UNIT 20

REPRODUCTION

Major Concept

20.1 Reproductive system of Man
20.2 Disorders of Reproductive System
20.3 Sexually Transmitted Diseases

Learning Outcomes

Students will be able to:

- Describe the structures of male reproductive system and identifying their functions.
- Explain the principal reproductive hormones of human male and explain their role in the maintenance and functioning of reproductive system.
- Explain the structures of female reproductive system and describe their functions.
- Describe the menstrual cycle emphasizing the role of hormones.
- Describe the causes of female and male infertility.
- Explain that *in vitro* fertilization (test tube babies) is one of the methods to solve the problem of infertility.
- Define miscarriage and state its causes.
- Relate miscarriage with abortion.
- Describe the causes, symptoms and treatment of gonorrhoea and syphilis.
- Explain AIDS as a worldwide sexually transmitted disease.

Introduction

Reproduction is the biological process by which organisms give birth or give rise to new organisms which may or may not be like their parents. It helps to continue their race. This is a fundamental process and seen in all organisms. Reproduction is important for survival and maintenance of all organisms. Without this process life would come to an end. A living organism does not need reproduction to survive, but as a species, they need this mechanism for continuity and to ensure that they are not extinct.

20.1 Reproductive System of Human

The reproductive system of human is different from all other systems of body in two ways.

i) It becomes functional at the age of puberty while other systems are functional at birth or shortly after birth.

ii) The other systems are almost similar but reproductive system is quite different in male and female human.

20.1.1 Male Reproductive System

The male reproductive system performs following main functions:

i) To produce, maintain and transport semen (sperms + fluids).

ii) To discharge semen within the female reproductive tract during **sexual intercourse**.

iii) To produce and secrete male **sex hormones,** responsible for maintaining the male reproductive system.

Unlike the female reproductive system, most part of male reproductive system is located outside of the body *i.e.* **penis**, **scrotum**, and **testicles** (testes) while some parts *i.e.* vas deferens and associated glands like seminal vesicles, prostate gland and Cowper's gland are located inside the body. (Fig.20.1)

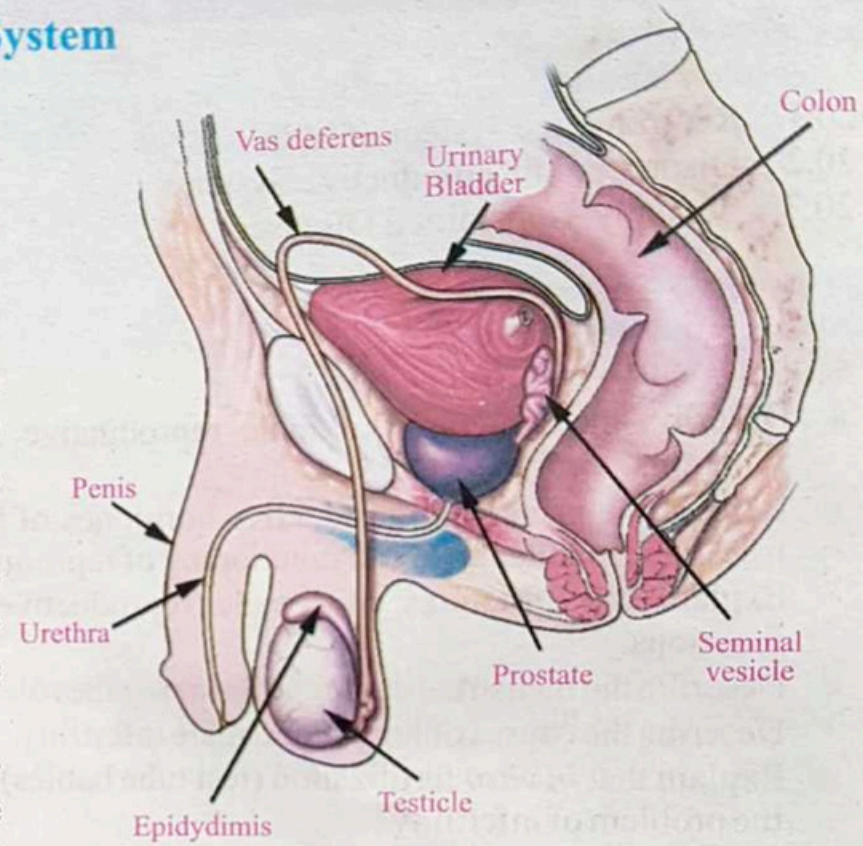


Fig. 20.1: Human Male Reproductive System

Testes

The testes (singular testis) are the male gonads. These are oval-shaped organs about the size of large olive seeds. These are located outside of body in scrotum. The scrotum is a large

