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Male reproductive function

Question: Write short note on the following

1. Spermatogenesis

Spermatogenesis is the process by which haploid spermatozoa develop from germ cells in the seminiferous tubules of the testis. This process starts with the mitotic division of the stem cells located close to the basement membrane of the tubules These cells are called spermatogonial stem cells. The mitotic division of these produces two types of cells. Type A cells replenish the stem cells, and type B cells differentiate into primary spermatocytes. The primary spermatocyte divides meiotically (Meiosis I) into two secondary spermatocytes; each secondary spermatocyte divides into two equal haploid spermatids by Meiosis II. The spermatids are transformed into spermatozoa (sperm) by the process of spermiogenesis. These develop into mature spermatozoa, also known as sperm cellsThus, the primary spermatocyte gives rise to two cells, the secondary spermatocytes, and the two secondary spermatocytes by their subdivision produce four spermatozoa and four haploid cells

Spermatogenesis is a complex process involving Lmitotic cell division, meiosis and the process of spermiogenesis. The regulation of spermatogenesis involves both endocrine and paracrine mechanisms. The endocrine stimulation of spermatogenesis involves both follicle stimulating hormone (FSH) and luteinizing hormon the latter acting through the intermediary testosterone, produced by the Leydig cells in the testis. Since the germ cells do not possess receptors for FSH and testosterone, the hormonal signals are transduced through the Sertoli cells and peritubular cells by the production of signals that have yet to be defined. Although the hormonal signals are essential for successful spermatogenesis, there is increasing evidence that a multiplicity of growth factors and cytokines are involved in local control mechanisms influencing stem cell renewal by

mitosis and the complicated process of the two meiotic cell divisions. The final complex metamorphosis which converts a round cell into the complexstructures of the spermatozoa is well defined at a structural level, but the control systems regulating this process still remain to be elucidated.

2. 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 In addition, testosterone is involved in health and well-being and the prevention of osteoporosis Insufficient levels of testosterone in men may lead to abnormalities including frailty and bone loss.Testosterone is a steroid from the androstane class containing a keto and hydroxyl groups at positions three and seventeen respectively. It is biosynthesized in several steps from cholesterol and is converted in the liver to inactive metabolites it exerts its action through binding to and activation of the androgen receptor In humans and most other vertebrates, testosterone is secreted primarily by the testicles of males and, to a lesser extent, the ovaries of females. On average, in adult males, levels of testosterone are about 7 to 8 times as great as in adult females As the metabolism of testosterone in males is more pronounced, the daily production is about 20 times greater in men Females are also more sensitive to the hormone in addition to its role as a natural hormone, testosterone is used as a medication in the treatment of low testosterone levels in men, transgender hormone therapy for transgender men, and breast cancer in women Since testosterone levels decrease as men age, testosterone is sometimes used in older men to counteract this deficiency. It is also used illicitly to enhance physique and performance, for instance in athletes

3.Semen

Semen, also called seminal fluid, fluid that is emitted from the male reproductive tract and that contains sperm cells, which are capable of fertilizing the female eggs. Semen also contains other liquids, known as seminal plasma, which help to keep the sperm cells viable.In the sexually mature human male, sperm cells are produced by the testes (singular, testis); they constitute only about 2 to 5 percent of the total semen volume. As sperm travel through the male reproductive tract, they are bathed in fluids produced and secreted by the various tubules and glands of the reproductive system. After emerging

from the testes, sperm are stored in the epididymis, in which secretions of potassium, sodium, and glycerylphosphorylcholine (an energy source for sperm) are contributed to the sperm cells. Sperm mature in the epididymis. They then pass through a long tube, called the ductus deferens, or vas deferens, to another storage area, the ampulla. The ampulla secretes a yellowish fluid, ergothioneine, a substance that reduces (removes oxygen from) chemical compounds, and the ampulla also secretes fructose, a sugar that nourishes the sperm. During the process of ejaculation, liquids from the prostate gland and seminal vesicles are added, which help dilute the concentration of sperm and provide a suitable environment for them. Fluids contributed by the seminal vesicles are approximately 60 percent of the total semen volume; these fluids contain fructose, amino acids, citric acid, phosphorus, potassium, and hormones known as prostaglandins. The prostate gland contributes about 30 percent of the seminal fluid; the constituents of its secretions are mainly citric acid, acid phosphatase, calcium, sodium, zinc, potassium, protein-splitting enzymes, and fibrolysin (an enzyme that reduces blood and tissue fibres). A small amount of fluid is secreted by the bulbourethral and urethral glands; this is a thick, clear, lubricating protein commonly known as mucus.

