MALE REPRODUCTIVE SYSTEM

OUTLINE

- Introduction
- An overview of the male reproductive system
- Regulation of testicular functions
- Male reproductive organs
- Spermatogenesis
- Reproductive axis during fetal development, childhood and puberty
- Reproductive dysfunctions

INTRODUCTION

Testis is a bi-functional organ serving as the site for sex steroid (testosterone synthesis) and sperm production;

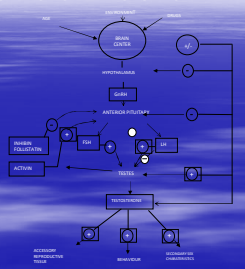
- Spermatogenesis
- Steroidogenesis

OVERVIEW OF MALE REPRODUCTIVE SYSTEM

Endocrine glands of male reproductive systems include hypothalamus, anterior pituitary and testes. Hypothalamus processes information obtained from external and internal environment using neurotransmitters that regulate GnRH secretion.

FIGURE 1

REGULATION OF REPRODUCTION IN MALES



Regulation of reproduction in male+
- Main reproductive hormones in boxes
- +ve/-ve regulations by ⊕/⊖

Regulation Of Testicular Function

- **HYPOTHALAMIC NEURONS PRODUCE GNRH**

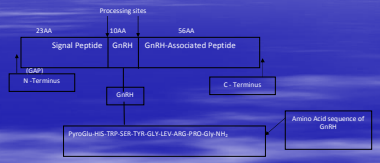
GnRH is produced by hypothalamic neurons and it regulates secretion of the LH and FSH.

GnRH enters hypothalamic- pituitary portal system and binds to receptors on plasma membranes of pituitary cells resulting in synthesis and release of LH and FSH.

Prolactin is a potent inhibitor of GnRH secretion

FIGURE 2.

Precursor Molecules, PreproGnRH that contains GnR



Regulation OF LH and FSH Secretions by Steroids and Polypeptides from the Testes

Major hormones are testosterone, inhibin, follistatin, estradiol and activin. Testosterone, inhibin and estradiol reduce the secretion of LH and FSH in the male.

– Activin stimulates secretion of FSH

– Follistatin inhibits FSH secretion

Testosterone inhibits LH release by decreasing GnRH secretion and to a lesser extend, gonadotroph sensitivity to GnRH. Testes removal results in increase circulatory levels of LH and FSH.

Synthesis of Testosterone and Transport in Blood

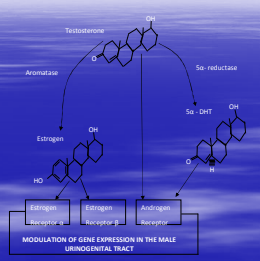
. Synthesis occurs either through delta 4 or delta 5 pathways with delta 5 more prominent.

Testosterone is produced by the leydic cells. Testosterone circulates mainly bound to two plasma protein.

Sex hormone - binding globulin (testosterone-binding globulin) and albumin.

About 54% of testosterone is bound to albumin, 44% to SHBG and 2-3% unbound or free in young adult men. SHBG testosterones are tightly bound and serve a storage role.

Action of Testosterone



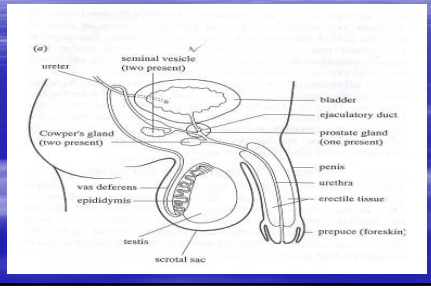
THE MALE REPRODUCTIVE ORGANS

Testes are located in the scrotum and have a temperature of 2 – 3 degree lower than core body temperature. Two systems help maintain testes at a cooler temperature;

- pampiniform plexus of blood vessels which serve as a countercurrent heat exchanger between warm arterial blood reaching the testes and cooler venous blood leaving the testes.
- Cremasteric muscles, respond to temperature changes by moving testes closer or further away from the body.

FIGURE 4A.

- Male reproductive system side view



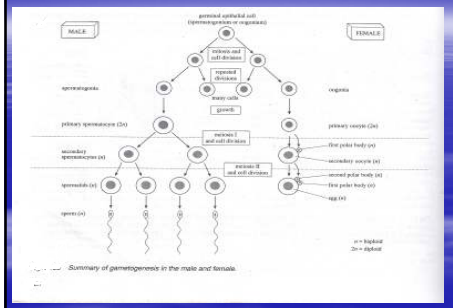
Erection and **Ejaculation** are neurally regulated. Erection is associated with sexual arousal resulting from sexually related psychic and/ or physical stimuli. During sexual arousals, impulses together with nerve signals elicite motor impulses in the spinal cord carried by parasympathetic nerves to the penis. These signals cause vasodilatation of arterioles and corpora cavernosa. Their smooth muscles then relax, blood vessels dilate and blood flow is encouraged. The thin - wall veins compress by swelling of arterioles and cavernosa blood filling thus restricting blood flow, thereby trapping blood in surrounding erectile tissue leading to rigidity, engorgement and elongation of penis in an erect manner.