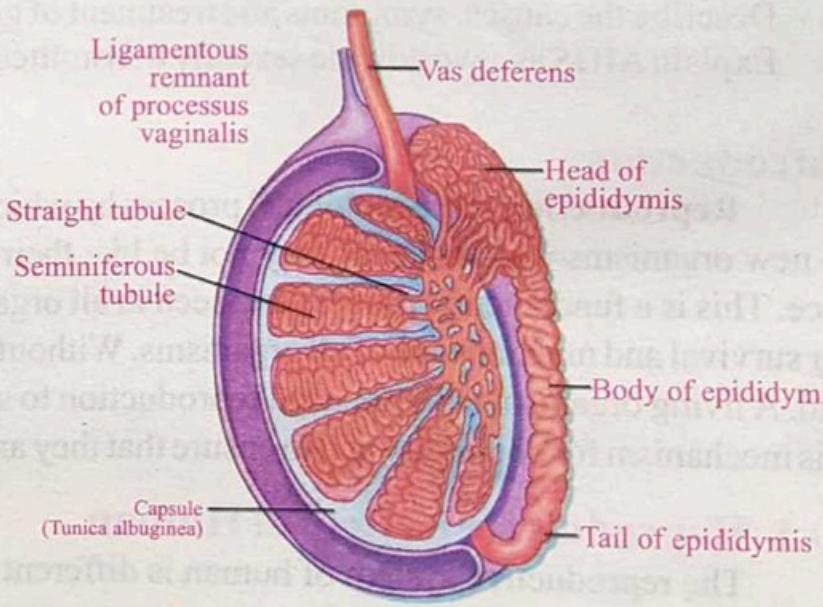


Fig. 20.2: Internal Structure of Testis

pouch like sac of skin that hangs behind and below the penis. The scrotum acts as climate control system for the testes, because for the normal sperm development, the testes must be at a temperature slightly cooler than the body temperature. The testes are usually two in number. In the testes there are coiled masses of tubules called **seminiferous tubules**. The sperms are produced in these tubules. The testes also produce male sex hormone called **testosterone** by leydig cells (interstial cells). (Fig.20.2)

Accessory Ducts

These include the following:

Epididymis:- It is a long coiled tube that rests on the back side of each testis. It stores and transports sperms. Here sperms also get mature.

Vas deferens:- It is a long muscular tube that travels from epididymis into the pelvic cavity to just behind the bladder.

Ejaculatory ducts:- The two vas deferens and two **seminal vesicles** join to form ejaculatory duct. The ejaculatory ducts empty into urethra.

Urethra:- The urethra is the tube that carries urine from bladder to outside of the body. In male, it has the additional function of ejaculating semen during sexual excitement. Therefore, urethra is also called **urinogenital duct**.

Copulatory Organ (Penis)

It is the male organ used in sexual intercourse. The skin of penis is loose and elastic to accommodate changes in penis size during an erection. The penis consists mainly of tissues that can fill with blood to cause an erection.

Accessory Glands:- Following three types of glands are associated with male reproductive system.

Extra Information

About 100 million sperms are released into the vagina during intercourse, only one of these will fertilize the egg.

Human Sperm

The human sperm has a head with a diameter of about 2.5um. It contains a large nucleus with little cytoplasm and acrosome. The nucleus carries a haploid set of chromosomes. The middle piece containing mitochondria which provide energy for sperm activity. The tail of sperm is a flagellum which enables the sperm to swim towards the egg.

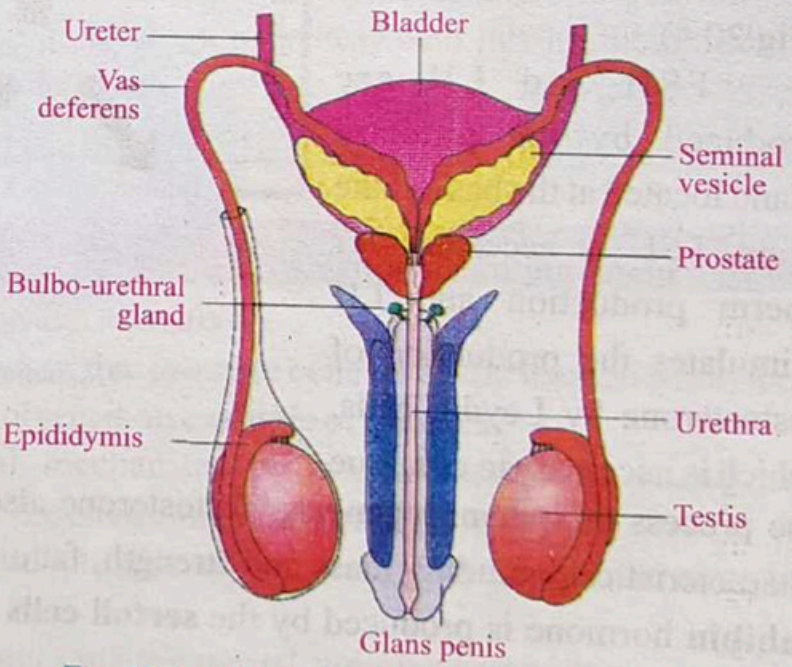


Fig. 20.3: Male Reproductive Organs (Front View)

Seminal Vesicle:- These are sac like pouches that attached to vas deferens near the base of the bladder. It produces a sugar rich fluid that provides sperms with a source of energy to help them move. (Fig.20.3)

Prostate glands

These are walnut size structure that are located below the urinary bladder at both side of urethra. The prostate gland contributes additional fluid to ejaculate, to nourish and protect the sperms.

