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PHYSIOLOGY ASSIGNMENT

Write short notes on the following:

Spermatogenesis

Testosterone

Spermatogenesis is the sequence of events by which spermatogonia are transformed into mature sperms

This maturation process begins at puberty

Spermatogonia, which have been dormant in the seminiferous tubules of the testes since the fetal period, begin to increase in number at puberty

After several mitotic divisions, the spermatogonia grow and undergo changes and are transformed into primary spermatocytes, the largest germ cells in the seminiferous tubules.

The walls of the tubules are composed of two compartments separated by tight junctions between the Sertoli cells:

• The basal layer, which consists of the Leydig cells and the spermatogonia

• The adluminal layer, which is made up of Sertoli cells and spermatocytes

Each primary spermatocyte subsequently undergoes 1st meiotic division (reduction division) to form two haploid secondary spermatocytes, which are approximately half the size of primary spermatocytes

The initial step in the process is transformation of type A spermatogonia, which are epithelioid-like cells, to type B spermatogonia, a process involving four divisions. The type B cells embed in the Sertoli cells. In association with the Sertoli cells, the type B cells are transformed to primary spermatocytes and then, in a step involving the first meiotic division, to secondary spermatocytes. The secondary spermatocytes undergo

a second meiotic division, yielding spermatids, each of which has 23 unpaired chromosomes. The steps described are stimulated by testosterone and follicle stimulating hormone (FSH).

Spermiogenesis Is the Process of Transformation of the Spermatids, Which Are Still Epithelioid, to Sperm Cells. The process of spermiogenesis takes place with the cells embedded in the Sertoli cells; it requires estrogen and FSH. Once the sperm cells are formed, they are extruded into the lumen of the tubule in a process stimulated by luteinizing hormone (LH). The first division of the type A spermatogonia to extrusion of the sperm cells requires a period of approximately 64 days. The newly formed sperm cells are not functional and require a maturation process, which takes place in the epididymis over a period of 12 days. Maturation requires both testosterone and estrogen. The mature sperm are stored in the vas deferens.

Sperms are transported passively from the seminiferous tubules to the epididymis, where they are stored and become functionally mature

The epididymis is the elongated coiled duct along the posterior border of the testis

It is continuous with the ductus deferens (vas deferens), which transports the sperms to the urethra

Mature sperms are free-swimming, actively motile cells consisting of a head and a tail

The neck of the sperm is the junction between the head and tail

The head of the sperm forms most of the bulk of the sperm and contains the haploid nucleus.

The anterior two thirds of the nucleus is covered by the acrosome, a caplike saccular organelle containing several enzymes

TESTOSTERONE

Testosterone or 17-beta-hydroxy-4-androstene-3-one is an anabolic steroid hormone from the androgen group. It is primarily secreted by the testes in the male and ovaries in the female, but small amounts are also secreted by the adrenal glands. Testosterone, similar to other steroid hormones, is derived from cholesterol. The testicle produces the largest amount of testosterone by Leydig cells

Responsible for the formation of male sexual charateristics which includes

1. Spermatogenesis
2. Growth of facial,axillary and pubic hair
3. Growth of larynx (hardening of the male voice

In puberty, the hypothalamic-pituitary-gonadal axis takes a major role in regulating testosterone levels and gonadal function. The hypothalamus secretes GnRH, which travels down the hypothalamo-hypophyseal portal system to the anterior pituitary, which secretes luteinizing hormone (LH) and follicle stimulating hormone (FSH). LH and FSH are two gonadotropic hormones which travel through the blood and act on receptors in the gonads. LH in particular acts on the Leydig cells to increase testosterone production. Testosterone limits its own secretion via negative feedback. High levels of testosterone in the blood feedback to the hypothalamus to suppress the secretion of GnRH and also feedback to the anterior pituitary, making it less responsive to GnRH stimuli.Throughout the reproductive life of males, the hypothalamus releases GnRH in pulses every 1 to 3 hours. Despite this pulsatile release, however, average plasma levels of FSH and LH remain fairly constant from the start of puberty, where levels spike, to the third decade of life, where levels peak and slowly begin to decline. Prior to puberty, testosterone levels are low, reflecting the low secretion of GnRH and gonadotropins. Changes in neuronal input to the hypothalamus and brain activity during puberty, cause a dramatic rise in GnRH secretion.

Leydig cells in the testes function to turn cholesterol into testosterone. LH regulates the initial step in this process. Two important intermediates in this process are dehydroepiandrosterone (DHEA) and androstenedione. Androstenedione is converted to testosterone by the enzyme 17-beta-hydroxysteroid dehydrogenase. The majority of testosterone is bound to plasma proteins such as sex-hormone-binding-globulin and albumin. This majority supply of protein-bound testosterone acts as a surplus of testosterone hormone for the body. The small amounts of free testosterone in the blood act at the level of the tissues, primarily the seminal vesicles, bone, muscle, and prostate gland. At the cellular level, testosterone gets converted to dihydrotestosterone by the enzyme 5-alpha-reductase. Testosterone and dihydrotestosterone can bind to cell receptors and regulate protein expression. Both men and women also produce weak acting androgens in the zona reticularis of the adrenal glands. These weak-acting androgens are known as dehydroepiandrosterone and androstenedione. They bind to testosterone receptors with weaker affinity but can also be converted to testosterone in the peripheral tissues if produced at high amounts. Testosterone Has Effects on Reproductive and Nonreproductive Organs. Testosterone is required for stimulation of prenatal differentiation and pubertal development of the testes, penis, epididymis, seminal vesicles, and prostate. Testosterone is also required in adult men for maintenance and normal function of the primary sex organs. Testosterone has effects on bone, stimulating growth and proliferation of bone cells, resulting in increased density of the bones. It also has effects on hair distribution and causes the skin to thicken. Testosterone affects the liver, causing synthesis of clotting factors and hepatic lipases