a series of mitotic divisions).

Pregnancy

i. ***Physiology of pregnancy*** :

a. Spermatozoa reach the tube between 30 minutes and 3 hours after coitus.
Sperm are attracted to the ovum by chemotaxis.

b. *Fertilization* : usually occurs in the ampullary region of the tube.

c. *Blastocyst formation* : Fertilization is followed by blastocyst formation.
The *blastocyst* is carried down the tube by ciliary and peristaltic action and reaches to the uterine cavity.
Duration : Within 3 days (5-6 days after ovulation).

d. *Implantation* : Placement of blastocyst usually into the posterior wall of the endometrium.
Duration : Tt the end of the 1st week.

e. *Trophoblast formation :* It develops from the outermost cells of the blastocyst

f. *Development of placenta* : It provides nutritional connection between mother and embryo.

ii. ***Endocrine changes in pregnancy*** :

a. *Placenta* secretes human chorionic gonadotropin (hCG), which prevent regression of the corpus luteum after fertilization.

b. *Corpus luteum* is enlarged by hCG and secretes estrogen, progesterone and relaxin.
* *Relaxin* : Maintain pregnancy by inhibiting myometrial contraction.
* *Estrogen and progesterone* : Inhibit GnRH secretion, so no new cycle starts.

Corpus luteum function begins to declines after 8 weeks of pregnancy but it persists throughout pregnancy.

c. *Placenta* becomes capable to produce sufficient estrogen and progesterone within 10-12 weeks of pregnancy.

iii. ***Duration of pregnancy*** :

a. 280 days from the first day of the last menstrual period.
b. 274 days : from fertilization.
c. 266 days : from the date of intercourse - if pregnancy has followed a single coitus.

iv. ***Symptoms of pregnancy*** :

a. *Amenorrhoea* : in women with previous regular periods
b. Morning sickness
c. Tenderness and fullness of the breasts
d. Frequency of micturation
e. Later stage : breasts enlargement, abdominal enlargement and feeling of the fetal movement (*quickening*).

v. ***Signs of pregnancy*** :

a. Uterus :
1. Enlargement of the body of the uterus.
2. Softening of the uterus : uterus becomes progressively enlarged.

b. *Foetus* :
1. Palpation of fetal parts; fetal movements may be felt *(absolute sign of pregnancy).*
2. Fetal heart sounds may be heard.

c. Pigmentation on the abdomen breasts and face.

vi. ***Most common tests for pregnancy*** :

a. *Ultrasonography for pregnancy* : It determines the embryonic heart movements within six weeks of the pregnancy *(absolute sign).*

b. *Urine for pregnancy* : Presence of large amount of hCG in the patient urine sample (morning specimen) : It is not absolutely specific for pregnancy.

Physiological changes during pregnancy

Anatomical and physiological changes that occur during pregnancy chiefly involve the genital tract and the breasts. Many other interrelated changes occur in other systems of the body. The most important alterations in maternal physiology during pregnancy include :

a. ***Endocrine and paracrine changes during pregnancy*** :

i. *Human chorionic gonadotrophin* : The *trophoblast* produces large amounts of human chorionic gonadotrophin (hCG), particularly in the first trimester of pregnancy. hCG can be detected in the blood as early as 6-14 days after conception.

ii. *Estrogens* and *progesterone* : Large amounts of estrogens and progesterone are found in the blood and urine during pregnancy.
At first these are secreted by the corpus lutcum and then by the placenta after the 12th week.

iii. The alpha-fetoprotein-AFP (embryonic origin) concentrations in the maternal serum are increased by highest concentrations is in amniotic fluid.

iv. Other maternal endocrine changes include-
1. Hpertrophy of the anterior pituitary lobe
2. Thyroid enlargement
3. Increased BMR
4. Increased concentration of adrenal hormones in the blood and urine.

b. ***Meternal metabolic changes during pregnancy*** :

i. Body weight : It increases 7-17 kg

ii. Considerable salt and water retention at term : 3300 ml.
1. Increase in intracellular water : 550 ml
2. Increase in extracellular water :
Intravascular (plasma) : 900 ml
Extravascular : 1850 ml.

iii. Increase basal metabolic rate-BMR : 10-25%

iv. Increase total need for calories

v. Plasma levels of triglyceride, cholesterol and free fatty acids rises.

vi. Increased demand for iron and calcium and proteins.

c. ***Hematological changes during pregnancy*** :

i. *Blood volume* : is increased during pregnancy by about 30 percent.

ii. *Red cells* : Total number and volume of red cells increase by about 20 percent

iii. *Hemoglobin* : Total amount of hemoglobin in the maternal blood is increased.

iv. *ESR* : is much increased (up to 100 mm in the 1st hour are not unusual).

d. ***Changes in the different systems of the body during pregnancy*** :

i. *Changes in the CVS* :

1. *Cardiac output* : Rises from 4-5 to 6 liters per minute during the first ten weeks of pregnancy.
2. *Systolic blood pressure* : is unaltered during normal pregnancy.
3. *Diastolic pressure* : is reduced in the first and second trimester, returning to non-pregnant levels by term.
4. Heart rate rises by between 6-8 beats per minute.

ii. *Changes in the respiratory system* :

1. *Pulmonary ventilation* : is increased by about 40 percent as a result of increased tidal volume.
2. *Oxygen requirements* : only increased by 20 percent and PCO_2 is decreased.

iii. *Changes in the alimentary tract* :

1. Nausea
2. Morning sickness.
3. Appetite and thirst increase.

iv. *Changes in the genital tract* :

1. *Uterus* : increase in size with enormous growth of the myometrium.
   * Weight of the uterus : increased upto 1 kg (in non-pregnant 65 g only).
   * Cervical mucus glands : Increased vascularity and secretions of cervical mucus glands.
2. *Vagina* : vascularity increased; increased watery vaginal secretions.

iv. *Changes in the urinary tract* :

Kidney :

* Increased GFR and renal plasma flow.
* A progressive fall in the plasma creatinine levels
* A progressive fall in the blood urea levels
* Increased salt and water retention due to increased aldosterone, renin and angiotensin II and angiotensin I.
* Increased frequency of micturation.

v. *Changes in the skin* :

1. *Abdominal skin* : become stretched and form striae gravidarum.
2. *Pigmentation* on the
   - abdominal wall ***(linea nigra)***
   - areolae of the breasts
   - face, forehead or cheeks.

