UNIT 12

REPRODUCTIVE SYSTEM

The reproductive system includes the male reproductive system functions to produce and deposit sperm and the female reproductive system functions to produce egg cells (ovum) and to protect and nourish the fetus until birth.

Reproduction

Reproduction is the process of producing own kinds of off springs to maintain the continuity of race. In human beings, sexual type of reproduction takes place and for this type of reproduction, male and female reproductive systems are required.

MALE REPRODUCTIVE SYSTEM

Male reproductive system is the system of sex organs of male human beings that is a part of the overall reproductive process of human beings.

Functions of Male Reproductive System

1. Production, maturation and storage of spermatozoa (sperm cell).
2. Delivery of spermatozoa in semen into the female reproductive tract.

Organs of Male Reproductive System

1. Primary sex organs
    - Testes
2. Accessory sex organs
    - Scrotum
    - Penis
    - Urethra
    - Epididymis
    - Vas deferens
    - Spermatic cords
    - Seminal vesicle
    - Ejaculatory duct
    - Prostate gland

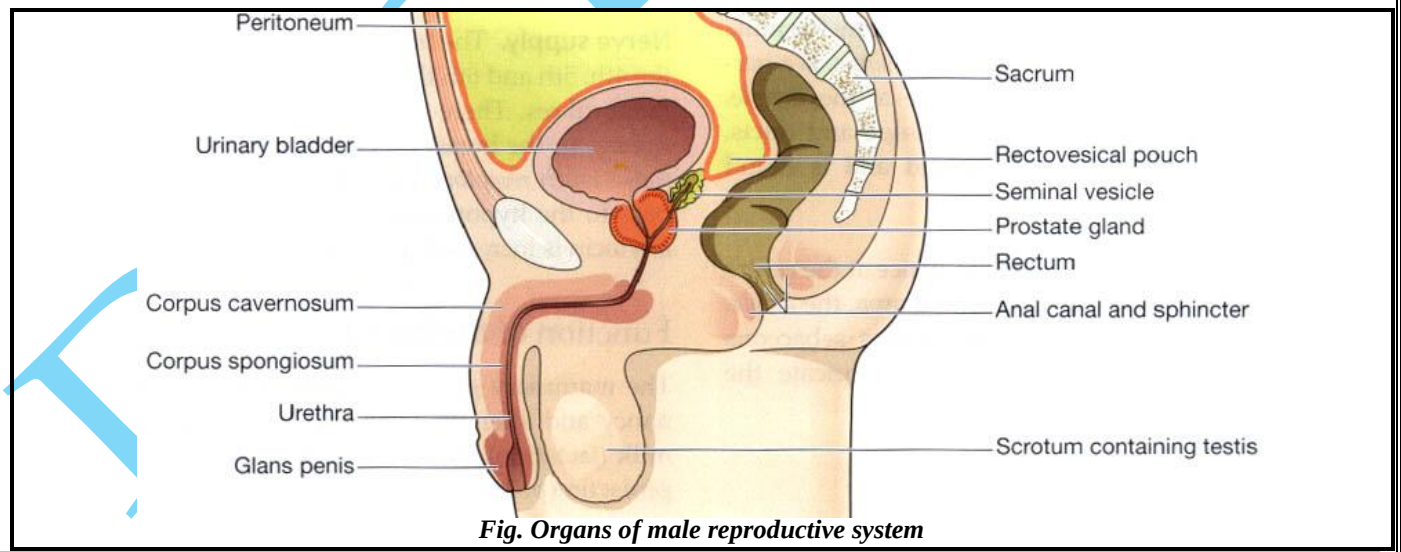


Fig. Organs of male reproductive system

TESTES

Testes are the male reproductive glands or organs. It is paired small, oval, pink coloured bodies. It is situated outside the abdominal cavity and inside the scrotum. It is about 4.5cm long, 2.5cm wide and 3cm thick. It is about 10 to15gm in weight.

Structure of Testes

1. **Covering of testis:** The testes are covered by three layers of tissues.

- **Tunica vaginalis:** Tunica vaginalis is the outer layer of testes. It is made up of serous membrane.

- **Tunica albuginea:** Tunica albuginea is the middle layer of testes. It is made up of fibrous tissue.
- **Tunica vasculosa**: Tunica vasculosa is the inner layer of testis. It is made up of connective tissue and it is rich in blood vessels.