Essential to sperm motility (self-movement) are small quantities of potassium and magnesium, the presence of adequate amounts of oxygen in the plasma, proper temperature, and a slightly alkaline pH of 7 to 7.5. Sulfate chemicals in semen help prevent the sperm cells from swelling; and fructose is the main nutrient to sperm cells.The total volume of semen for each ejaculation of a human male averages between 2 and 5 ml (0.12 to 0.31 cubic inch); in stallions the average ejaculate is about 125 ml (7.63 cubic inches). In human beings each ejaculation contains normally 200 to 300 million sperm. Semen frequently contains degenerated cells sloughed off from the network of tubules and ducts through which the semen has passed.

4 Male orgasm

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. Testosterone is the primary factor which drives sexual desire.

This sexual desire, or libido, is key in kicking off the process that will lead to orgasm. If a man has no sex drive — for example, if he has clinically low testosterone or is suffering from depression — his body may not respond to sexual stimuli and he may not be able to experience orgasm.

The steps that lead a man to successful orgasm include:

1.Arousal The man perceives something or someone that prompts sexual interest. That perception prompts the brain to send a signal down the spinal cord to the sex organs, causing an erection. The penis becomes erect when blood fills spongy tissue inside its shaft, brought by arteries that have expanded to allow blood to race in at up to 50 times its normal speed. The veins in the penis that normally drain blood out squeeze shut so that more blood remains inside, producing a firm erection. The scrotum pulls toward the body, and muscles throughout the body increase in tension.

2.Plateau The male body prepares for orgasm in this phase, which can last from 30 seconds to 2 minutes. Muscle tension increases even more and involuntary body movements, particularly in the pelvis, begin to take over. The man's heart rate increases to between 150 and 175 beats per minute, says Ingber. A clear fluid may begin to flow from the urethra. This pre-ejaculatory fluid is meant to change the pH balance of the urethra, to improve the chances of sperm survival.

3.Orgasm The orgasm itself occurs in two phases, emission and ejaculation. In emission, the man reaches ejaculatory inevitability, the "point of no return." Semen is deposited near the top of the urethra, ready for ejaculation. Ejaculation occurs in a series of rapid-fire contractions of the penile muscles and around the base of the anus. Involuntary pelvic thrusting may also occur. The nerves causing the muscle contractions send messages of pleasure to the man's brain.

4.Resolution and refraction After ejaculation, the penis begins to lose its erection. About half of the erection is lost immediately, and the rest fades soon after. Muscle tension fades, and the man may feel relaxed or drowsy, according to Ingber. Men usually must undergo a refractory period, or recovery phase, during which they cannot achieve another erection. This period is variable in men, says Ingber. In an 18-year-old, this is typically less than 15 minutes. In elderly men, it can be up to 10 to 20 hours. The average refractory period is about half an hour. Men differ from women in that men usually are satiated after one orgasm. Women can experience more than one orgasm with no loss of sexual arousal, and do not have to undergo a refractory period.

Male Orgasm: When There's a Problem

Some men can have problems reaching orgasm. These most often stem from psychological factors; for example, they are still affected by a traumatic event or a restrictive upbringing, or they have fallen into masturbation patterns that could have conditioned the body to take longer to orgasm. However, the problem also can be caused by certain medications or by a neurological or cardiovascular disease, or by having surgery where nerves are cut

5.Male infertility

Male infertility refers to a male's inability to cause pregnancy in a fertile female. In humans it accounts for 40–50% of infertility.[1][2][3] It affects approximately 7% of all men.[4] Male infertility is commonly due to deficiencies in the semen, and semen quality is used as a surrogate measure of male fecundity

Causes

Factors relating to male infertility includ

1. Immune infertility

Antisperm antibodies (ASA) have been considered as infertility cause in around 10–30% of infertile couples.[7] ASA production are directed against surface antigens on sperm, which can interfere with sperm motility and transport through the female reproductive tract, inhibiting capacitation and acrosome reaction, impaired fertilization, influence on the implantation process, and impaired growth and development of the embryo. Risk factors for the formation of antisperm antibodies in men include the breakdown of the blood-testis barrier, trauma and surgery, orchitis, varicocele, infections, prostatitis, testicular cancer, failure of immunosuppression and unprotected receptive anal or oral sex with men.[7][8]

2. Genetics

Chromosomal anomalies and genetic mutations account for nearly 10–15% of all male infertility cases.