Bulbourethral glands (Cowper's gland)

These are pea sized structures located on the side of urethra, just below the prostate glands. These glands produce a clear, slippery fluid which serves to lubricate and neutralize any acidity in urethra.

Hormonal Control of Male Reproductive Function

The entire male reproductive system is dependent on hormones. The primary hormones which involved in the functioning of the male reproductive system are: Follicle Stimulating Hormone (FSH), Luteinizing Hormone (LH) and testost-erone. (Fig.20.4)

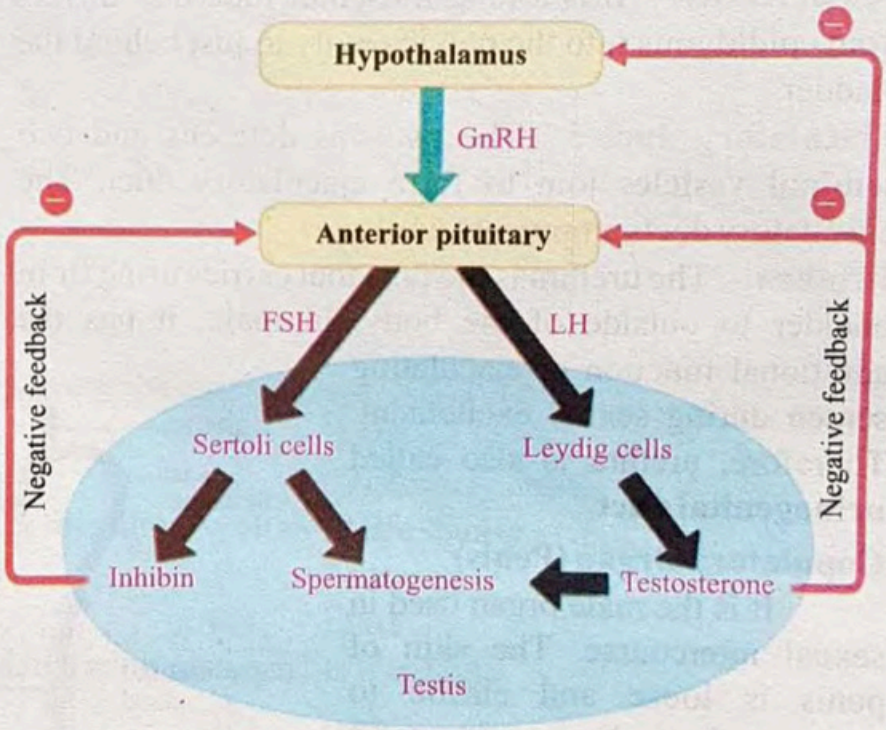


Fig.20.4: Hormonal Control of Male Reproductive System

FSH and LH are produced by the pituitary gland located at the base of the brain. FSH is necessary for sperm production and LH stimulates the production of testosterone by Leydig cells, which is necessary to continue the process of **spermatogenesis**. Testosterone also helps in the development of male characteristics, including mass and strength, fat distribution, bone mass and sex drive. **Inhibin** hormone is produced by the **sertoli cells** and controls the spermatogenesis at normal rate.

20.1.2 Female Reproductive System

The female reproductive system is more complex than the male reproductive system, because the male needs only to produce and deliver gametes. However, female reproductive system besides producing gametes also gestates, gives birth and nourishes the new born. The female reproductive system is also under the influence of menstrual cycle.

Structure of Female Reproductive System

The female reproductive system consists of following parts.

i) Ovaries ii) Ducts iii) External genitalia

i) Ovaries

There is a pair of **ovaries**, which are oval-shaped and attached to the dorsal body wall just below the kidneys. Eggs or ova develop inside the ovaries of mature female. There are approximately **4,000,00 potential (follicles) cells** are already present at birth, only about 500 will ever become mature within two ovaries and they are released from puberty to menopause. Usually, only one egg is released every month. The ovaries take turn alternate to release an egg.

