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ASSIGNMENT

Write short note on the following

- **Spermatogenesis**
- **Testosterone**
- **Semen**
- **Male orgasm**
- **Male infertility**

ANSWER

SPERMATOGENESIS

Spermatogenesis is the process by which the male gametes called spermatozoa (sperms) are formed from the primitive spermatogenic cells (spermatogonia) in the testis. It takes 74 days for the formation of sperm from a primitive germ cell. Throughout the process of spermatogenesis, the spermatogenic cells have cytoplasmic attachment with S attachment with Sertoli cells. Sertoli cells supply all the necessary materials for spermatogenesis through the cytoplasmic attachment.

STAGES OF SPERMATOGENESIS

Spermatogenesis occurs in four stages:

1. Stage of proliferation

2. Stage of growth

3. Stage of maturation

4. Stage of transformation.

1. Stage of Proliferation

Each spermatogonium contains diploid number (23 pairs) of chromosomes. One member of each pair is from maternal origin and the other one from paternal origin. The 23 pairs include 22 pairs of autosomal chromosomes and one pair of sex chromosomes. Sex chromosomes are one X chromosome and one Y chromosome. During the proliferative stage, spermatogonia divide by mitosis, without any change in chromosomal number. In man, there are usually seven generations of spermatogonia. The last generation enters the stage of growth as primary spermatocyte. During this stage, the spermatogonia migrate along with Sertoli cells towards the lumen of seminiferous tubule.

2. Stage of Growth

In this stage, the primary spermatocyte grows into a large cell. Apart from growth, there is no other change in spermatocyte during this stage.

3. Stage of Maturation

After reaching the full size, each primary spermatocyte quickly undergoes meiotic or maturation division, which occurs in two phases:

First phase

In the first phase, each primary spermatocyte divides into two secondary spermatocytes. The significance of the first meiotic division is that each secondary spermatocyte receives only the haploid or half the number of chromosomes. 23 chromosomes include 22 autosomes and a X or a Y chromosome.

Second phase

During this phase, each secondary spermatocyte under- goes second meiotic division, resulting in two smaller cells called spermatids. Each spermatid has haploid number of chromosomes.

4. Stage of Transformation

There is no further division. Spermatids are transformed into matured spermatozoa (sperms), by means of spermeogenesis and released by spermination.

Spermeogenesis

Spermeogenesis is the process by which spermatids become matured spermatozoa.

Changes taking place during spermeogenesis:

i. Condensation of nuclear material

ii. Formation of acrosome, mitochondrial spiral filament and tail structures

iii. Removal of extraneous (extra volume of nonessential) cytoplasm.

Spermination

Spermination is the process by which the matured sperms are released from Sertoli cells into the lumen of seminiferous tubules.

TESTOSTERONE

Testosterone is the primary male sex hormone and anabolic steroid. In male humans, testosterone plays a key role in the development of male reproductive tissues such as testes and prostate, as well as promoting secondary sexual characteristics such as increased muscle and bone mass, and the growth of body hair.

Testosterone secretion starts at 7th week of fetal life by fetal genital ridge. Fetal testes begin to secrete testosterone at about 2nd to 4th month of fetal life. In fetal life, testosterone secretion from testes is stimulated by human chorionic gonadotropins, secreted by placenta.

But in childhood, practically no testosterone is secreted approximately until 10 to 12 years of age. Afterwards, the testosterone secretion starts and it increases rapidly at the onset of puberty and lasts through most of the remaining part of life. The secretion starts decreasing after 40 years and becomes almost zero by the age of 90 years

FUNCTIONS OF TESTOSTERONE

In general, testosterone is responsible for the distinguishing characters of masculine body. It also plays an important role in fetal life.

Functions of Testosterone in Fetal Life

Testosterone performs three functions in fetus:

1. Sex differentiation in fetus

2. Development of accessory sex organs

3. Descent of the testes.

1. Sex differentiation in fetus

Sex chromosomes are responsible for the determination of sex of the fetus whereas testosterone is responsible for the sex differentiation of fetus.

Fetus has two genital ducts:

i. Müllerian duct, which gives rise to female

accessory sex organs such as vagina, uterus

and fallopian tube

ii. Wolffian duct, which gives rise to male accessory sex organs such as epididymis, vas deferens and seminal vesicles.