2. **Glandular part of testis (internal structure):** Each testis consists of 200 to 300 lobules. Each lobule contains 1 to 4 highly convoluted loops of germinal epithelial cells called seminiferous tubule. Between the seminiferous tubule are group of Interstitial cells (cells of Leydig) that secrete the hormone testosterone after puberty.

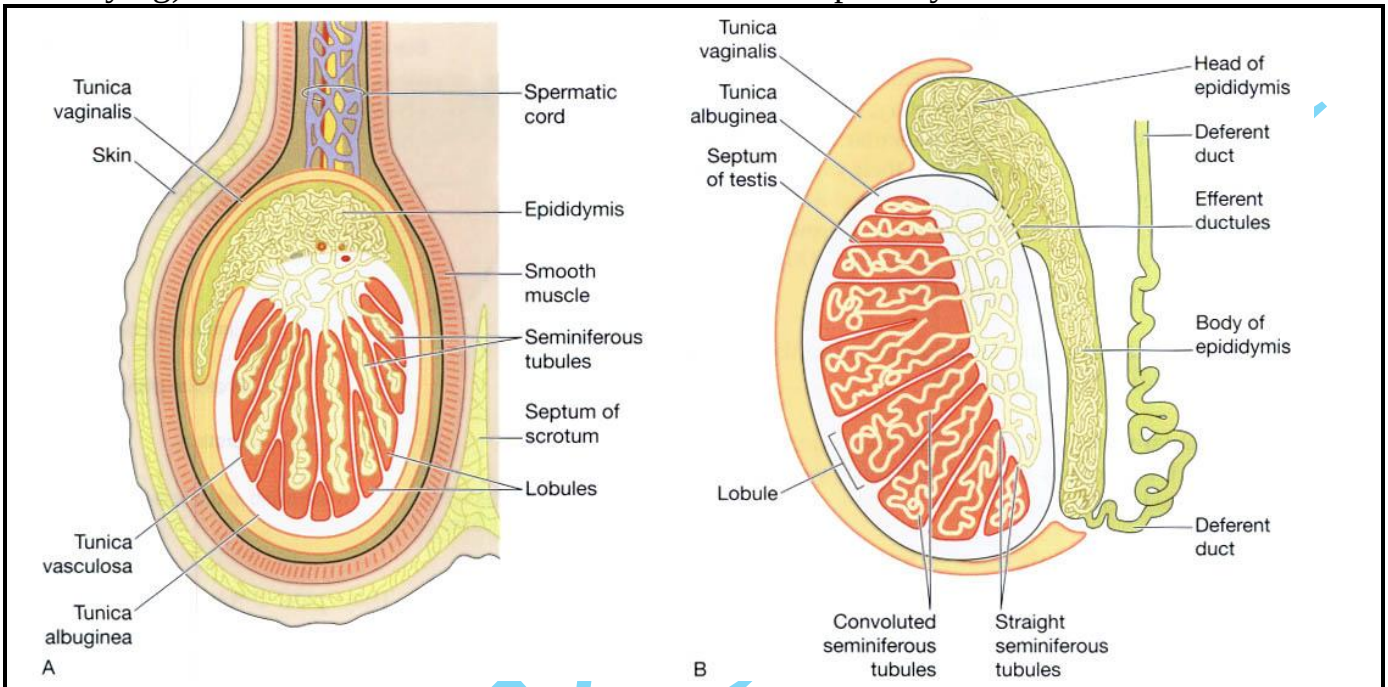


Fig. Structure of testes

Functions of Testis

1. Gametogenic function: Testes produce spermatozoa.
2. Endocrine function: Testes secrete male sex hormone known as testosterone.

SCROTUM

The scrotum is a pouch of pigmented skin. It lies below the symphysis pubis, in front of the upper parts of the thighs and behind the penis. Scrotum maintains optimal temperature during spermatogenesis.

PENIS

The penis is the male external genital organ for passage of urine and semen to the exterior. It is cylindrical, muscular, erectile, spongy organ, about 10cm long, 4cm breadth. It is also known as copulation organ.

URETHRA

See the Unit 10 (Urinary System)

EPIDIDYMIS

It is in the form of a narrow, coiled tube connecting the efferent ducts from the rear of each testis to its vas deferens. The epididymis stores sperm and transport from testes to vas deferens.