   The *cause of these changes* in unknown, but may be related to estrogen, progesterone, adrenal hormones or an increase in melanocyte stimulating hormone (MSH).

e. ***Emotional changes during pregnancy.***

Pregnancy tests

1. Friedman test
2. Galli manini test
3. Hoggben test
4. Aschheim Zondek test .
5. Immunological test
6. Kupperman test
7. Haemagglutination test.

Physiological basis of pregnancy test : During the early stage of pregnancy female placenta secretes large amount of chorionic gonadotropins which come out in urine. So, tests are carried out with the patients morning urine and note whether it contain such hormone or not.

Immunological pregnancy test: Immunological pregnancy test based on the precipitation of latex particle coated with antibodies due to chorionic ganadotropin hormone. Antibodies are produced after administration of human gonadotropin in rabbits. Antiserum taken from this rabbits and are used to detect the presence of chorionic gonadotropin in pregnant women's urine with the help of compliment fixation test.

Labor pain

With each uterine contraction, the mother experiences considerable pain. The cramping pain in early labor is probably caused mainly by hypoxia of the uterine muscle resulting from compression of the blood vessels in the uterus. This pain is felt when the visceral sensory *hypogastric nerves*, carry the visceral sensory fibers leading from the uterus.

However, during the *second stage of labor*, when the fetus is being expelled through the birth canal, much more severe pain is caused by cervical stretching, perineal stretching, and stretching or tearing of structures in the vaginal canal itself. This pain is conducted to the mothers spinal cord and brain by somatic nerves instead of by the visceral sensory nerves.

(Ref. Guyton & Hall-11th Edition; page 1038)

Parturition

It is the process of giving birth.

Stages of Labour (parturition) :

i. *1st stage of labour :* It starts from the onset of true labour

pain and ends with full dilatation of the cervix.

ii. *2nd stage :* It starts from the full dilatation of the cervix and ends with expulsion of the foetus from the birth canal.

iii. *3rd stage :* It begins after the expulsion of the foetus and ends with expulsion of the placenta and membranes.

(Ref. Obstetrics D.C. Dutta. 2nd. page 121-125)

Role of Oxytocin in Parturition :

Increase in oxytocin receptors
↓
Prostaglandins
↓
Uterine contractions
↓
Dilation of cervix & distention of vagina
↓
Stimuli from cervix & Vagina
↓
Incereased secretion of oxytocin

Puerperium

It is the period following child birth during which the body tissues, specially the pelvic organs revert back approximately to the prepregnant state both anatomically and physiologically.

Puerperium begins as soon as the placenta is expelled and lasts for approximately 6 weeks.

(Ref. Obstetrics D.C Datta. 2nd-157)

Placenta

Placenta is a flattened, disscoidal mass with circular or oval outline. The placenta is essentially a fetal organ. At full term, the placenta has a diameter of 15-25 cm, is approximately 3 cm thick, and has a weight of about 500-600 gm.

It is an organ in which blood vessels of the embryo are brought into relationship with the blood of the mother.

i. ***Components of placenta*** : The placenta consists of-
   a. Chorionic frondosum (villous chorion)
   b. Decidua basalis
   c. Intervillous lack of maternal blood
   d. Cytotrophoblast cells.

ii. ***Functions of placenta*** : Placenta is the only means of transfer of anabolites and catabolites and, as such, is the main interface between the fetus and the outside world.
   The main functions of the placenta are :
   a. Exchange of gases
   b. Exchange of nutrients and electrolytes
   c. Transmission of maternal antibodies, providing the fetus with passive immunity
   d. Production of hormones
   e. Forms a protective barrier against transfer of infection to the fetus
   f. Detoxification of some drugs.

Exchange of gases : O_2, CO_2 and CO is exchanged by simple diffusion. At term, the fetus extracts 20-30 ml of oxygen per minute from the maternal circulation. The amount of oxygen reaching the fetus is primarily dependent on delivery and not diffusion.

Exchange of nutrients and electrolytes : Amino acids, free fatty acids, carbohydrates, and vitamins exchange occur rapidly and increases as pregnancy advances.

Transmission of maternal antibodies : Maternal antibodies are taken up by pinocytosis by the syncytiotrophoblast and subsequently transported to fetal capillaries. In this manner, the fetus acquires maternal antibodies of immunoglobulin G (IgG) class against various infectious diseases. The fetus has little capacity to produce its own antibodies until after birth.

iii. ***Placental transport :***
   i. Substances that can cross the placental barrier :
      a. Gases : O_2, CO_2, CO.
      b. Nutrients : Carbohydrates, FAs, triacylglycerol, cholesterol, proteins.
      c. Electrolytes : Na^+, K^+, Ca^{++}, Mg^{++}.
      d. Amino acids, nucleic acids, urea, uric acid.
      e. Water.
      f. Low molecular weight substances (<1000) i.e anesthetic drugs.
      g. Hormones : Thyroid hormones, estrogens and androgens.
      h. Immunoglobulin : IgG only.
      i. Fetal red cells (nucleated) to maternal blood.
   ii. *Substances that cannot cross the placental barrier* :
      a. Substances of very high molecular weight (>1000).
      b. Hormones : Insulin, parathyroid hormones, ADH, oxytocin.
      c. Immunoglobulin : IgA and IgM.

iv. ***Hormones of the placenta*** : Placental hormones maintain pregnancy. In all probability, all hormones are synthesized in the *syncytial trophoblast* and are secreted into the maternal blood.
   Placental hormones are :
   1. Human chorionic Gonadotropin (hCG)
   2. Progesterone
   3. Estrogenic hormones (predominently estriol)
   4. Chorionic growth hormone- Prolaction (CGP)
   5. Human chorionic somatomammotropin (hCS)
   6. Relaxin
   7. Others : GnRH, lnhibin and TSH etc.

