

The Reproductive System: Chpt. 28

1. primary sex organs or gonads: organs that produce gametes and hormones

2. accessory reproductive organs: glands & ducts

- form the reproductive tract

- external genitalia

male: function to make sperm & deliver it to the female

female: produce eggs & incubate embryo-fetus

zygote:

both organs release hormones

Male Reproductive System

•primary sex organs: male gonads or testes: make sperm & androgens (testosterone)

Sperm made in testes and travel through: epididymis, ductus deferens, ejaculatory duct, urethra

Testes: w/i scrotum: sac of skin outside abdominopelvic cavity

descend into scrotum during fetal development

cryptorchidism:

-if not corrected = sterility

Spermatic cords: paired structures extend between abdominopelvic cavity & testes

Consist of layers of fascia & muscle enclosing vas (ductus) deferens, blood (testicular artery) & lymph vessels, nerves to testes

pass through inguinal canal: passageways through abdominal musculature

inguinal hernia

Scrotum

2 internal chambers – scrotal cavity
prevents spread of infections

tunica vaginalis: serous membrane which lines each scrotal cavity has parietal and visceral layer

Dartos & Cremaster muscles: muscles which elevate testes when cooling occurs

Dartos muscle: layer of smooth muscle

Cremaster muscle: skeletal muscle

relaxes when warm & tenses to pull testes closer to body when cold

Temperature regulation: sperm require 2° cooler than body temp.

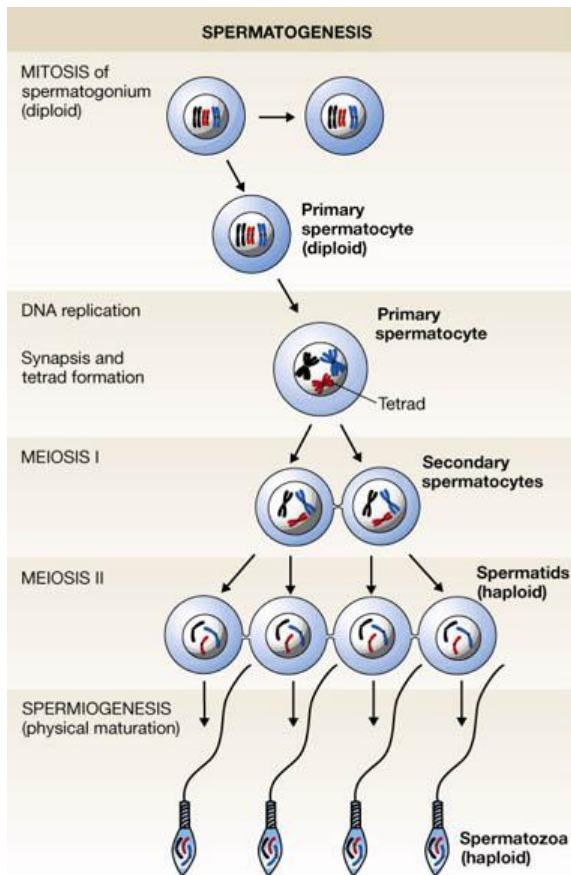
tunica albuginea: covers each testis and forms partitions or septa within testis

Histology of the Testes

septa divide testis into lobules
each lobule contains seminiferous tubules

seminiferous tubules connected to efferent ductules

-seminiferous tubules – spermatogenesis
begins at outer edge and proceeds toward lumen



- begins during puberty

- meiosis --> 4 sperm each

1. spermatogonia cells (stem cells)
undergo mitosis

2. daughter cells – one becomes the:

3. primary spermatocyte
undergo meiosis I

4. secondary spermatocyte
undergoes meiosis II

5. spermatids
(each with the haploid # of chromosomes)

Spermiogenesis: last step of spermatogenesis
Each spermatid matures into one spermatozoon (sperm)

Nurse Cells or Sertoli cells function:

1. maintenance of the Blood-Testis Barrier
protects seminiferous tubules fluid & developing sperm
2. help with mitosis/meiosis and spermiogenesis
FSH stimulates sustentacular cells to trigger mitosis/meiosis
3. secrete inhibin (decreases FSH) – feedback to control spermatogenesis

Interstitial cells: between tubules

Anatomy of a spermatozoon:

head
acrosomal cap

middle piece

tail – flagellum

The Male Reproductive Tract

Ducts:

A. Epididymis: the start of the male reproductive tract

- coiled tube
- receives sperm from the efferent ductules

•Functions:

1. Monitors and adjusts fluid
2. Recycles damaged spermatozoa
3. Stores & protects spermatozoa

•smooth muscle

sperm passes through epididymis in aprx. 2 weeks & matures during that time

when sperm leave are mature but immobile

capacitation- process that makes sperm motile
secretions from seminal vesicles

B. Ductus Deferens or Vas Deferens

•move and store sperm (16-18 inches long)

•from epididymis -->inguinal canal --> pelvic cavity --> post. to bladder --> thru prostate gland --> urethra.