VAS DEFERENS

Vas deferens is also known as deferent duct. It passes upwards from the testis and joined by the duct from the seminal vesicle to form the ejaculatory

SPERMATIC CORD

The spermatic cords suspend the testes in the scrotum. Each cord contains a testicular artery, testicular veins, lymphatics, a deferent duct and testicular nerves.

SEMINAL VESICLES

Seminal vesicles are two small fibro muscular pouches. They are situated in the lower abdomen on either side of prostate.

Functions of Seminal Vesicles

The seminal vesicles secrete seminal fluid. The seminal fluid provides nutrition of sperm and clotting of sperm.

EJACULATORY DUCT

The ejaculatory ducts are two short tubes about 2 cm long. They pass through the prostate gland and join the prostatic urethra, carrying seminal fluid and spermatozoa to the urethra.

PROSTATE GLANDS

Prostate gland is lies in the pelvic cavity in front of rectum and behind the symphysis pubis, completely surrounded by the urethra as it emerges from the bladder. The gland weighs about 8 to 16 gm but progressively enlarges with age and is likely to weigh about 40 gm by the age of 50. The prostate gland secretes prostatic fluids.

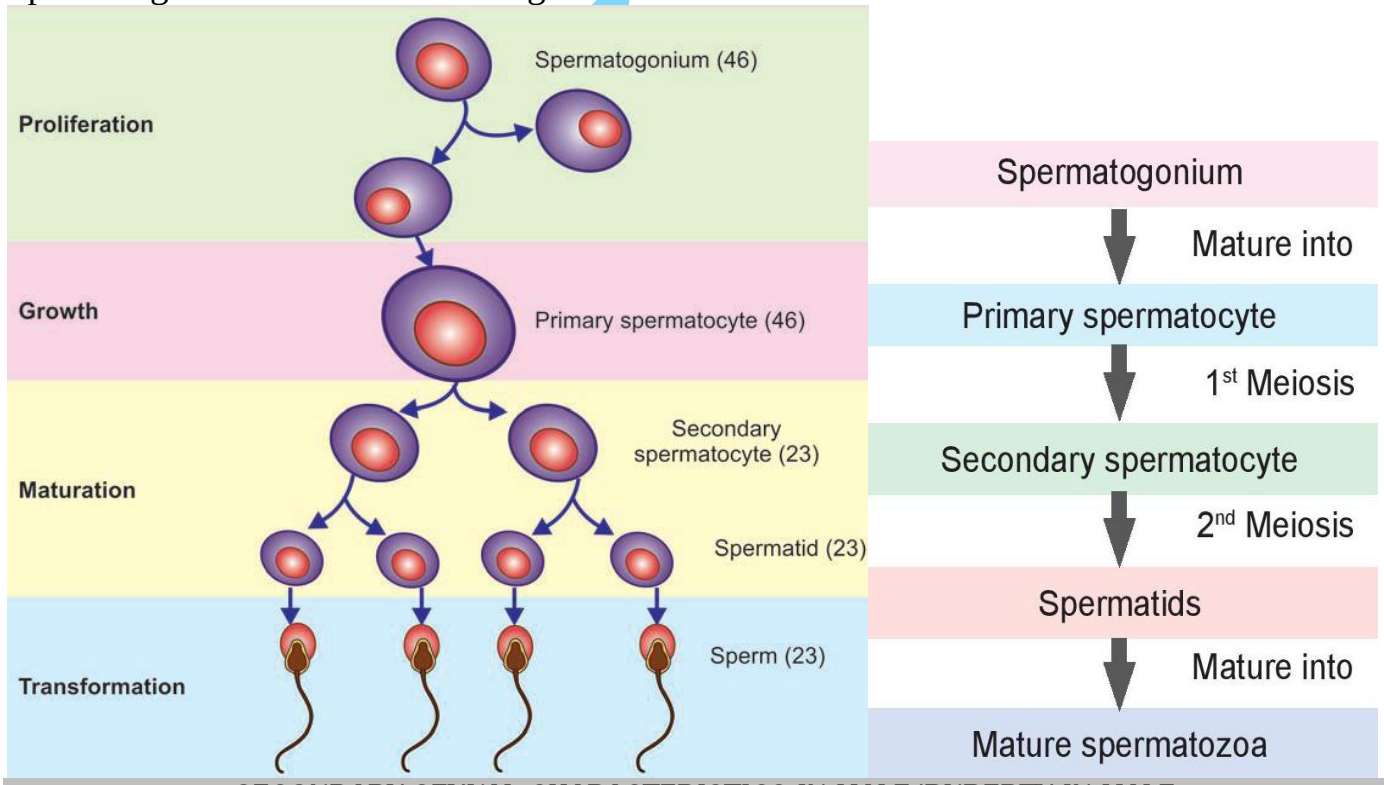
SPERMATOGENESIS

The maturation process by which spermatogonium is converted into mature sperm is known as spermatogenesis.

- **Site of production** : Seminiferous tubule in testes.
- **Starting** : From puberty
- **Duration** : 64 days

Stages of Spermatogenesis

Spermatogenesis occurs in four stages:



SECONDARY SEXUAL CHARACTERISTICS IN MALE/PUBERTY IN MALE

Puberty occurs between the ages of 10 to 14. Luteinizing hormone from the anterior lobe of the pituitary gland stimulates the interstitial cells of the testes to increase the production of testosterone. Under the influence of testosterone, sexual maturation and other characteristic changes take place, including:

1. Growth of muscles and bones and a marked increase in height and weight.
2. Enlargement of the larynx and deepening of the voice.

3. Enlargement of the penis, scrotum and prostate gland.
4. Maturation of the seminiferous tubules and production of spermatozoa.
5. Thickening of the skin, which becomes oilier.
6. Growth of hair on the face, axilla, chest, abdomen and pubis.