Human chorionic Gonadotropin (hCG) : hCG is a glycoprotein secreted by the syncytiotrophoblast.

i. *Plasma detection* : hCG can be detected in the maternal plasma by radioimmunoassay as early as 6 days after fertilization of the ovum and found in urine as early as 14 days after conception.

ii. *Peak concentration* : It reaches its peak concentration in the blood and urine at 12 weeks of gestation.

iii. *Importance* :

a. hCG support the corpus luteum untill the placenta produces amounts of progesterone sufficient to support the pregnancy.

b. The presence of hCG in the urine forms the basis of the routine tests for pregnancy *(hCG is not absolutely specific for pregnancy).*

Double Bhor effect

Bohr effect, enhances transport of oxygen by the fetal blood. That is, hemoglobin can carry more oxygen at a low Pco_2 than it can at a high Pco_2 . The fetal blood entering the placenta carries large amounts of carbon dioxide, but much of this carbon dioxide diffuses from the fetal blood into the maternal blood.

Loss of the carbon dioxide makes the fetal blood more alkaline, whereas the increased carbon dioxide in the maternal blood makes this more acidic. These changes cause the combining capacity of fetal blood for oxygen to become increased and that of the maternal blood to become decreased.

This forces still more oxygen from the maternal blood while enhancing oxygen uptake by the fetal blood. Thus, the Bohr shift operates in one direction in the maternal blood and in the other direction in the fetal blood, these two effects making the Bohr shift twice as important here as it is for oxygen exchange in the lungs; therefore, it is called the *double Bhor effect.*

(Ref. Guyton & Hall-10th Edition;)

Involution of the uterus after parturition

i. *During the first 4 to 5 weeks after parturition* : The uterus involutes. Its weight becomes less than one half its immediate postpartum weight within 1 week.

ii. *In 4 weeks after parturition* : If the mother lactates, the uterus may be as small as it had been before pregnancy. This effect of lactation results from the suppression of pituitary gonadotropin and ovarian hormone secretion during the first few months of lactation.

During early involution of the uterus, the placental site on the endometrial surface autolyzes, causing a vaginal discharge known as *lochia*, which is first bloody and then serous in nature, continuing in all for about 10 days. After this time, the endometrial surface becomes re-epithelialized and ready for normal, nongravid sex life again.

(Ref. Guyton & Hall-11th Edition; page 1038)

Lactation

Definition : The process of formatoin and secretion of milk in the alveoli of breast and its expulsion from mammary gland is called lactation.

Phages of lactation : Lactation include 4 phases-

1. *Mammogenesis :* It means development of breast . Female sexual hormones at puberty act on the stromal tissues , alveoli and ducts of the breast and influenced its development . Estrogen cause devlopment of stoma and duct system. Progesterone is responsible for the development of lobule and alveoli .
2. *Lactogenesis :* It means synthesis of milk . It is initiated by the prolactin and is ***continued by*** the growth hormone, thyroxin and ACTH. This three hormones form a modified solution of carbohydrate, protein and fat etc.
3. *Lactopoesis :* Continuation of lactogenesis by maintaining the secretion of leutotropic hormone (LTH) is called lactopoesis.
4. *Ejection of milk :* When baby sucks the breast, stimulation from nipple passes to hypothalamus which stimulates posterior pitutary to secrete oxytocin. The oxytocin contracts the muscle fibre (myoepithelial cells) of alveoli and duct repeatedly and initiate the ejection of milk.

Role of hormones on lactation *(Mammary gland)*

1. Estrogen : Responsible for the development of stroma & duct system of the brest.
2. Progesterone : Responsible for the development of lobule & alveoli of the brest.
3. Prolactin :
   i. Final development of breast.
   ii. Synthesis and secretion of milk.
4. Oxytocin :
   i. Contraction of myoepithelial cells of breast .
   ii. Ejection of milk.
   iii. Contraction of uterus during parturation .
5. Growth Hormone : It is essential for overall development of breast.
6. Thyroid hormone : Helps in the development of breast and lactation by increasing the metabolism.
7. ACTH : It helps in development of breast.

Mammogenesis

i. *Definition* : It is the process of development of breast.

ii. Stages : It occurs in three phases (stage) :

1. *Quiescent phases (upto puberty) :* Very little growth of mammary tissue is observed in this phases.
2. *Phases of active growth :* With the onset of puberty

under the influence of hormone (Oestrogen and progesterone). Active growth of the gland (deve lopment and proliferation of duct and alveolar system) occur.

3. *Phase of lactation* : During pregnancy further development of the ducts and alveolar systems occurs due to hormones of ovary and placenta. After pregnancy the glands begin secretion of milk under the influence of prolactin.

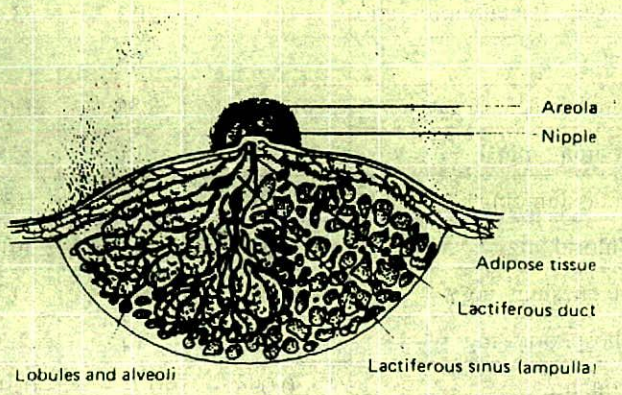

Fig.9-10. *The Breast & its Mammary Gland.*

Regulation of lactogenesis

Immediately after the baby is born, the sudden loss of both estrogen and progesterone secretion by the placenta now allows the lactogenic effect of the prolactin from the mother's pituitary gland. Over the next 1 to 7 days the breast begins to secret copious quantities of milk instead of colostrum.