3. Klinefelter Syndrome

One of the most commonly known causes of infertility is Klinefelter Syndrome, affecting 1 out of 500–1000 newborn males[10] Klinefelter Syndrome is a chromosomal defect that occurs during gamete formation due to a non-disjunction error during cell division. Resulting in males having smaller testes, reducing the amount of testosterone and

sperm production.[11] Males with this syndrome carry an extra X chromosome (XXY), meaning they have 47 chromosomes compared to the normal 46 in each cell. This extra chromosome directly affects sexual development before birth and during puberty (links to learning disabilities and speech development have also been shown to be affected). There are varieties in Klinefelter Syndrome, where some cases may have the extra X chromosome in some cells but not others, referred to as Mosaic Klinefelter Syndrome, or where individuals have the extra X chromosome in all cells. The reduction of testosterone in the male body normally results in an overall decrease in the production of viable sperm for these individuals thereby forcing them to turn to fertility treatments to father children.[10]

Y chromosome deletions

Y chromosomal infertility is a direct cause of male infertility due to its effects on sperm production, occurring in 1 out of every 2000 males.[12] Usually affected men show no sign of symptoms other than at times can exhibit smaller teste size. Men with this condition can exhibit azoospermia (no sperm production), oligozoospermia (small number of sperm production), or they will produce abnormally shaped sperm (teratozoospermia).[12] This case of infertility occurs during the development of gametes in the male, where a normal healthy male will produce both X and a Y chromosome, affected males have genetic deletions in the Y chromosome. These deletions affect protein production that is vital for spermatogenesis. Studies have shown that this is an inherited trait; if a male is fathered by a man who also exhibited y chromosome deletions then this trait will be passed down. These individuals are thereby “Y-linked”, although daughters are not affected due to the lack of the Y chromosome.

Othrs include

4.Age (see also: Paternal age effect)

5.Abnormal set of chromosomes

6.Centriol

6.Neoplasm, e.g. seminoma

8.Idiopathic failure

9.Cryptorchidism

10.Trauma

11.Hydrocele

12.Hypopituitarism in adults, and hypopituitarism untreated in children (resulting in growth hormone deficiency and proportionate dwarfism.)

13.Mump

14.Malaria

15.Testicular cancer

16.Defects in USP26 in some cases[15]

17. Acrosomal defects affecting egg penetration

18.Idiopathic oligospermia - unexplained sperm deficiencies account for 30% of male infertility

Treatments vary according to the underlying disease and the degree of the impairment of the male's fertility. Further, in an infertility situation, the fertility of the female needs to be considered.

Pre-testicular conditions can often be addressed by medical means or interventions.

Testicular-based male infertility tends to be resistant to medication. Usual approaches include using the sperm for intrauterine insemination (IUI), in vitro fertilization (IVF), or IVF with intracytoplasmatic sperm injection (ICSI). With IVF-ICSI even with a few sperm pregnancies can be achieved.

Obstructive causes of post-testicular infertility can be overcome with either surgery or IVF-ICSI. Ejaculatory factors may be treatable by medication, or by IUI therapy or IVF.

Vitamin E helps counter oxidative stress, which is associated with sperm DNA damage and reduced sperm motility] A hormone-antioxidant combination may improve sperm count and motility Giving oral antioxidants to men in couples undergoing in vitro fertilisation for male factor or unexplained subfertility may lead to an increase in the live birth rate but overall the risk of adverse effects is unclear

Administration of luteinizing hormone (LH) (or human chorionic gonadotropin) and follicle-stimulating hormone (FSH) is very effective in the treatment of male infertility due to hypogonadotropic hypogonadism Although controversial off-label clomiphene citrate, an antiestrogen, may also be effective by elevating gonadotropin levels Though androgens are absolutely essential for spermatogenesis and therefore male fertility, exogenous testosterone therapy has been found to be ineffective in benefiting men with low sperm count This is thought to be because very high local levels of testosterone in the testes (concentrations in the seminiferous tubules are 20- to 100-fold greater than circulating levels are required to mediate spermatogenesis, and exogenous testosterone therapy (which is administered systemically) cannot achieve these required high local concentrations (at least not without extremely supraphysiological dosages) Moreover, exogenous androgen therapy can actually impair or abolish male fertility by suppressing gonadotropin secretion from the pituitary gland, as seen in users of androgens/anabolic steroids (who often have partially or completely suppressed sperm production) This is because suppression of gonadotropin levels results in decreased testicular androgen production (causing diminished local concentrations in the testesand because FSH is independently critical for spermatogenesi In contrast to FSH, LH has little role in male fertility outside of inducing gonadal testosterone production