If testosterone is secreted from the genital ridge of the fetus at about 7th week of intrauterine life, the Müllerian duct system disappears and male sex organs develop from Wolffian duct. In addition to testosterone, Müllerian regression factor (MRF) secreted by Sertoli cells is also responsible for regression of Müllerian duct.

In the absence of testosterone, Wolffian duct regresses and female sex organs develop from Müllerian duct.

2. Development of accessory sex organs and external genitalia

Testosterone is also essential for the growth of the external genitalia, viz. penis and scrotum and other accessory sex organs, namely genital ducts, seminal vesicles and prostate.

3 Descent of testes

Descent of testes is the process by which testes enter scrotum from abdominal cavity. Initially, testes are developed in the abdominal cavity and are later pushed down into the scrotum through inguinal canal, just before birth. The process by which testes enter the scrotum is called the descent of testes. Testosterone is necessary for descent of testes.

Cryptorchidism

Cryptorchidism is a congenital disorder characterized by the failure of one or both the testes to descent from abdomen into scrotum. In such case, the testes are called undescended testes. Males with untreated testes are prone for testicular cancer.

Treatment

Administration of testosterone or gonadotropic hormones (which stimulate Leydig cells) causes descent of testes, provided the inguinal canal is large enough to allow the passage of testes. Surgery is required if the inguinal canal is narrow.

Functions of Testosterone in Adult Life

Testosterone has two important functions in adult:

1. Effect on sex organs

2. Effect on secondary sexual characters.

1. Effect on sex organs

Testosterone increases the size of penis, scrotum and the testes after puberty. All these organs are enlarged at least 8 folds between the onset of puberty and the age of 20 years, under the influence of testosterone. Testosterone is also necessary for spermatogenesis.

2. Effect on secondary sexual characters

Secondary sexual characters are the physical and behavioural characteristics that distinguish the male from female. These characters appear at the time of puberty in humans. Testosterone is responsible for the development of secondary sexual characters in males.

Secondary sexual characters in males:

i. Effect on muscular growth

One of the most important male sexual characters is the development of musculature after puberty. Muscle mass increases by about 50%, due to the anabolic effect of testosterone on proteins. Testosterone accelerates the transport of amino acids into the muscle cells, synthesis of proteins and storage of proteins. Testosterone also decreases the breakdown of proteins.

ii. Effect on bone growth

After puberty, testosterone increases the thickness of bones by increasing the bone matrix and deposition of calcium. It is because of the protein anabolic activity of testosterone. Deposition of calcium is secondary to the increase in bone matrix.

In addition to increase in the size and strength of bones, testosterone also causes early fusion of epiphyses of long bones with shaft. So, if testes are removed before puberty, the fusion of epiphyses is delayed and the height of the person increases.

iii. Effect on shoulder and pelvic bones

Testosterone causes broadening of shoulders and it has a specific effect on pelvis, which results in:

a. Lengthening of pelvis

b. Funnel-like shape of pelvis.

c. Narrowing of pelvic outlet.

Thus, pelvis in males is different from that of females, which is broad and round or oval in shape.

iv. Effect on skin

Testosterone increases the thickness of skin and ruggedness of subcutaneous tissue. These changes in skin are due to the deposition of proteins in skin. It also increases the quantity of melanin pigment, which is responsible for the deepening of the skin color.

Testosterone enhances the secretory activity of sebaceous glands. So, at the time of puberty, when the body is exposed to sudden increase in testosterone secretion, the excess secretion of sebum leads to development of acne on the face. After few years, the skin gets adapted to testosterone secretion and the acne disappears.

v. Effect on hair distribution

Testosterone causes male type of hair distribution on the body, i.e. hair growth over the pubis, along linea alba up to umbilicus, on face, chest and other parts of the body such as back and limbs.

SEMEN

Semen is a white or grey fluid that contains sperms. It is the collection of fluids from testes, seminal vesicles, prostate gland and bulbourethral glands. Semen is discharged during sexual act and the process of discharge of semen is called ejaculation.