The secretion of milk requires an adequate secretion of most of the mother's other hormone as well, are growth hormore, cortisol and parathyroid hormone. These hormones are necessary to provide the amino acids, fatty acids, glucose and calcium that are required for milk formatin

Low level of oestrogen & progesterone → anterior pitutary → prolactin → breast → milk scertion.

(Ref. Guyton & Hall-11th edition; page 1039)

Double threshold theory of lactation

After expulsion of the placenta at parturation, there is an abrupt decline in circulating estrogens and progesterone. Lactation is then initiated because :

a. Low progesterone increases prolactin secretion
b. Low estrogens increase prolactin secretion.

High level of circulatory prolactin initiates milk. This is the double threshold theory regarding secretion of milk.

Galactopoaesis

Galactopoiesis means maintenance of lactation. Factors maintaining lactation are :

i. Maternal nutrition
ii. Fluid intake
iii. Hormonal role.

Two neuroendocrine reflexes ensure secretion of prolactin and oxytocin and aids in the maintenance of lactation.

Lactational amenorrhoea

i. *Definition* : Absence of menstruation in women who nurses regularly is called lactational amenorrhoea.

ii. *Duration* : It may last for 25-30 weeks. If no nursing, the women have their first menstrual period 6 weeks after delivery.

iii. Mechenism : Nursing the baby increases the prolactin secretion. Prolactin causes inhibition of GnRH secretion. So inhibit the action of GnRH on anterior pituitary gland. Antagonizes the FSH and LH action on the ovaries. Preventing follicular development. Ultimately no ovulation and so, no luteinization. Decrease estrogen and progesterone output and no meanstrual period.

Process in milk ejection

It is the process by which the milk is ejected or 'let down' from the alveoli to the duct before the baby can obtain it.

The process is caused by a combined neurogenic and hormonal reflex involving the posterior pituitary hormone oxytocin.

When the baby suckles the breast or when cries for milk, sensory impulse are transmitted through somatic nerves from the nipples to the spinal cord and then to the hypothalamus, there causing oxytocin secretion at the same time that they cause prolactin secretion. Oxytocin then carried via blood to the breast, where it causes contraction of the myoepithelial cells that surround the outer walls of the alveoli, and initiates the ejection of milk.

(Ref. Guyton & Hall-11th edition; page 1040)

Diagrammatic representations of milk let-down process :

Suckling of the breasts
↓
Somatic touch receptors are stimulated and generate impulses
↓
Impulses go to the hypothalamus via Bundle of Schultze and mammary peduncle of the spinal cord
↓
Supraoptic and paraventricular nuclei are stimulated
↓
Oxytocin is released from the posterior pituitary
↓
Oxytocin causes contraction of myoepithelial cells
↓
Milk let-down.

Colostrum

The fluid that is secreted the last few days before and first few days after parturation is called *colostrum.*

It contains essentially the same concentrations of proteins and lactose as milk but almost no fat, and its maximum rate of production is about 1/100 the subsequent rate of milk production.

Composition of colostrum : (Units are weight per deciliter)

Component	*Human Colostrum*
a. Water, gm	...
b. Lactose, gm	5.3
c. Protein, gm	2.7
d. Fat, gm	2.9
e. Sodium, mg	92
f. Potassium, mg	55
g. Chlorid, mg	117
h. Magnesium, mg	4
i. Phosphorus, mg	14
j. Iron, mg	0.09[2]
k. Vitamin A, µg	89
l. Vitamin D, µg	...
m. Thiamine µg	15
n. Riboflavin, µg	30
o. Nicotinic acid, µg	75
p. Ascorbic acid, µg	4.4

(Ref. Guyton & Hall-11th Edition and others)

Pre-eclampsia : During the last four months of pregnancy approximately 4% of pregnant women experience a rapid rise in arterial blood pressure associated with loss of large amounts of protein in the urine. This condition is called preeclampsia.

1. *Cause of pre-eclampsia* :
   i. Development of autoimmunity resulting from presence of foetus,
   ii. Excessive secretion of placental or adrenal hormones.
2. *Effect of pre-eclampsia :*
   i. Salt and water retention by the kidney, weight gain and oedema.
   ii. Arterial spasm specially in kidney, brain, liver etc.
   iii Renal blood flow and glomerular filtration decreased.

(Ref. Guyton & Hall-11th Edition)

Eclampsia : It is an extreme degree of preeclampsia occurs shortly before pregnancy, characterized by extreme vascular spasticity throughout the body, clonic convulsions followed by coma, greatly decreased kindney output, malfunction of liver, extreme hypertension and generalized toxic condition of the body.

Treatment : Use of rapidly acting vasodilator drug to decrease the blood pressure normal.

Composition of colostrum and milk.

(Units are weight per deciliter.)