7. Mental inclination to the opposite sex.

FEMALE REPRODUCTIVE SYSTEM

Female reproductive system is the system of reproduction in female human beings. Females have to bear fetus during fetal period of development within their bodies.

Functions of Female Reproductive System

1. Formation of ova.
2. Reception of spermatozoa.
3. Provision for suitable environments for fertilization for fetal development.
4. Parturition (child birth).
5. Lactation, the production of breast milk, which provides complete nourishment for the baby in its early life.

Organs of Female Reproductive System

The female reproductive organs are divided into three parts:

1. External female reproductive organs/ External genitalia/ the vulva
    a. Mons pubis
    b. Labia majora
    c. Labia minora
    d. Clitoris
    e. Hymen
    f. Vestibular glands
    g. Perineum
2. Internal female reproductive organs/Internal genitalia
    a. Vagina
    b. Uterus
    c. Uterine tube
    d. Ovary
3. Mammary glands/ Breast

EXTERNAL FEAME REPRODUCTIVE ORGANS

a. Mons pubis: It is a rounded eminence present in front of the pubic symphysis. It is formed by accumulation of subcutaneous fat. It is covered with pubic hair, after puberty.

b. Labia majora: Labia majora are two large folds forming the boundary of the vulva.

c. Labia minora: Labia minora are two smaller folds of skin between the labia majora, containing numerous sebaceous and eccrine sweat glands.

d. Clitoris: The clitoris is an erectile organ, homologous (similar) to the penis .It is situated behind the anterior commissure of the labia majora.

e. Hymen: Hymen is a thin membrane which covers the vaginal orifice of virgin woman. It is usually perforated so as to allow menstrual flow.

f. Vestibular glands: The vestibular glands (Bartholin's glands) are situated on each side near the vaginal opening. They are about size of a small pea and have ducts. The vestibular glands are secreting mucus that keeps the vulva moist.

g. Perineum: The perineum is the short stretch of skin starting at the bottom of the vulva and extending to the anus. It is a diamond shaped area between the symphysis pubis and the coccyx.

INTERNAL FEMALE REPRODUCTIVE ORGANS

The internal female reproductive organs are lies in the pelvic cavity and consist of vagina, uterus, fallopian tube, ovaries.