At the time of ejaculation, human semen is liquid in nature. Immediately, it coagulates and after some time it becomes liquid once again (secondary liquefaction).Fibrinogen secreted from the seminal vesicle is converted into a weak coagulum by the clotting enzymes secreted from prostate gland. Coagulum is liquefied after about 30 minutes, as it is lysed by fibrinolysis produced in prostate gland.

When semen is ejaculated, the sperms are non- motile due to the viscosity of coagulum. When the coagulum dissolves, the sperms become motile.

COMPOSITION OF SEMEN

Semen contains 10% sperms and 90% of fluid part, which is called seminal plasma. Seminal plasma contains the products from seminal vesicle and prostate gland (Fig. 77.1). It also has small amount of secretions from the mucus glands, particularly the bulbourethral glands.

SPERM

Sperm is the male gamete (reproductive cell), developed in the testis. It is also called spermatozoon (plural = spermatozoa). Matured sperm is 60 μ long.

SPERM COUNT

Total count of sperm is about 100 to 50 million/mL of semen. Sterility occurs when the sperm count falls below 20 million/mL. Though the sperms can be stored in male genital tract for longer periods, after ejaculation the survival time is only about 24 to 48 hours at a temperature equivalent to body temperature.

Rate of motility of sperm in female genital tract is about 3 mm/minute. Sperms reach the fallopian tube in about 30 to 60 minutes after sexual intercourse. Uterine contractions during sexual act facilitate the movement of sperms.

Minimum required qualities of semen for fertility are:

1. Volume of semen per ejaculation must be at least 2 mL
2. Sperm count must be at least 20 million/mL
3. Number of sperms in each ejaculation must be at-least 40 million
4. 75% of sperms per ejaculation must be alive
5. 50% of sperms must be motile
6. 30% of sperms must have normal shape and structure
7. Sperms with head defect must be less than 35%
8. Sperms with midpiece defect must be less than 20%
9. Sperms with tail defect must be less than 20%.

MALE ORGASM

The male orgasm is a complex process involving hormones, blood vessels, nerves and other aspects of sexual health. Men achieve orgasm through a series of steps involving a number of organs, hormones, blood vessels, and nerves working together. The typical result is ejaculation of fluid that may contain sperm through strong muscle contractions. An orgasm is the climax of sexual arousal, or the release of built-up sexual tension that's felt throughout the body.

The fuel for the process leading to orgasm is testosterone, a hormone produced in steady supply by the testicles. The testicles also make millions of sperm each day, which mature and then are mixed with whitish, protein-rich fluids. These fluids nourish and support the sperm so they can live after ejaculation for a limited time. This mixture of fluid and sperm, known as semen, is what is moved through the urethra and out the penis during orgasm.

The hormone testosterone, produced in the testicles, plays a central role by enhancing the sexual desire (libido) that leads to arousal, erection, and ultimately orgasm. By contrast, low testosterone not only decreases a man's energy and mood, it makes him less responsive to sexual stimuli, both physical and mental.

The male ejaculate, semen, is comprised of sperm cells and seminal fluid, the latter of which contains phosphoryl choline (an enzyme that aids in fertility) and fructose (which provides fuel for sperm). The average volume of semen expelled by a healthy man is around a teaspoon.

PHASES OF MALE ORGASM

- **Arousal**

Arousal is the stage in which physical, sensory, and emotional cues prompt the brain to release a neurotransmitter known as acetylcholine. This, in turn, triggers the release of nitric oxide into the arteries of the penis, causing them to expand and rapidly fill with blood. The resulting erection is generally accompanied by changes in respiration, increased overall muscle tension, and the retraction of the scrotal sac.

- **Plateau**

Plateau is the phase immediately preceding orgasm in which the voluntary thrusts of the body, specifically the pelvis, suddenly become involuntary, increasing both in intensity and speed. It is at this stage that the heart rate increases to between 150 and 175 beats per minute, accompanied by a marked rise in blood pressure and body temperature.

Traces of seminal fluid ("pre-cum") may leak from the urethra. The release of pre-ejaculatory fluid is more than just incidental; it alters the pH of the urethra so that the sperm has a better chance of survival.

- **Orgasm**

The orgasm phase is divided into two parts. The first, known as emission, is the stage where ejaculation is inevitable. This is immediately followed by the second stage, ejaculation, in which strong contractions of the penile muscle, anus, and perineal muscles help propel the semen from the body.