Component	*Human Colostrum*	*Human Milk*	*Cows' Milk*
Water, g	...	88	88
Lactose, g	5.3	6.8	5.0
Protein, g	2.7	1.2	3.3
Casein, Lactalbumin ratio		1.2	3.1
Fat, g	2.9	3.8	3.7
Linoleic acid of fat		8.3%	1.6%
Sodium, mg	92	15	58
Potassium, mg	55	55	138
Chlorid, mg	117	43	103
Magnesium, mg	4	4	12
Phosphorus, mg	14	15	100
Iron, mg	0.09[2]	0.15[2]	0.10[2]
Vitamin A, µg	89	53	34
Vitamin D, µg	...	0.032	0.062
Thiamine µg	15	16	42
Riboflavin, µg	30	43	157
Nicotinic acid, µg	75	172	85
Ascorbic acid, µg	4.4[2]	4.3[2]	1.6[2]

Abnormal conditions that cause female sterility : About one of every six to eight marriages is infertile; in about 60 per cent of these marriages, the infertility is due to female sterillty.

i. *Failure to ovulate* : *Cause-*
   a. Hyposecretion of gonadotropic hormones.
   b. Abnormal ovaries that will not allow ovulation. For instance, thick ovarian capsules occasionally exist of the outsides of the ovaries, making ovulation difficult.

ii. *Endometriosis* : Endometriosis causes fibrosis throughout the pelvis, and this fibrosis sometimes so enshrouds the ovaries that an ovum cannot be released into the abdominal cavity. Often, endometriosis occludes the fallopian tubes, either at the fimbriated ends or elsewhere alone their extent.

iii. *Salpingitis* : This causes fibrosis in the tubes, thereby occluding them.

iv. *Secretion of abnormal mucus by the uterine cervix* : Ordinarily, at the time of ovulation, the hormonal environment of estrogen causes secretion of mucus with special characteristics that allow rapid mobility of sperm into the uterus and actually guide the sperm up along mucous *threads*. Abnormalities of the cervix itself, such as

low-grade infection or inflammation, or abnormal hormonal stimulation of the cervix, can lead to a viscous mucus plug that prevents fertilization.

(Ref. Guyton & Hall-11th Edition; page1024)

Tests :

i. One of the tests of is simply to *analyze the urine for a surge in pregnanediol*, the end product of progesterone metabolism, during the latter half of the sexual cycle, the lack of which indicates failure of ovulation.

ii. Another common test is for the woman to chart her *body temperature throughout the cycle*. Secretion of progesterone during the latter half of the cycle raises the body temperature about 0.5°F, the temperature rise coming abruptly at the time of ovulation.

(Ref. Guyton & Hall-11th Edition; page1025)

Lack of ovulation caused by hyposecretion of the pituitary gonadotropic hormones can sometimes be treated by appropriately timed administration of *human chorionic gonadotropin*, a hormone that is extracted from the human placenta. This hormone, although secreted by the placenta, has almost the same effects as LH and, therefore, is a powerful stimulator of ovulation. However, excess use of this hormone can cause ovulation from many follicles simultaneously; this results in multiple birth, an effect that has caused as many as eight babies (but mostly stillborn babies) to be born to mothers treated for infertility with this hormone.

(Ref. Guyton & Hall-11th Edition; page1024)

Q. **What are the change takes place to pregnant mother's body?**

1. *Weight gain :* The average weight gain is about 24 lbs. of which-

Foetus	: 7 lbs
Amnitotic fluid	: 4 lbs.
Uterus	: 2 lbs.
Breast	: 2 lbs.

2. *Metabolism :* About 15% increases due to several hormone such as TSH, ACTH, GH.
3. *Nutrition :* It also increasees.
4. *Changes in circulatory system :*
   i. Increase blood volume
   ii. Increase blood pressure
   iii. Increase cardiac output.
5. *Respiration :* The rate and depth of respiration increases.

(Ref. Guyton & Hall-11th Edition)

Ways of controlling population

Population can be controlled in various ways as follows-

1. By adopting contraceptive methods-
   a. Barrier methods-
      i. Physical methods : Condom, Cervical diaphragm.
      ii. Chemical method : Foams, Pastes, Jellies etc.
      iii. Combined method : Physical+Chemical method.
   b. Intrauterine devices : Copper - T.
   c. Hormonal methods : Contraceptive pill e.g.-Maya, Ovacon etc.
   d. Post conceptional methods : Menstrual regulation (MR), Menstrual induction (MI) etc.
   e. Miscellaneous or behavioral methods : Sexual abstinence & maintain safe period etc.
   f. Sterilization program : Tubectomy for female and vasectomy for male.
2. By sociological approach : Raising age of marriage to a reasonable limit.
3. Improvement of econonic conditon of the people.
4. Increase recreation facilities
5. Health education.

(Ref. Community medicine- Park)

Q. **What are the functions of Maya pill.**

Ans. It converts the ovulatory cycle into anovulatory cycle, because maya pill contain high doses of progesterone and low doses of estrogen, which inhibits the anterior pituitatry gland for the decrease secreation of L.H. and due to absence of LH no ovulation occurs.

Introduction 9.28 | *Female reproductive system 9.30* | *ovulation 9.31* | *Contraception 9.7*
Male reproductive system 9.28 | *Menstruation &* | *Pregnancy, Labour & Lactation 9.32* | *Menopause 9.33*

Directions : Write T for true & F for false against each of the following statement.

Introduction

Q. 01. **Androgens**
- T a. secretion decreases after the age of 30 in male.
- T b. are secreted by the ovary
- T c. are secreted by adrenal cortex
- F d. inhibits the masculinization
- F e. are secreted by sertoli cells

Q. 02. **Androgen receptors are coded in**
- T a. Long arm of X chromosome
- F b. Short arm of X chromosome
- F c. Long arm of Y chromosome
- F d. Short arm of Y chromosome
- F e. All.

Q. 03. **Which of the following determines the sex of the individual :**
- T a. Genotype only
- F b. Genotype + phenotype
- F c. FSH + LH only
- F e. Any of the above
- F e. All.

Q. 04. **A premature infant is more likely than a full term infant to**
- T a. Excrete urine with a uniform specific gravity
- T b. Suffer from anaemia
- T c. Suffer from jaundice of hepatic origin
- F d. Maintain a normal body temperature in a cold environment
- F e. All.