SPERMATOGENESIS (From Puberty to Senescence)

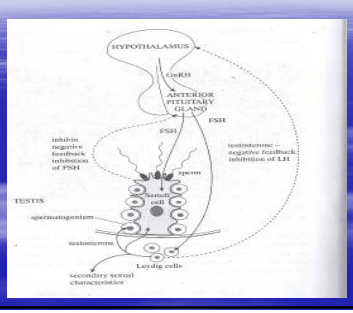
It's a continual process involving mitosis of male germ cells and meiosis to produce haploid spermatozoa. Sperm production occurs throughout life beginning from puberty and declines in elderly males.It involve 3 phases:

- **Phase I:** Cellular proliferation by mitosis.
- **Phase II:** Two reduction divisions by meiosis to produce haploid spermatids.
- **Phase III:** Cell differentiation by spermatogenesis.

Shortly before puberty, spermatogenesis is initiated by rising levels of gonadotropins and testosterone. Time required to produce mature spermatozoa from earliest stage of spermatogonia is 65 – 70 days



Hormonal control of spermatogenesis



REPRODUCTIVE AXIS DURING FETAL DEVELOPMENT CHILDHOOD AND PUBERTY

Adrenarche occurs at about 7 or 8 years when zona reticularis of adrenal mature leading to increase secretion of androgen precursors (androstenedione, dehydropiandrosterone (DHEA) and DHEA-sulfate and this process is controlled by ACTH and independent of LH and FSH control. Prepubertal growth and early pubic and axillary hair development are mediated by conversion of these precursors to testosterone and dihydrotestosterone (DHT).

MALE HYPOGONADISM

Hypogonadism refers to low circulating levels of testosterone. Most androgen-deficient men are infertile and primary hypogonadism indicates abnormality originating in the testes while secondary hyponadism indicates defect at the hypothalamus or pituitary resulting to decrease LH and FSH. Their causes may be congenital due to:

- GnRH deficiency, multiple hypothalamic and pituitary hormone deficiency or acquired due to;
- Trauma, post surgery, glucocorticoids, tranquilizers, malnutrition, renal and liver failure.

Abnormalities in pubertal development

- Delayed puberty in boys is a temporary form of hypothalamic hypogonadism in which sexual development has not begun by 13 years.
- Precocious puberty is the onset of pubertal development and begins before 9 years.

SEXUAL DYSFUNCTION

Divided into 4 main categories

- Loss of libido
- Erectile dysfunction
- Ejaculatory insufficiency
- Anorganasmic states

Loss of libido is the reduction in sexual interest, initiative and frequency and intensity of response to internal or external erotic stimuli.

Ejaculatory insufficiency is absent or reduced seminal emission or impaired ejaculatory contractions and usually associated with neurologic conditions.

Anorgasmic state is when the normal process of erection and ejaculation occurs in absence of subjective sensation of pleasure initiated at the time of emission and ejaculation.

- Erectile dysfunction is the inability of a man to obtain rigidity sufficient to permit coitus of adequate duration to satisfy himself and his partner. Causes are psychological, endocrine, systemic illness, neuralgic, drug related and aging.
- Studies in U.S suggest 10-15% of all U.S males and data from Massachusetts aging study report 52% of men age 40-70 experience some degree of erectile dysfunction.
- Oral sildenafil has been approved by U.S food and drug administration for treatment of erectile dysfunction.

Hypogonadism and Androgen Resistance

- Primary testicular hypogonadism refers to a condition of androgen deficiency. Causes are chromosomal disorders, testosterone biosynthetic enzyme defects;
- Hypogonadotropic hypogonadism is a deffeiciency in the secretion of gonadotropins due to instrinsic or functional abnormalities in the hypothalamus or pituitary glands.

Male Infertilty

- This may be due to ;
- Endocrine disorder
- Vasectomy
- Obstruction of the deferent duct
- Failure of erection or ejaculation during intercourse.
- Suppression of spermatogenesis by ionising radiation, chemotherapy and other drugs.

THANKS FOR YOUR KIND ATTENTION