Male reproductive system

I. Sexual reproduction -- overview

- production of two types of gametes -- fused at fertilization to form zygote

- promotes genetic variety among members of a species -- each offspring is a particular combination of genes contributed by both parents, not a genetic copy of a single individual

II. Differentiation of male and female gonads and external genitalia

- five - six week embryo -- sexually indifferent

- gonadal ridges -- undifferentiated gonads
- Mullerian ducts -- future female ducts
- Wolffian ducts -- future male ducts
- cloaca -- future urethra, urinary bladder

A. Embryo with XY chromosome

- sex-determining region of Y chromosome (SRY) expresses protein that directs differentiation of gonads into testes (7 weeks)
- testes secrete testosterone
    - degeneration of Mullerian ducts
    - Wolffian ducts develop into male reproductive tract
    - undifferentiated external genitalia develops along male lines
        - genital tubercle -- glans penis
        - urethral folds -- fuse, form shaft of penis, encircle urethra
        - genital swellings -- scrotum

B. Embryo with XX chromosome

- no SRY
    - gonads develop it ovaries
- no testosterone
    - degeneration of Wolfian ducts
    - Mullerian ducts develop into female reproductive tract
    - undifferentiated external genitalia develop along female lines
        - genital tubercle -- clitoris
        - urethral folds -- do not fuse, form labia minora
        - genital swellings -- form labia majora

III. Male reproductive system – introduction

- role: production of sex cells and production of offspring -- in the male specific function is to produce gametes and deliver them to the female reproductive tract for fertilization.

- reproductive system consists of :

- primary sex organs (gonads): produce sex cells or gametes and secrete sex hormones.
- accessory reproductive organs: ducts, glands, external genitalia.

IV. Anatomy of male reproductive system.

- sex organs (gonads):

- testes: produce sperm and male sex hormone, testosterone

- system of ducts to deliver sperm to exterior:

- epididymis
- vas deferens
- ejaculatory ducts
- urethra

- accessory sex glands: empty contents into ducts during ejaculation, materials to nourish, protect, activate sperm

- seminal vesicles
- prostate gland
- bulbourethral glands

A. Scrotum

- sac of skin and fascia that hangs outside abdominopelvic cavity

- testes suspended in scrotum by cremaster muscle

- to produce viable sperm testes temperature must be at 3 degrees C below body temp; cremaster raises or lowers testes to keep them at this optimal temperature

B. Testes

- male gonads

- divided into 250-300 wedges or lobules, each lobule contains 1-4 sets of highly coiled tubules, seminiferous tubules (site of spermatogenesis).

- between seminiferous tubules are the interstitial cells of Leydig, produce testosterone.

- seminiferous tubules converge to form epididymis.

C. Duct system

1. sperm move from seminiferous tubules ---> epididymis

2. epididymis on top, posterior aspect of each testis -- location where sperm mature and become mobile; can remain there for several months

- during ejaculation epididymis contracts, sperm moved to vas deferens

3. vas deferens propels sperm from epididymis storage site into ejaculatory duct and finally the urethra

- during ejaculation vas deferens and ejaculatory ducts contract vigorously

4. urethra conveys both urine and semen (sperm and secretions of accessory glands, see below

D. Accessory glands

1. seminal vesicles: secretion make up 60% of semen
- contents (enter prostatic urethra during ejaculation):

- ascorbic acid -- vitamin C
- prostaglandins: cause uterine contractions
- fructose: nutrition for sperm

2. prostate gland: surrounds urethra, secretion makes up 13-33% of semen

- alkaline secretion with enzymes -- activate sperm, neutralize acidity of urethra, vagina.

3. bulbourethral glands: pea sized glands

- produce thick, clear mucus prior to ejaculation, neutralize acidity of urethra.

E. Penis

- cylindrical organ -- deliver sperm to female reproductive tract.

- cross section shows three long bodies of erectile tissue each surrounded by a fibrous CT; during sexual exc itement, arousal, vascular spaces in erectile tissue fill with blood, penis enlarges and becomes rigid.

F. Semen: sperm and accessory gland secretions.

V. Physiology of male reproductive system.

A. Male sexual response has two phases:

- erection of penis: allows it to penetrate vagina
- ejaculation: expels semen into vagina

1. Physiology of erection

- during sexual arousal nerve impulses sent to area, release of nitric oxide (NO) by neurons in area ---> blood vessel dilation, more blood flows into erectile tissue ---> penis enlarges and becomes rigid ---> due to this veins draining erectile tissue compressed ---> more blood flowing into erectile tissue than out of it, further contributes to maintaining enlarged/rigid penis.

2. Physiology of ejaculation

- when sexual arousal reaches a certain level, have massive neural discharge (whole body) ---> orgasm results

- as far as reproductive tract during orgasm:

    - accessory glands contract and empty their contents to urethra, system of ducts contracts moving sperm to urethra, muscles of penis contract also facilitating the process

B. Spermatogenesis: sperm formation in seminiferous tubules -- basal cells are immature, more luminal cells are more mature

- begins at puberty

- involves reduction of number of chromosomes by 1/2, production of haploid cells (46 (2n) --> 23 (n) chromosomes): spermatogonium (2n)---> primary spermatocyte (2n) ---> secondary spermatocytes (n) ---> spermatids (n) ---> sperm (n) (only mature in epididymis).

- Sertoli cells: supporting cells in tubules -- nutrition of developing sperm cells

C. Hormone regulation

a. hypothalamus produces gonadotrophin releasing hormone (GnRH) ---> goes to anterior pituitary, stimulates AP cells to produce follicle stimulating hormone (FSH) and luteinizing hormone (LH)

- FSH: acts on Sertoli cells to stimulate spermatogenesis

- LH: stimulates Leydig cells to produce testosterone

- testosterone in turn causes negative feedback of GnRH, FSH, LH

b. development hormone patterns

- GnRH and testosterone levels in infant or midpubertal boy similar; levels drop until mid puberty as very small amounts of testosterone inhibit GnRH release.

- at puberty GnRH release only inhibited by much greater testosterone levels -- thus testosterone levels increase dramatically, testosterone and GnRH levels cycle dramatically; eventually stable adult levels of both hormones achieved.

c. roles of testosterone

- primary sex characteristics -- growth reproductive organs, accessory structures

- maintenance of all accessory ducts and glands

- development of male secondary sex characteristics: pubic and facial hair, deepening of voice, thickening of skin, increased bone size and density, increased muscle mass