Q. 05. **A premature infant is more likely than a full term infant to**
- T a. Excrete urine with a uniform specific gravity
- T b. Suffer from anaemia
- T c. Suffer from jaundice of hepatic origin
- F d. Maintain a normal body temperature in a cold environment
- F e. All.

Male reproductive system

Q. 06. **Primary sex organ of the male is**
- T a. testes
- F b. prostate
- F c. seminal vesicles.
- F d. penis
- F e. scrotum

Q. 07. **Cart wheel appearance of nucleus is seen in**
- T a. Sertoli cell
- F b. Leydig cell
- F c. Sperms
- F d. Spermatid
- F e. All.

Q. 08. **Testes does not produce**
- T a. Fructose
- F b. Estradiol
- F c. Testesterone
- F d. Inhibin
- F e. All.

Q. 09. **Testes can produce**
- T a. Estradiol
- T b. Testesterone
- T c. Inhibin
- F d. Fructose
- F e. All.

Q. 10. **For development of seminiferous tubules require**
- T a. androgens
- T b. FSH
- F c. LH
- F d. somatostatin
- F e. oxytocin.

Q. 11. **The seminal vesicles**
- T a. secrete fibrinogen.
- T b. provide fructose
- T c. secrete prostaglandins
- F d. increases motility of the sperm
- F e. provide clotting enzymes.

Q.12. **Prostaglandins found in the seminal fluid are the secreting products of**
- T a. Seminal vesicle
- F b. Prostate gland
- F c. Leydig cells
- F d. Sertoli cells.
- F e. All.

Q. 13. **The epididymis**
- T a. is the storage site for sprem.
- T b. increases motility of sperm
- T c. increases fertility of sperm
- F d. secretes alkaline fluid
- F e. secretes fibrinogen

Q. 14. **Prostate gland**
- T a. provides clotting enzymes.
- T b. secretes alkaline fluid
- F c. provides fructose
- F d. secretes prostaglandin
- F e. is the storage site for sperm

Q. 15. **The interstitial cells of the testes**
- T a. are stimulated by luteinizing hormone
- T b. secrete hormone testosterone
- F c. contribute to the volume of seminal fluid
- F d. secrete hormone inhibin
- F e. are under control of follicle stimulating hormone.

Q. 16. **Blood testis barrier is formed by**
- T a. Sertoli cells
- F b. Leydig cells
- F c. Epididymis
- F d. Vas deferens
- F e. All.

Q. 17. **Testicular function is regulated by the (action of)**
- T a. luteinizing hormone
- T b. gonadotropin releasing hormone
- T c. follicle stimulating hormone
- F d. human chorionic gonadotropin
- F e. prolactin.

Q. 18. **Precursor of testesterone is**
- T a. Pregnenalone
- F b. Methyl testeterone
- F c. Aldosterone
- F d. Cortison
- F e. All.

Q. 19. **Testosterone**
- T a. secretion is regulated by LH
- T b. causes descend of testes
- T c. causes the development of secondary sexual charac teristics in male.
- F d. is secreted by sertoli cells of testes
- F e. it is protein hormone

Q. 20. **Testosterone**
- T a. induces the DNA-RNA transcription process.
- T b. is formed by the leydig cells
- F c. is a large polypeptide
- F d. does not liberate from fetal testes
- F e. inhibits the descent of the testes

Q. 21. **Peak testosterone levels are seen at about**
- T a. 7-8 AM
- F b. 7-8 PM
- F c. 2 AM
- F d. 12 PM
- f e. 10 PM

Q. 22. **Testosterone is produced and secreted by**
- T a. interstitial cells of leydig
- F b. spermatogonia
- F c. sertoli cell
- F d. tubules
- F e. epididysis.

Q. 23. **Testosterone is formed from**
- T a. Cholesterole
- T b. Pregnenolone
- T c. Androstenedione
- T d. All.
- F e. None.

Q. 24. **Testosterone causes**
- T a. development of accessory organ
- T b. loss of hair during puberty
- T c. acne.
- F d. development of fetal brain
- F e. depletion of protein

Q. 25. **Following are the effects of teslostone**
- T a. Calcium retention
- T b. Increase total quantity of bone matrix
- T c. Increase BMR
- F d. Haemopoiesis
- F e. All.

Q. 26. **Following are the effects of teslostone except:**
- T a. Haemopoiesis
- F b. Calcium retention
- F c. Increase total quantity of bone matrix
- F d. Increase BMR
- F e. All.

Q. 27. **Anabolic action on protein is mediated by**
- T a. Testesterone
- F b. ACTH
- F c. Insulin

F d. TSH
F e. All.

Q. 28. **The acrosome contains**
T a. proteolytic enzyme
T b. hyaluronidase
F c. spermatocyte
F d. chromatin
F e. miochondria.

Q. 29. **Sperm becomes motile in the**
T a. epididymis
F b. urethra
F c. testes.
F d. seminiferous tubules
F e. vas deferens

Q. 30. **Human spermatozoa**
T a. contain 23 chromosomes
T b. have enzymes in their head (which aid penetration of the ovum)
F c. are motile in the seminiferous tubules
F d. are stored in the seminal vesicles
F e. are produced faster at 37°c.

Q. 31. **The sperms are normally motile at the rate of**
T a. 1-3 cm/min
F b. 0-1 cm/min
F c. 3-10 cm/min
F d. 10-15 cm/min
F e. 5-8 cm/min.

Q. 32. **In spermatogenesis**
T a. testosterone is essential for growth of sperm
T b. estrogen is essential for spermatogenesis
T c. GH necessary for metabolic function of testes.
F d. LH stimulates the sertoli cells
F e. FSH stmulates leyding cells

Q. 33. **Spermatogenesis**
T a. starts at the time of puberty.
T b. requires testosterone and LH
T c. requires 64-74 days
F d. occurs in epididymis
F e. requires high temperature

Q. 34. **Hormones that regulate spermatogenesis are**
T a. growth hormone
T b. testosterone
T c. follicle stimulating hormone
T d. estrogen
F e. aldosterone.