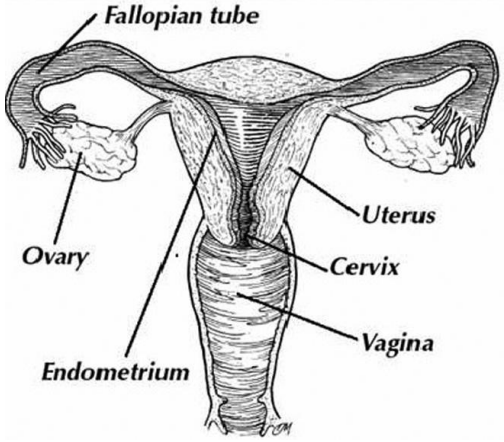


Fig: Internal female reproductive organs

VAGINA

The vagina is a fibro muscular tube. It lies in the front of the rectum & anus and behind the urinary bladder. It is about 8cm long. The vagina is also known as vaginal canal, birth canal or vaginal orifice.

Structure of Vagina

The vagina is composed of three layers:

- The outer layer is composed of areolar tissue.
- The middle layer is composed of smooth muscle.
- The inner layer is composed of stratified squamous epithelium.

Functions of Vagina

1. It provides pleasurable sensations during sexual intercourse.
2. The walls of the vagina self-lubricate to reduce the friction that can be caused by sexual activity.
3. It forms part of the birth canal and it is the excretory duct for the menstrual flow.

UTERUS

Uterus is a hollow, pear shaped, thick walled, muscular organ. It is situated in the pelvic cavity between the urinary bladder and rectum. It is also known as womb. It is about 7.5cm long, 5cm wide, 2.5cm thick and weight is about 30 to 40 gm.

Parts of Uterus

The uterus is divided into three parts:

a. **Fundus:** It lies above the entrance of the uterine tubes.
b. **Body:** It lies below the entrance of the uterine tubes.
c. **Cervix:** It lies pierces the anterior wall of the vagina.

Structure of Uterus

The wall of the uterus is composed of three layers of tissue:

a. **Perimetrium:** The outer layer of uterus is known as perimetrium. It consists of peritoneum (serous membrane).
b. **Myometrium:** The middle layer of uterus is known as myometrium. It consists of smooth muscle fibers interlaced with areolar tissue, blood vessels and nerves.
c. **Endometrium:** The inner layer of uterus is known as endometrium. It consists of columnar epithelium and large number of mucus secreting tubular glands.

Support of Uterus

The uterus is supported in the pelvic cavity by surrounding organs, muscles of the pelvic floor and ligaments. The ligaments are:

1. Broad ligaments:
2. Round ligaments
3. Uterosacral Ligaments
4. Transverse ligaments

5. Pubocervical ligament

Functions of Uterus

1. It provides site for implantation of embryo.
2. It provides space for growth of fetus.
3. It provides nutrition to the fetus.
4. It helps in passage way of sperm to reach to the fallopian tube for fertilization, for menstruation.
5. The periodic contraction and relaxation of uterus during labor, it expel out the fetus.

FALLOPIAN TUBE

The fallopian tubes are two tortuous ducts, which extend from the lateral side of uterus to ovary. They are also known as oviducts, uterine tubes or salpinges (singular salpinx). It is about 10 cm long.

Parts of Fallopian Tube

The fallopian tube is divided into four parts:

a. **Interstitial or Intramural Part:** It is the segment that pierces the uterine wall.
b. **Isthmus:** It is situated just lateral side to the uterus.
c. **Ampulla:** It is the widest part of the tube. It is most common site of fertilization.
d. **Infundibulum:** It is the funnel-shaped lateral end of the fallopian tube that projects beyond the broad ligament and overlies the ovary.

Structure of Fallopian Tube

The uterine tube consists of three layers of tissue:

- The outer layer consists of peritoneum and is formed by the broad ligament.
- The middle layer consists of smooth muscle.
- The inner layer consists of ciliated epithelium tissue.

Functions of Fallopian Tube

1. It receives ovum from the ovary and provide a site of fertilization.
2. It provides nourishment for the fertilized ovum and transports it to the cavity of the uterus.
3. It transports spermatozoa from the uterus to the ampulla part of the uterine tube.

OVARIES

The ovary is the female reproductive organs or endocrine glands of the body. It is situated in the shallow fossae on the lateral wall of the pelvis. It is about 2.5 to 3.5 cm long, 2 cm wide and 1 cm thick.

Structure of Ovary

The ovary contains:

- A central soft tissue known as stroma.
- An outer surface known as germinal epithelium.