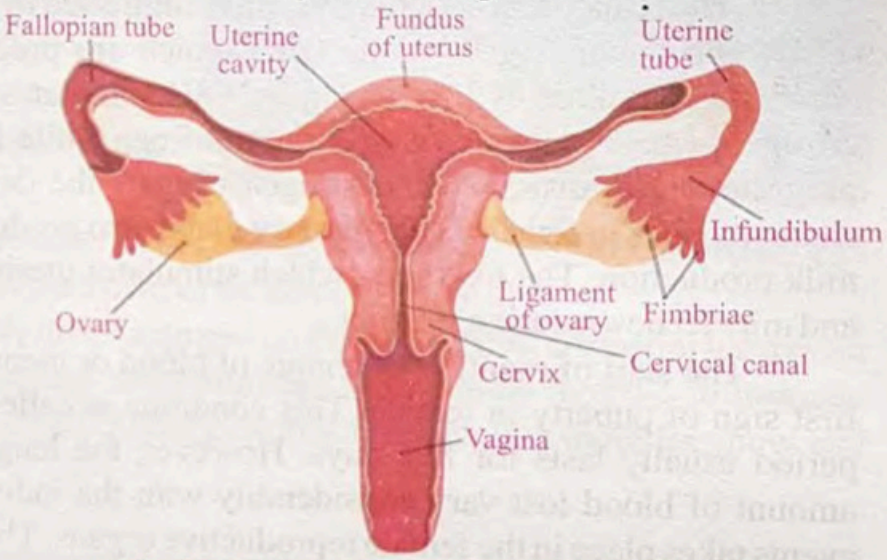


Fig. 20.5: Human Female Reproductive System

The egg is spherical in shape and about **120μm** in diameter, containing a large nucleus with haploid number of chromosomes. (Fig.20.5)

ii) Oviduct (Fallopian tube or uterine tube)

The ovary releases mature egg into oviduct which is a narrow muscular tube. It leads from ovary to the uterus. The egg is fertilized in the oviduct.

Uterus

Uterus is a pear shape elastic sac about 7.5cm long. It is the site for development of **fetus**. During pregnancy, the wall of the uterus consists of three layers. The outer layer is called perimetrium, middle layer is myometrium which is thick and muscular. The inner layer is known as endometrium which is spongy lining of

Extra Information

Reproductive system contains the largest cell of the body: the egg, which is about **120mμ** in diameter and smallest human cell: the sperm, about **5mμ** in diameter.

uterus. At the lower narrow end of the uterus is a circular ring of muscle known as cervix.

iii) External Genitalia (Vagina)

Leading from the cervix to the outside is the birth canal or vagina. It is thin walled 8-10cm long tube. The opening of the vagina is the **vulva**. Semen is deposited in the vagina during intercourse.

Extra Information

A female uterus is normally about 3 inches long and 2 inches wide which can expend up to 20 times during pregnancy. Uterus contains one of the strongest muscles in the female body.

20.1.3 Female Reproductive Cycle and its Hormonal Regulation

The female reproductive system is controlled by the follicle stimulating hormone (FSH) and luteinizing hormone (LH) which are produced by pituitary gland. Their release is controlled by hypothalamus. FSH stimulates the ovarian follicles to produce estrogen, which helps in the maturation of egg while LH stimulates the production of progesterone in ovaries. The estrogen triggers the development of secondary sexual characteristics in female. The pituitary gland also produces **prolactin**, which stimulates milk production. The **oxytocin**, which stimulates uterine contraction during child birth and milk let down during sucking.

The start of monthly discharge of blood or menses from uterus via vagina is the first sign of puberty in female. This condition is called **menstruation**. The menstrual period usually lasts for five days. However, the length of the menstrual period and amount of blood lost vary considerably with the individual. Every month, a cycle of events takes place in the female reproductive organs. This is called **menstrual cycle**. The average menstrual cycle for an adult female is 28 days. However, the menstrual cycle ranging from 21-33 days, are not abnormal. The effects of emotional disturbances, stress, mental fatigue and illness may alter or stop the menstrual cycle. An unbalance diet or malnutrition may cause the periods to be very irregular or to stop completely. A young girl may take about three years before her periods become regular.

The menstrual cycle has 4 phase:

Menstrual Phase

Menstruation is the elimination of the thickened lining of the uterus (endometrium) and blood from the body through the vagina. Menstrual fluid contains blood, cells from the lining of the uterus and mucus. The average length of this phase is 5 days.

Follicular Phase

The follicular phase starts on the stoppage of menstruation and ends with ovulation. The pituitary gland releases follicle stimulating hormone (FSH), which stimulates the ovary to produce about **5-20 follicles**. Each follicle houses an immature egg. Usually only one follicle will mature into an egg while the others die. The growth of

the follicles stimulates the lining of the uterus to thicken in preparation for possible pregnancy.

Extra Information

Fallopian tubes are about 12cm long and wide as a sewing needle.

Ovulation Stage

Ovulation is the release of mature egg from the surface of the ovary. This usually occurs mid of the cycle, about 14th day of the cycle.

During the follicular phase, the development of follicle causes a rise in the level of estrogen. The hypothalamus in the brain recognizing these rising levels and releases a chemical called **gonadotropin releasing hormone (GnRH)**. This hormone stimulates the pituitary gland to produce raised levels of luteinizing hormone (LH) and FSH within two days, ovulation is triggered by the high level of LH. The egg is funneled into the fallopian tube and toward the uterus by waves of small hair like projections. The life span of the typical egg is only around 24 hours.

