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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 cells. Thus, 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.

Spermatozoa are the mature male gametes in many sexually reproducing organisms. Thus, spermatogenesis is the male version of gametogenesis, of which the female equivalent is oogenesis. In mammals it occurs in the seminiferous tubules of the male testes in a stepwise fashion. Spermatogenesis is highly dependent upon optimal conditions for the process to occur correctly, and is essential for sexual reproduction. DNA methylation and histone modification have been implicated in the regulation of this process. It starts at puberty and usually continues uninterrupted until death, although a slight decrease can be discerned in the quantity of produced sperm with increase in age.

Spermatogenesis starts in the bottom part of seminiferous tubes and, progressively, cells go deeper into tubes and moving along it until mature spermatozoa reaches the lumen, where mature spermatozoa are deposited. The division happens asynchronically; if the tube is cut transversally one could observe different maturation states. A group of cells with different maturation states that are being generated at the same time is called a spermatogenic wave. Spermatogenesis produces mature male gametes, commonly called **sperm**, but more specifically known as **spermatozoa**, which are able to fertilize the counterpart female gamete, the oocyte, during conception to produce a single-celled individual known as a zygote. This is the cornerstone of sexual reproduction and involves the two gametes both contributing half the normal set of chromosomes to result in a chromosomally normal zygote.

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.

In general, androgens such as testosterone promote protein synthesis and thus growth of tissues with androgen receptors. Testosterone can be described as having virilising and anabolic effects (though these categorical descriptions are somewhat arbitrary, as there is a great deal of mutual overlap between them).

- Anabolic effects include growth of muscle mass and strength, increased bone density and strength, and stimulation of linear growth and bone maturation.
- Androgenic effects include maturation of the sex organs, particularly the penis and the formation of the scrotum in the fetus, and after birth (usually at puberty) a deepening of the voice, growth of facial hair (such as the beard) and axillary (underarm) hair. Many of these fall into the category of male secondary sex characteristics.

Testosterone effects can also be classified by the age of usual occurrence. For postnatal effects in both males and females, these are mostly dependent on the levels and duration of circulating free testosterone.

3. SEMEN

Semen, also known as seminal fluid, is an organic fluid that contains spermatozoa. It is secreted by the gonads (sexual glands) and other sexual organs of male or hermaphroditic animals and can fertilize the female ovum. In humans, seminal fluid contains several components besides

spermatozoa: proteolytic and other enzymes as well as fructose are elements of seminal fluid which promote the survival of spermatozoa, and provide a medium through which they can move or "swim". Semen is produced and originates from the seminal vesicle, which is located in the pelvis. The process that results in the discharge of semen is called **ejaculation**. Semen is also a form of genetic material. In animals, semen has been collected for cryoconservation. Cryoconservation of animal genetic resources is a practice that calls for the collection of genetic material in efforts for conservation of a particular breed.

4. MALE ORGASM

Orgasm is widely regarded as the peak of sexual excitement. It is a powerful feeling of physical pleasure and sensation, which includes a discharge of accumulated erotic tension.

When a man is stimulated physically or psychologically, he gets an erection. Blood flows into the corpora (spongy tissue running the length of the penis), causing the penis to grow in size and become rigid. The testicles are drawn up toward the body as the scrotum tightens. As the blood vessels in and around the penis fill with blood, the glans and testicles increase in size. In addition, thigh and buttock muscles tense, blood pressure rises, the pulse quickens, and the rate of breathing increases. Semen is forced into the urethra by a series of contractions in the pelvic floor muscles, prostate gland, seminal vesicles, and the vas deferens. Contractions in the pelvic floor muscles and prostate gland also cause the semen to be forced out of the penis in a process called ejaculation. The average male orgasm lasts for 10-30 seconds. The man now enters a temporary recovery phase where further orgasms are not possible. This is known as the refractory period, and its length varies from person to person. It can last from a few minutes to a few days, and this period generally grows longer as the man ages. During this phase, the man's penis and testicles return to their original size. The rate of breathing will be heavy and fast, and the pulse will be fast.

MALE ORGASIMIC DISORDER

Male orgasmic disorder involves a persistent and recurrent delay or absence of orgasm following sufficient stimulation. Male orgasmic disorder can be a lifelong condition or one that is acquired after a period of regular sexual functioning. The condition can be limited to certain situations or can generally occur. It can occur as the result of other physical conditions such as heart disease, psychological causes such as anxiety, or through the use of certain medications such as antidepressants.

PREMATURE EJACULATION

Ejaculation in men is closely associated with an orgasm. Premature ejaculation is a common sexual complaint, whereby a man ejaculates (and typically orgasms) within 1 minute of penetration, including the moment of penetration itself.

Premature ejaculation is likely to be caused by a combination of psychological factors such as guilt or anxiety, and biological factors such as hormone levels or nerve damage.

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. It affects approximately 7% of all men. Male infertility is commonly due to deficiencies in the semen, and semen quality is used as a surrogate measure of male fecundity.

CAUSES OF MALE INFERTILITY

- **Immune Infertility**

Antisperm antibodies (ASA) have been considered as infertility cause in around 10–30% of infertile couples. 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.

- **Genetics**

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

- **Klinefelter Syndrome**

One of the most commonly known causes of infertility is Klinefelter Syndrome, affecting 1 out of 500–1000 newborn males. This 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. 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.

PREVENTION

Some strategies suggested or proposed for avoiding male infertility include the following:

- Avoiding smoking, as it damages sperm DNA
- Avoiding heavy marijuana and alcohol use.
- Avoiding excessive heat to the testes.
- Maintaining optimal frequency of coital activity: Sperm counts can be depressed by daily coital activity, and sperm motility may be depressed by coital activity that takes place too infrequently (abstinence 10–14 days or more).[39]
- Wearing a protective cup and jockstrap to protect the testicles, in any sport such as baseball, football, cricket, lacrosse, hockey, softball, paintball, rodeo, motor cross, soccer, wrestling, karate or other martial arts or any sport where a ball, foot, arm, knee or bat can come into contact with the groin.
- Diet: Healthy diets (i.e. the Mediterranean diet) rich in such nutrients as omega-3 fatty acids, some antioxidants and vitamins, and low in saturated fatty acids (SFAs) and trans-fatty acids (TFAs) are inversely associated with low semen quality parameters. In terms of food groups, fish, shellfish and seafood, poultry, cereals, vegetables and fruits, and low-fat dairy products have been positively related to sperm quality. However, diets rich in processed meat, soy foods, potatoes, full-fat dairy products, coffee, alcohol and sugar-sweetened beverages and sweets have been inversely associated with the quality of semen in some studies. The few studies relating male nutrient or food intake and fecundability also suggest that diets rich in red meat, processed meat, tea and caffeine are associated with a lower rate of fecundability. This association is only controversial in the case of alcohol. The potential biological mechanisms linking diet with sperm function and fertility are largely unknown and require further study.

TREATMENT

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.

- 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.
- 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 fertilization 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.
- **Hormonal Therapy**

  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.