The germinal epithelium contains the graffian follicles. The graffian follicles contain the ova. The ova are surrounded by a fluid known as liquor folliculi.

Functions of Ovary

1. Formation, development and maturation of ova (ovum cells).
2. Discharge mature ovum at each mense.
3. Production of sex hormones such as oestrogen and progesterone.

ESTROGEN

In a normal nonpregnant female, estrogen is secreted in large quantity by ovarian follicles and in small quantity by corpus luteum of the ovaries. A small quantity of estrogen is also secreted by adrenal cortex. In pregnancy, a large amount of estrogen is secreted by the placenta.

Functions of Estrogen

1. It increases the size of uterus which is about double of its childhood size.
2. It increases the blood supply of endometrium (inner layer of uterus).
3. It increases the size of uterine tube.
4. It reduces the pH of vagina causing more acidity.
5. It increases the shape and size of vagina.
6. It develops the mammary glands (breast).
7. It develops the hair in the pubic region and axilla.
8. It brings softness and smoothness of the skin.
9. It changes the voice: The larynx remains in pre pubertal stage which produces high pitch voice.
10. It increases the bone growth (osteoblasts activity).

PROGESTERONE

In non pregnant female, a small quantity of progesterone is secreted by theca interna cells of ovaries during the first half of menstrual cycle, i.e. during follicular stage. But, a large quantity of progesterone is secreted during the latter half of each menstrual cycle, i.e. during secretory phase by the corpus luteum of ovaries. Small amount of progesterone is secreted from adrenal cortex also.

In pregnant female, large amount of progesterone is secreted by the corpus luteum in the first trimester. In the second trimester corpus luteum degenerates. Placenta secretes large quantity of progesterone in second and third trimesters.

Functions of Progesterone

1. It increases the thickness of the endometrium by increasing the number and size of the cells.
2. It increases the size of the uterine glands.
3. It increases the secretory activities of glandular cells.
4. It increases the deposition of lipid and glycogen in the stromal cells.
5. It promotes secretory changes in the mucosal lining of the fallopian tube.
6. It promotes the development of lobules and alveoli of the breasts by proliferating and enlarging the alveolar cells.
7. It increases the reabsorption of sodium and water through the renal tubules.

MAMMARY GLANDS

The mammary glands or breast are the modified apocrine sweat glands. It is found in both sexes but rudimentary in the male and well developed in the female after puberty.

Position of Mammary Glands

The breast is situated in the superficial fascia of the pectoral region, extent to the vertically, the 2nd to 6th rib and horizontally, it extends from the lateral border of sternum to the mid axillary line.

Structure of Mammary Glands

The mammary glands contain varying amounts of glandular tissue, supported by fat and fibrous connective tissue.

The breast contains 15 to 20 lobes, each of which contains a number of glandular structures known as lobules, which produce milk after child birth. Lobules open into tiny lactiferous ducts, which drain milk towards the nipple.

Function of Mammary Glands

It is only active during pregnancy and after childbirth, when they produce milk (lactation). The lactation is stimulated by hormones known as prolactin.

MENSTRUAL CYCLE

Menstrual cycle is defined as cyclic events that take place in a rhythmic fashion during the reproductive period of a woman's life. Menstrual cycle starts at the age of 12 to 15 years,

which marks the onset of puberty. The commencement of menstrual cycle is known as menarche. Menstrual cycle stops at the age of 45 to 50 years. Permanent cessation (stoppage) of menstrual cycle in old age is known as menopause.

Duration of Menstrual Cycle

Duration of menstrual cycle is usually 28 days. But, under physiological conditions, it may vary between 20 and 40 days.

Phases of Menstrual Cycle

During each menstrual cycle series of changes occur in uterus, ovaries, vagina and cervix. All these changes can be grouped into three phases:

- Menstrual phase
- Proliferative phase
- Secretory phase.

1. **Menstrual phase**
   - It is also known as mense.
   - It involves discharge of blood, connective tissue and mucus from endometrium.
   - The loss is about 50-100 ml and continues for 3-5 days.
   - In this time level of oestrogen and progesterone is very low in the blood.
   - It occurs only when the ovum is not fertilized.
2. **Proliferative phase**
   - It consists of rapid proliferation of endometrial cells, after mense from 5-14 days.
   - The follicle stimulating hormone (FSH) stimulates the development of graffian follicles.
   - The graffian follicles cells secrete oestrogen. Its level is maximum at 12th day of cycle.
   - The endometrium becomes thick and more vascular and becomes ready for implantation
   - The uterine movements increase due to contraction of uterine muscles.