Luteal Phase

During ovulation, the egg bursts out from its follicle, but the ruptured follicle stays on the surface of the ovary. For the next two weeks or so, the follicle transforms into the

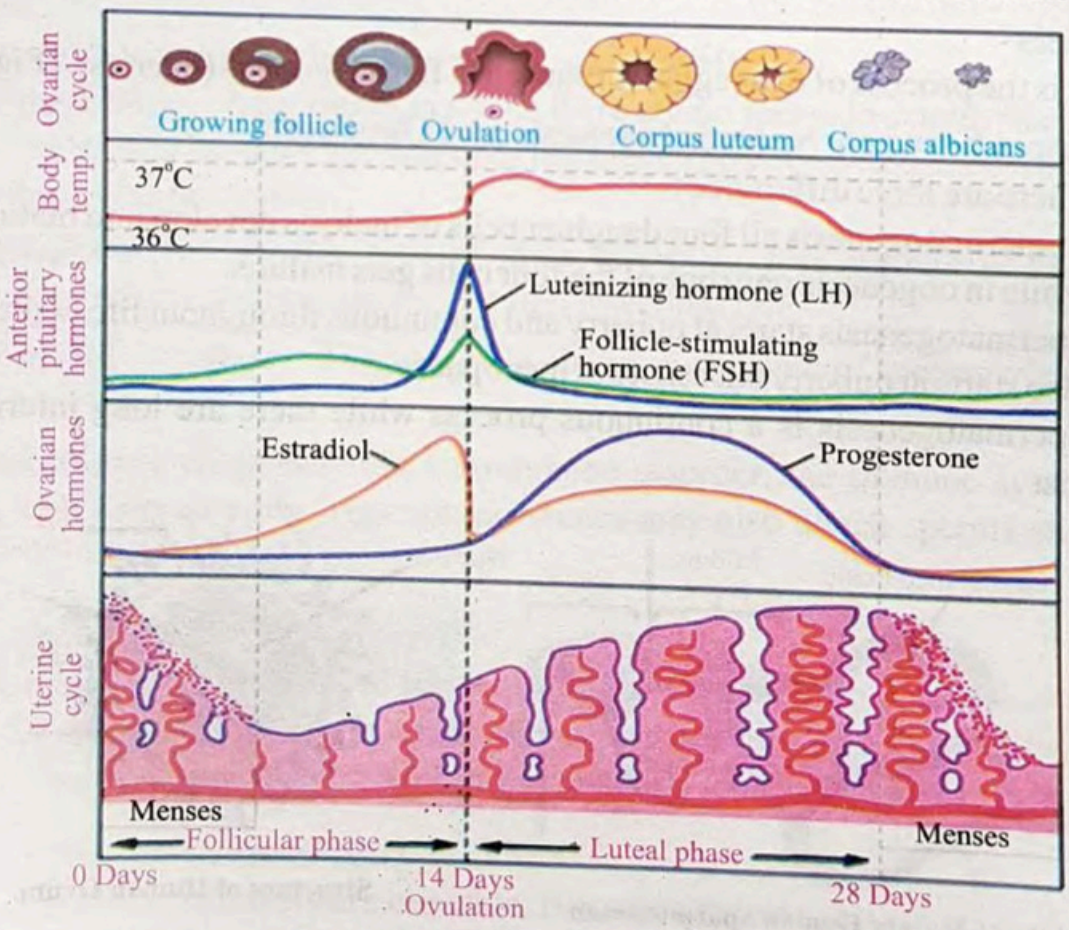


Fig.20.6: Menstrual Cycle in Human

structure called **corpus luteum**. This structure starts releasing progesterone along with small amount of estrogen. The combination of hormone maintains the thickened lining of the uterus of fertilized egg implants in the lining of the uterus. It produces the hormones that are necessary to maintain the corpus luteum. It induces the **human chorionic gonadotropin (hCG)**, the hormone that is detected in urine test for pregnancy. If pregnancy does not occur, the corpus luteum degenerates usually during day 22 after menstruation. The drop in progesterone level causes the lining of the uterus to fall away. This is known as menstruation. The cycle repeats. (Fig.20.6)

Extra Reading

Gametogenesis

- The production of gametes is known as gametogenesis.
- The process of gametogenesis occurs in gonads.
- The process of gametogenesis starts at puberty.
- There are two types of gametogenesis i.e. spermatogenesis and oogenesis.

Spermatogenesis

It is the process of sperm formation in male gonads (testes).

Oogenesis

It is the process of ova (eggs) formation in female gonads (overies). (Fig.20.7)