Q. 35. **Spermatozoa mature in which of the following organs**
T a. Epidydimis
F b. Vas-deferens
F c. Rete-testes
F d. Prostate
F e. All.

Q. 36. **Regarding semen**
T a. contains fructose, prostaglandin, citrate and phosphate.
T b. has milky appearance.
F c. volume is 5-10 ml/ejaculation
F d. pH is acidic
F e. it is mainly provided by fluid in the vasdeferens.

Q. 37. **A man may become infertile**
T a. if the spermatozoa are non motile
T b. if the testes remain in abdomen
T c. if suffered from mumps
T d. due to vasectomy.
F e. if spermatozoa is below 200 million/ml in semen.

Q. 38. **Nightmares are seen in**
T a. REM sleep
F b. NREM stage II
F c. NREM stage III
F d. NREM stage IV
F d. NREM stage V.

Q. 39. **In a male newborn the adrenogenital syndrome (con genital hyperplasia of the adrenal glands) is most often associate with**
T a. Normal appearing genitalia
F b. Hypoglycemia
F c. Pseudohermaphroditism
F d. Persistent paramesonephros (Mullerian ducts)
F e. All.

Female reproductive system

Q. 40. **In the female genital tract the spermatozoa do not live for more than**
T a. 48 hours
F b. 12 hours
F c. 24 hours
F d. 36 hours
F d. 72 hours

Q. 41. **Maximum growth spurt is seen in girls at time of**
T a. Pubarche
F b. Thelarche
F c. Menarche
F d. Adrenarche
F e. All.

Q. 42. **Normal body temperature can be raised by**
T a. Gonadotrophins

F b. Androgens
F c. Oestrogen
F d. Progesterone
F e. None.

Menstruation & ovulation

Q. 43. **In the endometrial cycle**
T a. menstruation occurs due to lack of estrogen and progesterone.
T b. there are prolifemtive, secretory and menstrual phase.
F c. proliferative phase is under the influence of progesterone.
F d. secretory phase is under the influence of estrogen.
F e. LH surge is required for menstruation.

Q. 44. **Elasticity of cervical mucous is seen at time of**
T a. Midcycle
F b. Proliferative
F c. Luteal stage
F d. Menstruation
F e. All.

Q. 45. **During follicular phase occurs the**
T a. develoment of antral follicle
T b. menstruation
T c. proliferation of endometrium
F d. secretion of progesterone
F e. reduced vascularization.

Q. 46. **During luteal phase, occurs the**
T a. glycogen storage in endometrium
T b. secretion of progesterone
T c. vascularization of endometrium
F d. proliferation of endometrium
F e. development of antral follicle.

Q. 47. **Ovulation**
T a. leads to begin secretion of progesterone
T b. needs diminishing estrogen secretion after prolonged phase excessive secretion to occur.
T c. needs LH to occur
F d. occurs during proliferative phase of the female sexual cycle
F e. usually occurs 28 days after the onset of menstruation.

Q. 48. **If a lady presents with a very regular 29 days menstrual cycle, ovulation should occur on day**
T a. 15
F b. 14
F c. 17
F d. 19
F e. 9

Q. 49. **Ovulation coincides with**
T a. LH surge
F b. Increase in progesterone
F c. GnRH release
F d. Increase in Oestrogen
F e. None.

Q. 50. **In ovarian cycle**
T a. ovulation does not occur by contraceptive pills
T b. there is normally discharge of single mature ovum in each ovarin cycle.
F c. follicular phase is under the control of estrogen
F d. luteal phase is under control of progesterone
F e. basal body temperature is decreased at the time of ovulation.

Q. 51. **An important facilitatory neurotransmitter mediating coitus induced ovulation is**
T a. Serotonin
F b. Dopamine
F c. Adrenalin
F d. Noradrenalaine
F e. None.

Q. 52. **Progesterone**
T a. prepares the uterus for implantation of the fertilized ovum
T b. causes development of decidual cells in the uterine endometrium
T c. is a steriod hormone
T d. promotes the development of the lobule and alveoli of the breast
F e. increases the uterine contraction during pregnancy.

Q. 53. **Progesterone is produced by**
T a. Granulosa luteal cells
F b. Theca cells
F c. Stroma of ovary
F d. Sertoli cells
F e. All.

Q. 54. **Estrogen**
T a. stimulates the growth of ductile system of breast
T b. causes Na^+ and water retention by the renal tubules.
T c. is formed from cholesterol
F d. acts by activating cAMP system
F e. is only secreted by the ovarian cells

Q. 55. **Estrogen acts on**
T a. Nuclear receptors
F b. Cellular membrane receptors
F c. Cytoplasmic receptors

F d. Mitochondrial receptors
F e. All.

Q. 56. **Estrogen acts on**
T a. Nucleus
F b. Mitochondria
F c. Cell membrane
F d. Cytoplosmic receptor
F e. None.

Q. 57. **Which is not caused by estrogen**
T a. Decreased folate levels
F b. Decreased HDL
F c. Increased blood sugar
F d. Decreased serum alkaline phosphatase
F e. All.

Q. 58. **The excretion of estrogens and progesterones are through**
T a. Urine
F b. Bite
F c. Sweat
F d. Feces
F e. All.

Q. 59. **Function of leutenizing hormone is**
T a. Follicle maturation and ovulation
F b. Milk secretion
F c. Causes progesterone secretion during ovulation
F d. Maintains placenta
F e. All.

Pregnancy, Labour & Lactation

Q. 60. **The viability of the spermatozoa within the female genital tract is upto ..... hrs.**
T a. 48
F b. 6
F c. 12
F d. 24
F e. 36.