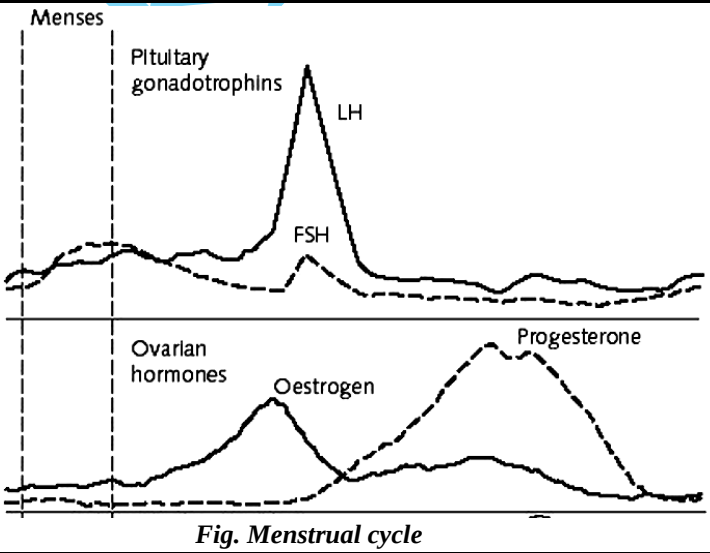


Fig. Menstrual cycle

3. **Secretary phase**
   - It occurs from 14th-28th days.
   - In this phase secretion of luteinizing hormone (LH) form anterior pituitary gland.
   - The luteinizing hormone (LH) and follicle stimulating hormone (FSH) stimulate ovulation.
   - The corpus luteum secretes progesterone hormone.
   - Progesterone inhibits further maturation of any follicle or ovulation.
   - Progesterone stimulates thickening of endometrium. It stimulates uterine gland to secrete mucus.

- Progesterone also affects the mammary gland.
- If ovum is not fertilized, the corpus luteum starts to degenerate and level of progesterone and estrogen is decreased. At 28th day, the progesterone level falls, the blood vessels constrict and prevent the blood supply to endometrium. It results in shedding off the endometrium causing menstrual flow.

MENOPAUSE

The permanent cessation of menstruation in old age is known as menopause. Normally, it occurs at the age of 45 to 55 years. It is also known as climacteric.

Causes of Menopause

Menopause is a natural process that occurs as the ovaries age and produce less reproductive hormones. The body begins to undergo several changes in response to lower levels of:

- Estrogen
- Progesterone
- Testosterone
- Follicle-stimulating hormone (FSH)
- Luteinizing hormone (LH)

Symptoms of Menopause

In the months or years leading up to menopause (perimenopause), the signs and symptoms includes:

- Irregular periods
- Vaginal dryness
- Hot flashes
- Chills
- Night sweats
- Sleep problems
- Mood changes
- Weight gain and slowed metabolism
- Thinning hair and dry skin
- Loss of breast fullness

Complications of Menopause

- Vulvovaginal atrophy
- Dyspareunia or painful intercourse
- Mood or sudden emotional changes
- Cataracts
- Periodontal disease
- Slower metabolic function
- Osteoporosis
- Urinary incontinence
- Heart or blood vessel disease
- Weight gain