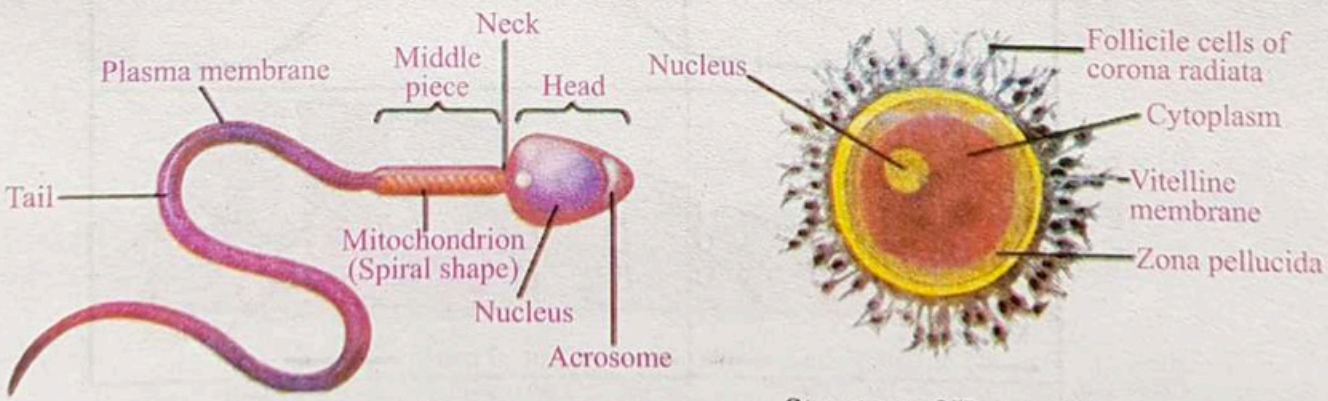
Differences between Spermatogenesis and Oogenesis

There are three differences

i) In spermatogenesis all four daughter cells of meiosis develop into mature gametes while in oogenesis only one of the four cells gets mature.

ii) Spermatogenesis starts at puberty and continuous throughout life while oogenesis also starts at puberty but ceases at menopause.

Spermatogenesis is a continuous process while there are long interruptions in oogenesis.



Structure of Mature Human Spermatozoan **Structure of Human Ovum**

Fig. 20.7: Structure of Sperm and Egg

Terms use for Human Ovum

Zona pellucida is thick transparent membrane surrounding a mammalian ovum before implantation.

Corona radiata is many layers' thick follicle cells adhering to oocyte which supply vital proteins to the cell.

Corpus albicans is regressed form of the corpusluteum.

20.2 Disorders of Reproductive System

The reproductive disorder is a disease or a condition when there is a problem in reproductive system of male or female. The main disorders of reproductive system include abnormal puberty, infertility in male and female and miscarriage in female. Here infertility and miscarriage will be discussed.

Infertility

In general, **infertility** is defined as not being able to get pregnant after one year (or longer of unprotected sexual intercourse between partners). This infertility may be in male or female.

20.2.1 Causes of Male Infertility

Some common causes of male infertility are as under:

a. Azoospermia:- A condition in which there are no sperm in semen when a man ejaculates. This may be because the man does not make sperm or because the sperms are blocked from entering the semen.

b. Oligospermia:- In this type of male infertility, less amount of sperms is produced due to increase in temperature of testes, infections, *etc.*

c. Sperm deformities:- The change in shape or structure of sperms may also be the cause of male infertility.

d. Autoimmune disorder:- In autoimmune disorder, the immune system start fighting its own parts of body. This autoimmunity may also attack sperms and cause infertility.

20.2.2 Causes of Female Infertility

The most common causes of female infertility include problems with ovulation, damage to fallopian tube or uterus or problems with cervix. Age also contributes to infertility because as a woman ages, her fertility naturally tend to decrease.

20.2.3 Treatment of Infertility

Some forms of infertility are treatable. Hormone therapy can sometimes increase sperm and egg production. Surgery can often correct ducts that formed improperly or

blocked. However, a commonly used technique to treat infertility is ***invitro*** **fertilization (IVF)** commonly known as **test tube baby**.

In Vitro Fertilization (IVF)

It means fertilization outside of female body in glass wares. In this process egg and sperm of couples are taken outside of body in laboratory and fertilized in test tube. Fertilized eggs are incubated until they have formed at least eight cells and are then transferred to the women uterus for implantation. If mature sperms are defective or low in number, a whole sperm or its nucleus is injected directly into the egg. (Fig.20.8)

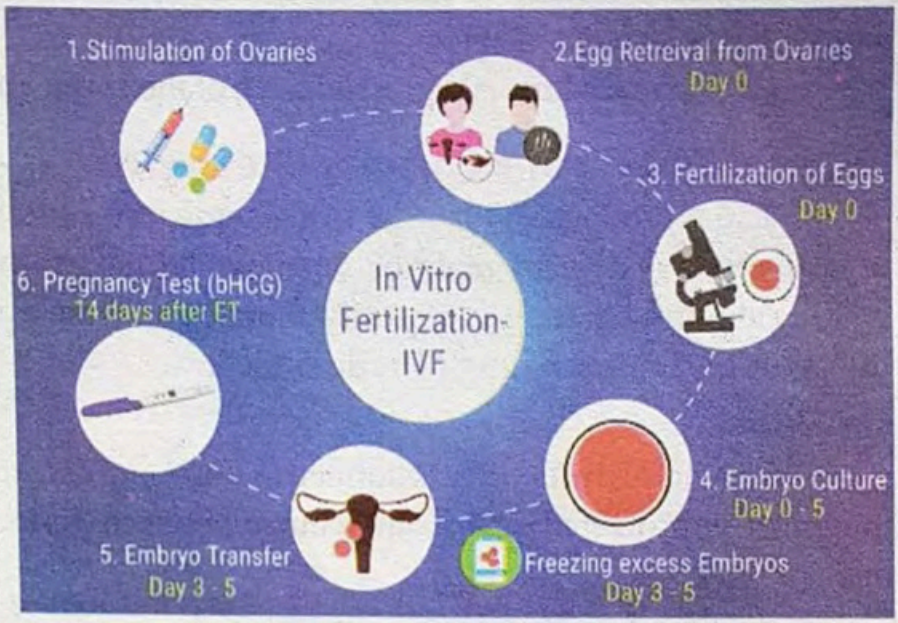


Fig.20.8: In Vitro Fertilization

Although it is a costly procedure but this has enabled more than a million couples to conceive children.