During orgasm, the reward center of the brain (specifically the cerebellum, amygdala, nucleus accumbens, and ventral tegmental area) is flooded with neurochemicals, inciting the intense emotional response associated with an orgasm. At the same time, the lateral orbitofrontal cortex located behind the left eye shuts down entirely. This is the part of the brain that plays a central role in judgment and self-control. The effect explains why people often describe an orgasm as a state where "nothing else matters."

- **Resolution and Refraction**

Resolution is the phase following orgasm where the penis starts to lose its erection. This is often accompanied by feelings of extreme relaxation or even drowsiness.

Refraction, also known as the refractory period, is the stage following climax when a man is unable to achieve another erection even with stimulation. In younger men, the refractory period may be as short as 15 minutes. In older men, it may last as long as an entire day.

MALE INFERTILITY

Male infertility is due to low sperm production, abnormal sperm function or blockages that prevent the delivery of sperm. Illnesses, injuries, chronic health problems, lifestyle choices and other factors can play a role in causing male infertility. Male infertility is any health issue in a man that lowers the chances of his female partner getting pregnant. Infertility in men can result from deficiencies in sperm formation, concentration, or transportation.

Azoospermia

Azoospermia is the condition characterized by lack of sperm in semen. It is a congenital disease. It is also caused by excess use of corticosteroids and androgens.

Oligozoospermia

Oligozoospermia is the low sperm count with less than 20 million of sperms/mL of semen. Oligozoospermia causes infertility.

Teratozoospermia

Teratozoospermia is the condition characterized by presence of sperms with abnormal morphology. It is also called teratospermia. It occurs in Crohn's disease, Hodgkin disease and celiac disease. The abnormal morphology of sperm results in infertility.

Aspermia

Aspermia is the lack of semen. It occurs due to retro- grade ejaculation. Retrograde ejaculation is the entrance of semen into urinary bladder instead of entering urethra. It is due to dysfunction of sphincter of the bladder, which is caused by prostatic surgery or excess use of drugs. Aspermia leads to infertility.

Oligospermia

Oligospermia is a genetic disorder characterized by low volume of semen.

Hematospermia

Hematospermia is the appearance of blood in sperm. It occurs due to infection of urethra or prostate. It is also common in congenital bleeding disorder.

Retrograde ejaculation

Retrograde ejaculation occurs when semen enters the bladder instead of emerging through the penis during orgasm. Retrograde ejaculation isn't harmful, but it can cause male infertility.

CAUSES OF MALE INFERTILITY

1 Varicocele

A varicocele is a swelling of the veins that drain the testicle. It's the most common reversible cause of male infertility.

2 Tumors

Cancers and non-malignant tumours can affect the male reproductive organs directly, through the glands that release hormones related to reproduction, such as the pituitary gland, or through unknown causes.

3 **Hormone imbalances**

Infertility can result from disorders of the testicles themselves or an abnormality affecting other hormonal systems including the hypothalamus, pituitary, thyroid and adrenal glands.

4 Chromosome defects

Inherited disorders such as Klinefelter's syndrome in which a male is born with two X chromosomes and one Y chromosome (instead of one X and one Y) cause abnormal development of the male reproductive organs. Other genetic syndromes associated with infertility include cystic fibrosis, Kallmann's syndrome and Kartagener's syndrome.

5 Antibodies that attack sperm

Anti-sperm antibodies are immune system cells that mistakenly identify sperm as harmful invaders and attempt to eliminate.

6 Infection

Some infections can interfere with sperm production or sperm health or can cause scarring that blocks the passage of sperm. These include inflammation of the epididymis (epididymitis) or testicles (orchitis) and some sexually transmitted infections, including gonorrhoea or HIV.

7 Radiation or X-rays

Exposure to radiation can reduce sperm production, though it will often eventually return to normal. With high doses of radiation, sperm production can be permanently reduced.

8 Drug use

Anabolic steroids taken to stimulate muscle strength and growth can cause the testicles to shrink and sperm production to decrease. Use of cocaine or marijuana may temporarily reduce the number and quality of your sperm as well.

9 Overheating the testicles

Elevated temperatures impair sperm production and function. Although studies are limited and are inconclusive, frequent use of saunas or hot tubs may temporarily impair your sperm count.