PUBERTY IN FEMALE/ SECONDARY SEXUAL CHARACTERISTICS IN FEMALE

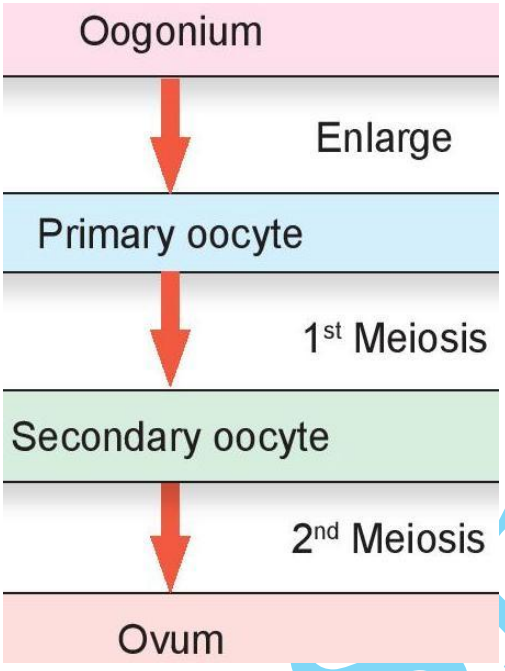
Puberty is the period during which growing girls undergo the process of sexual maturation. Puberty involves a series of physical stages or steps that lead to the achievement of fertility and the development of the secondary sex characteristics, the physical features associated with adult females (such as the growth of pubic hair). While puberty involves a series of biological or physical transformations, the process can also have an effect on the psychosocial and emotional development of the adolescent. The physical and physiological changes which occur at puberty are:

- Maturation of ovary, uterus and uterine tubes.
- Enlargement of vagina and breast.
- Growth of axillary and pubic hair.
- Increase in growth and widening of pelvis.
- Onset of menstruation and ovulation.
- Increase deposition of fat in subcutaneous tissues, especially at the hips and breast.
- Mental and emotional maturity.
- Changes in voice.
- Attraction of opposite sex.
- Increased deposition of fat in subcutaneous tissue.

OOGENESIS

The process of formation and development of ova from the primordial germ cell of the ovary is known as oogenesis. It starts during intrauterine life.

Stages of Oogenesis



Differences between Spermatogenesis and Oogenesis

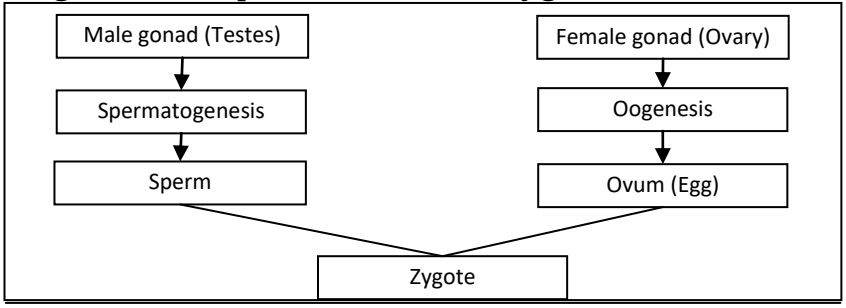
No	Spermatogenesis	Oogenesis
1.	It is the production of sperm from spermatogonia.	It is the production of ovum from oogonia.
2.	It occurs inside the testes in males.	It occurs inside the ovary in females.
3.	All stages occur inside the testes.	All stages, except the last stage, occur inside the ovary.
4.	A primary spermatocyte divides to form two secondary spermatocytes.	A primary oocyte divides to form on secondary oocyte and one polar body.
5.	No polar body is formed.	Polar body is formed.
6.	A spermatogonium forms four spermatozoa.	A oogonium forms only one ovum.
7.	It is a continuous process and completed in approximately 74 days.	It is a discontinuous process and completed in a few days to year

OVULATION

Ovulation is the process by which the Graafian follicle in the ovary ruptures and the ovum is released into the abdominal cavity. It occurs 14 +-1 days after the onset of menstruation.

FERTILIZATION

Fertilization is a process of fusion of male gamete (spermatozoa) and female gametes (ovum or eggs) in ampulla region of fallopian tube to form zygote.



IMPLANTATION

Tropoblast cells have strictly properties and capacity to penetrate other cells. Once zone pellucida disappears, the cells of tropoblast stick to the uterine endometrium. This process is called implantation. It occurs approximately 6 to 7 days after fertilization. Normally site of implantation in human is posterior wall of body of uterus near fundus.

SEX DETERMINATION

The sperm enters the ovum 23 chromosomes from ovum and 23 chromosomes from the sperm join together to form the 23 pairs (46) of chromosomes in the fertilized ovum. Now, sex determination occurs. Ovum contains the X chromosomes. Sperm has either X chromosome or Y chromosome. If the ovum is fertilized by a sperm with X chromosome, the child will be female with XX chromosome. And if the ovum is fertilized by a sperm with Y chromosome, the sex of the child will be male with XY chromosome. So, the sex of the child depends upon the male partner.

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