20.2.4 Miscarriage

It is a term used for a pregnancy that ends on its own, within the first 20 weeks of gestation.

Causes of Miscarriage

There are many reasons why a miscarriage may happen, although the cause is often not identified.

Most miscarriages happen when unborn baby has fatal genetic problems like abnormalities in chromosomal number and structure. The other causes include infection, medical conditions in mother, such as diabetes or thyroid disease, hormonal problems, immune system response, uterine abnormalities, weakness in cervix (cervical insufficiency), *etc.*

Extra Information

A pregnancy that ends before 37 weeks of gestation, resulting in a live born infant is known as premature birth.

Miscarriages versus Abortion

A miscarriage is a natural spontaneous termination of a pregnancy. An abortion occurs when a procedure is done with the purpose of ending a pregnancy.

20.3 Sexually Transmitted Diseases (STDs)

Sexually transmitted diseases are infections that are commonly spread by sexual activity. More than 30 different types of bacteria, viruses and parasites can be transmitted through sexual activity. Some examples of sexually transmitted diseases are chlamydia, gonorrhoea, syphilis, genital herpes, AIDS, *etc.* Here only gonorrhea, syphilis and AIDS will be discussed.

Gonorrhea

It is caused by the gram positive bacterium *Neisseria gonorrhaeae*. There is no blood test to diagnose gonorrhoea. In male, typical symptoms are pain upon urination and a thick greenish yellow urethral discharge. If a baby is exposed during birth, an eye infection leading to blindness can result. Gonorrhoea can spread to internal parts of the body, causing heart damage or arthritis. It is transmitted through direct contract or sexual contact. It is treated using antibiotics penicillin or tetracycline.

Syphilis

It is caused by a spirochete bacterium *Treponema palladium*. It has three stages, which are typically separated by latent periods. In the primary stage, a hard chancre (ulcerated sore with hard edges) appears. In the secondary stage, rash appears all over the body.

During the tertiary stage, syphilis may affect the cardiovascular and nervous system. It damages reproductive organs, eyes, bones joints, central nervous system, heart and skin. Sexual contact is the major source of its dissemination. Syphilis is a very devastating disease. Control depends on prompt and adequate treatment of all cases be treated with antibiotic therapy.

AIDS-A worldwide sexually transmitted disease

AIDS is caused by a virus called HIV (Human Immunodeficiency Virus). HIV destroys the body immune system. That is why this disease is called AIDS (Human Immune Deficiency Syndrome). The HIV attacks on specific type of white blood cells called T-cells. HIV may transmit through blood transfusion, contaminated syringes, surgical instruments, *etc.* However, the most prominent cause is sexual transmission. AIDS is a major global public health issue. There are approximately 38 million people living with HIV at the end of 2019. Over two thirds of all people with HIV infection live in African region (26 million). HIV can be diagnosed through rapid diagnostic tests. However, still there is no cure for AIDS.

List the measures that can help to prevent transmission of HIV.

The HIV is transmitted from one person to another by exchanging fluids of body. Therefore, following measures should be taken to prevent transmission because prevention is so for only cure for AIDS.

- Follow the Islamic teaching and refrain from immoral sexual activities.
- Avoid sharing instruments that are likely to break the skin and be contaminated with blood *e.g.* razors and tooth brushes.
- If you require acupuncture, ear, piercing, nose piercing, *etc.* You should go to reliable operators and make sure that needles used are sterilized or insist on using disposable instruments.
- Blood of donor must be screened before transfusion.
- Use disposable syringes and sterilized operation tools for surgery.
- Affected mothers must avoid breast feeding to their infants.

Science, Technology and Society (STS)

Become aware of the ethical implications of abortion.

Abortion is one of the most controversial issues associated with reproduction. It raises ethical issues. Some people think that abortion is always wrong. The others think that abortion is right at some circumstances. The commonly raised ethical issues are: (i)It is considered as murder. (ii) It can increase sexual corruptions. However, abortion should be allowed in following cases.

- When mother life is at risk.
- When there is a risk of injury or mother physical or mental health is at risk.
- When prenatal testing predicts the abnormal are handicapped fetus.