Q. 61. **Fertilization of ovum occurs in the**
T a. ampulla of the uterine tube
F b. body of the uterine tube
F c. fundus of the uterus
F d. isthmas of the uterine tube
F è. abdominal cavity.

Q. 62. **Endocrine function of placenta is to secrete**
T a. prolactin
T b. human chorionic gonadotropin
T c. estrogen
T d. progesterone
F e. oxytocin

Q. 63. **In pregnancy**
T a. Plasma fibrinogen levels are increased
F b. Fibrinogen levels are decreased
F c. Thyroglobulins are decreased
F d. IgD are markedly increased
F e. All.

Q. 64. **Maternal changes system during pregnancy are increased**
T a. blood volume
T b. cardiac output to 30-40% above normal
T c. heart rate
F c. blood pressue
F e. white blood cell count.

Q. 65. **For the maintenance of pregnancy, progesterone**
T a. stimulates the growth of the endometriun
T b. prepares breast for milk production
T c. serves as precursor for estrogen synthesis
F d. causes contractions of the uterus
F e. inhibits the secretion from endometrial gland

Q. 66. **During pregnancy ovultion is ceassed due to**
T a. high levels of estrogen
T b. inhibition of the secretion of GnRH
T c. low levels of LH
F d. low levels of progesterone
F e. high levels of FSH.

Q. 67. **Maximum production of HCG occurs during**
T a. Third trimester
F b. First trimester
F c. Second trimester
F d. Implantation
F e. All.

Q. 68. **Human chorionic gonadotropic hormone**
T a. is a placental hormone
T b. promotes growth of corpus luteum.
T c. can be detected in the urine as an early sign of pregnancy
F d. is chemically steroid in nature
F e. acts on the uterus to maintain normal endometrium

Q. 69. **HCG (human chorionic gonadotropin)**
T a. acts on the ovaries to maintain corpusluteum
T b. can be detected in the urine.
F c. is secreted by hypothalamus
F d. is a steroid hormone
F e. concentration in the blood rises steadily through out the pregnancy

Q. 70. **Human chorionic somatomammotropin hormone**
T a. is a placental hormone
T b. causes deposition of protein

T c. has molecular weight of about 38000
T d. decreases insulin sensitivity and deecrea ses utilization of glucose in mother.
F e. is chemically steroid in nature

Q. 71. **The human chorionic gonadotropin prevents regeneration of**
T a. corpus luteum
T b. stimulates the corpus luteum
T c. stimulates steroid synthesis in fetus
F d inhibits testosterone production by fetal testes
F e. stimulates maternal lymphocyte production

Q. 72. **Hormone which does not cross placenta**
T a. Insulin
F b. Thyroxine
F c. Oestrogen
F d. None
F e. All.

Q. 73. **The uterine contraction of labour are stimulated by**
T c. oxytocin
T e. prostaglandin.
T d. relaxin
F a. estrogen
F b. progesterone

Q. 74. **Under stressful condition, secretion of**
T a. cortisol is increased
T b. growth hormone is increased.
F c. oxytocin is decreased
F d. erythropoietin is increased
F e. aldosterone is decreased

Q. 75. **Prolactin**
T a. concentration during pregnancy is 10-20 times higher than that of non preganant preiod
T b. is concerned with secretion of milk
F c. is secreted by ovary
F d. is concerned with ejection of milk
F e. secretion is regulated by anterior pituitary gland.

Q. 76. **Braxton-Hicks contractions**
T a. Occur during most of the months of pregnancy
F b. Is a positive feedback system
F c. Is another terms for labor contractions
F d. Result in hypoxia of the fetus
F e. All.

Q. 77. **Pregnant women who have had five or more previous babies differ from those who have had none in that they have a greater risk of**
T a. Developing anaemia
T b. Complications due to Rhesus incompatibility
T c. Malpresentation
T d. Involuntary passing of urine while coughing or laughing
T e. All of the above

Q. 78. **Oogonia are derived from**
T a. Yolk Sac
F b. Amnion
F c. Stroma of ovary
F d. Germinal epithelium
F e. All.

Q. 79. **The role of Human placental lactogen is**
T a. Growth of fetus
F b. Stimulate milk production
F c. Fetal breast development
F d. Endocrine regulation
F e. None

Q. 80. **Disseminated intravascular coagulation is seen in**
T a. Retained placenta
F b. Hemophilia
F c. Thrombocytopenia
F d. None
F e. All.

Q. 81. **Temporary methods of contraception are**
T a. oral pill
T b. intrauterine contraceptive device (IUCD)
T c. condom
F d. vasectomy
F e. tubectomy.

Menopause

Q. 82. **Regarding menopause**
T a. it occurs at the ages of 45-55 years of life
T b. large quantities of FSH and LH are produced after menopause
T c. reproductive function of females is lost after menopause.
T d. it occurs due to burning out of ovaries
F e. concentration of estrogen is increased after menopause

Q. 83. **Menopause is characterizied by**
T a. diminished female sex hormones concentration
T b. continuous secretion of large amount of follicle stimulating hormone
T c. hot flushes.
F d. temporary amenorrhea
F e. onset of first menstruation

Q. 84. **Menopausal hormonal relations are**
T a. Gonadotropins increase estrogens decrease

F b. LH/TSH increase
F c. Estrogens and gonadotropins decrease
F d. Both increase.
F e. All.

Q. 85. **Levels of which of the following hormones are increased in post menopauusal women**

T a. FSH
F b. Estrogen
F c. Progesterone
F d. Cortisone
F e. All.

Q. 86. **Menopausal hot flushes is due to**

T a. LH Surge
F b. Decreased estroge
F c. Decreased progesteron
F d. FSH Surge
F e. None

Q. 87. **Estrogen in the post menopausal women is metabolised mostly into**

T a. Estrone
F b. Estriol
F c. Estradiol
F d. Androstenedione
F e. All.