SUMMARY

- Reproduction is the biological process by which organisms give birth to new organism of their own kinds to continue their race.
- The reproductive system is different from other systems of body.
- Unlike female, male reproductive system is mostly located outside of body.
- The male reproductive system consists of testes, ducts, associated glands and external genitalia.
- The female reproductive system consists of ovaries, ducts and external genitalia.
- The female reproductive system is more complex because it has to perform number of functions *i.e.* to produce gametes, gestate the fetus, give birth and nourish the new born.
- The male reproductive system is controlled by gonadotropins and testosterone.
- The female reproductive system is controlled by follicle stimulating hormone (FSH), Luteinizing hormone (LH), progesterone and estrogen hormone.

- Menstruation is the elimination of the thickened lining of the uterus and bleeding through the vagina.
- Ovulation is the release of mature egg from the surface of ovary.
- The production of gametes is called gametogenesis. In male it is called spermatogenesis while in female it is called oogenesis.
- The reproductive disorder is a disease or a condition where there is a problem in reproductive system of the male or female.
- Infertility is defined as not being able to get pregnant after one year or longer of unprotected sexual intercourse between partners.
- *In Vitro* Fertilization is a common way of treating infertility.
- Miscarriage is a term used to describe the end of pregnancy of its own.
- Sexually transmitted diseases are infections that are commonly spread by sexual activity.
- There are about 38 million people living with HIV infection at the end of 2019.

EXERCISE

SECTION-I: OBJECTIVE QUESTIONS

Multiple Choice Questions (MCQs)

A. Select the correct answer.

1. The first convoluted part of vas deferens is:
   (a) Vas deference (b) Epididymis
   (c) Sertoli (d) Placenta
2. Decrease of FSH and increase of estrogen, causes pituitary to secrete:
   (a) Luteotropic hormone (LTH) (b) Luteinizing hormone (LH)
   (c) Vasopressin (ADH) (d) Oxytocin
3. Uterus opens into the vagina through:
   (a) Cervix (b) External genitalia
   (c) Fallopian tube (d) Vulva
4. Pregnancy is maintained by the:
   (a) Luteotropic hormone (LTH) (b) Corticosteroids
   (c) Progesterone (d) LH and FSH
5. Syphilis is a sexually transmitted disease which is caused by:
   (a) *Neisseria gonorrhoeae* (b) *Treponema pallidum*
   (c) *E. coli* (d) *Myobacterium ovium*
6. Reproductive system is different from other systems of body due to the fact that
   (a) Functional at birth (b) Non-functional at birth

(c) Functional at puberty (d) Become functional in fetus

7. Fertilization occurs in
   (a) Ovary (b) Fallopian tube
   (c) Uterus (d) Vagina
8. The sperms are produced in the
   (a) Epididymis (b) Vas deferens
   (c) Seminiferous tubules (c) Prostate gland
9. The cervix is the opening of
   (a) Ovary (b) Vagina
   (c) Fallopian tube (d) Uterus
10. Sperms are stored in
   (a) Epididymis (b) Urethra
   (c) Prostate gland (d) Vas deferens
11. FSH is a hormone produced by
   (a) Pituitary gland (b) Adrenal gland
   (c) Ovary (d) Testes
12. Uterus is a pear-shaped elastic sac about
   (a) 4cm long (b) 5cm long
   (c) 7.5cm long (d) 10.5cm long
13. The average menstrual cycle of an adult human female is about
   (a) 5 days (b) 8 days
   (c) 28 days (d) 14 days
14. Oligospermia is a condition in male in which
   (a) Abnormal sperms are produced
   (b) More sperms are produced
   (c) No sperms are produced
   (d) Less sperms are produced
15. The number of AIDS patients in world are in 2019
   (a) More than 1 billion (b) Over 38 million
   (c) Less than 3 million (d) Less than 2 million

B. Fill the blank.

1. Most part of male reproductive system located ..... of body.
2. The scrotum acts as climate control for the .....
3. Female reproductive system is more ..... than male.
4. There are ..... potential follicle cells already present at birth in ovary.
5. The egg is spherical in shape and about ..... µm in diameter.

6. Ovulation is the release of mature ..... from the surface of the ovary.
7. Chorionic gonadotropin hormone in urine is checked for ..... test.
8. IVF is commonly used technique to treat .....
9. The natural or spontaneous termination of pregnancy is called .....
10. The wilful ending of pregnancy is called .....

SECTION-II: SHORT QUESTIONS

C. Give the short answers of the following questions.

1. Illustrate that reproductive system is different from all other system.
2. Write the functions of male reproductive system.
3. Describe that female reproductive system is more complex than male reproductive system.
4. Write the causes of male infertility.
5. Write the causes of female infertility.
6. Write some measures to prevent AIDS.
7. Differentiate miscarriage and abortion.
8. Write the main causes of miscarriage.
9. Briefly describe AIDS.
10. Describe the role of hormone to control the male reproductive function.

SECTION-III: EXTENSIVE QUESTIONS

D. Give detailed answers of the following questions.

1. Describe the structure and function of human male reproductive system.
2. Explain structure of female reproductive system.
3. Describe the hormonal control of female reproductive system.
4. Describe the menstrual cycle and also explain its phases.
5. Define infertility and explain in vitro fertilization procedure to treat infertility.