•moves sperm from

•lined with ciliated epithelium

•smooth muscle uses peristalsis

• can store sperm for several months

•vasectomy:

C. Urethra

•both urinary & reproductive functions

- divided into prostatic, membranous, & spongy regions

3. Accessory Glands: seminal vesicles, bulbourethral, prostate contribute to semen

A. Seminal Vesicles: post. wall of bladder

- secretions make up _____% of semen
- alkaline, thick contains:
 - fructose
 - prostaglandins: stimulate smooth muscle contraction & make sperm motile
 - fibrinogen: after ejaculation forms temporary clot in vagina

- vas deferens joins with duct from the seminal vesicles at the ejaculatory duct

B. Prostate Gland

- doughnut shaped gland
- secretions enter prostatic urethra
- prostatic fluid is a slightly acidic milky fluid
 - contains seminalplasmin (antibiotic enzyme) prevent UTI
- benign prostatic hypertrophy: very common in older men
- prostate cancer – 2nd most common cancer & cancer deaths in men
 - average age at diagnosis is 72
 - PSA test

C. Bulbourethral (Cowper's) Glands

- pea sized:
- thick clear alkaline mucus: neutralizes acidity from urine in urethra

Semen – typical ejaculation releases 2-5 mls

Abnormally low volume may indicate problems

- milky white
- contains sperm – normal sperm count 20-100 million sperm/ml of ejaculate (when taken after 36 hours of sexual abstinence)
- contains nutrients, chemicals to
- contains enzymes
 - protease – dissolve mucus in vagina
- prostaglandins in semen:
- alkaline: 7.1 - 7.6

4. External Genitalia - Penis: copulatory organ

- divided into 3 parts: root, body & glans
 - glans penis
 - prepuce or foreskin
 - smegma
 - circumcision
 - internally houses the urethra
 - erectile tissue - parasympathetic stimulation releases NO which dilates blood vessels
 - corpora cavernosa
 - corpus spongiosum: surrounds penile (spongy) urethra
- impotence:

Hormones for Men

brain testicular axis:

1. hypothalamus releases GnRH in small pulses arpx. every 60-90- minutes which controls the release of
2. FSH triggers spermatogenesis by stimulating sustentacular cells to
 - also stimulates rate of inhibin secreted by sustentacular cells
3. LH: affects interstitial cells: stimulates the secretion of androgens

Testosterone: synthesized from cholesterol: anabolic effect

- spermatogenesis
- stimulates bone, muscle growth and RBC formation
- effects CNS (libido)
- maintains accessory glands & organs of male reproductive tract
- male secondary sex characteristics

testosterone travels in bloodstream bound to protein carriers (gonadal steroid-binding globulin and albumin)

testosterone diffuses across cell membrane at receptor cells
some of it is converted into dihydrotestosterone or DHT.

some DHT diffuses back out of cell into bloodstream, DHT levels are about 10% of circulating testosterone levels.

DHT can bind to and stimulate cells like testosterone

(note dehydroepiandrosterone or DHEA is main androgen produced by adrenal cortex. DHEA is converted to testosterone by other tissues.)

testosterone production begins around week 7 of fetal development then peaks around month 6.

-remains low at birth and childhood – increases at puberty

(male plasma also contains a small amount of estradiol – most formed from testosterone)

Female Reproductive System

- produce eggs (gametes), sex hormones, and incubate

- primary sex organs:

- accessory organs:

broad ligament – encloses ovaries, uterine tubes and uterus

1. Ovaries: small almond shaped structures

3 main functions:

1. Production of female gametes

2. Secretion of female sex hormones

3. Secretion of inhibin

- held in place with mesovarium and ovarian ligament

- fibrous tunica albuginea:

Oogenesis: egg supply determined by birth 700,000 only release

- puberty --> menopause releases them

- primary oocytes - begin meiosis I and doesn't complete it

- after puberty: once a month grows: continues meiosis I

- produces secondary oocyte & 1 polar body

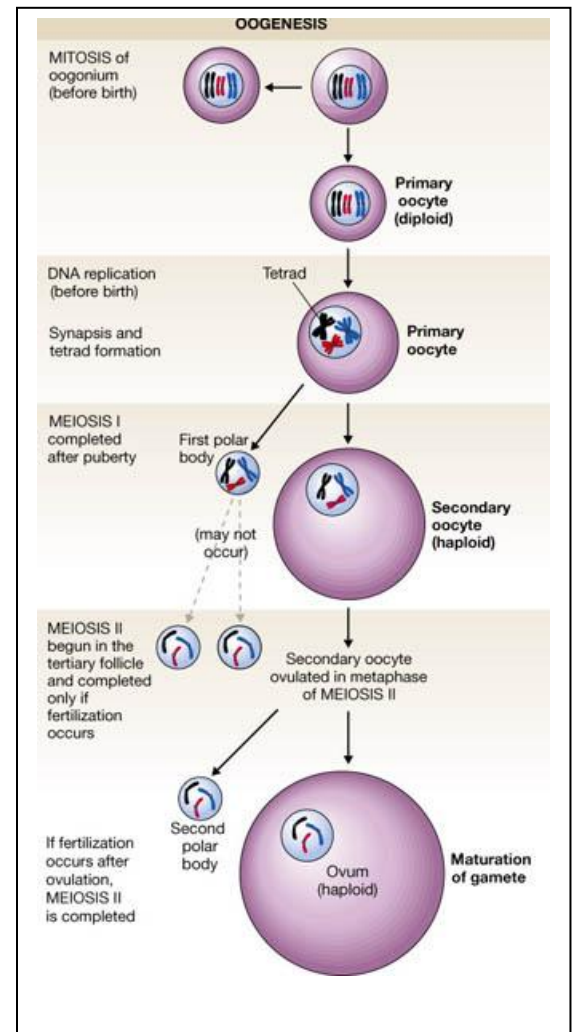
- secondary oocyte stops in metaphase II and is released:

- if not penetrated by sperm
- if penetrated by sperm completes

Ovarian Cycle

- ovarian follicles: structures which contain oocyte lined with follicular cells

(note as follicle grows, the follicle cells produce estrogen)



- 1.) Primordial follicle immature follicle – matures to become primary follicle: (under control of FSH)
 - follicle cells multiple and form several layers - now termed granulosa cells
 - contain primary oocyte

- 2.) Secondary follicle is formed
 - larger and contains follicular fluid

- 3.) Tertiary follicle or Graafian follicle is formed (aprx. 8-10 days after start of ovarian cycle)
 - central fluid filled chamber termed antrum
 - meiosis I is completed to form secondary oocyte

- 4.) Ovulation
 - tertiary (Graafian) follicle releases secondary oocyte (coated with layer of cells termed corona radiata)

- 5.) Formation of corpus luteum
 - tertiary follicle ruptured for ovulation and remaining granulose cells become corpus luteum (contains cholesterol used to make progesterone & some estrogen)

 - progesterone prepares the uterus to pregnancy if secondary oocyte is fertilized

 - if secondary oocyte is not fertilized corpus luteum degenerates

- 6.) If pregnancy does not occur progesterone & estrogen levels drop as corpus luteum degenerates

Ovarian Cysts: fluid filled sacs within or on the ovary
 Usually benign
 Might rupture

Ovarian cancer: causes more deaths than any other cancer of the female reproductive system
 s/s: back pain, bloating, fatigue, constipation, abdominal pain or pressure
 diagnosed: ultrasound, CT scan, blood test CA-125

2. Duct System

A. Uterine or Fallopian Tubes (oviducts):

- smooth muscle

- each tube divided into 3 segments:
 - infundibulum: closest to ovary
 - fimbriae w/ cilia

 - ampulla: middle segment

 - isthmus: closest to uterus

Uterine Tube and Oocyte Transport

Involves ciliary movement and peristaltic contractions in walls of uterine tube

From infundibulum to uterine cavity

Normally takes 3–4 days

B. Uterus:

- anterior to
- pear shaped, hollow, thick, muscular organ
- normally bends anteriorly near base (anteflexion)
Retroflexion:
- uterosacral ligaments – anchor uterus to sacrum prevent uterus from slipping
also broad & round ligaments & pelvic floor muscles support uterus
- body: largest portion
- fundus: rounded superior portion
- cervix: inferior – projects into the vagina
 - cervical os (external orifice) – curved surface at distal end
 - cervical canal

Uterine wall:

1. perimetrium:

2. myometrium:

3. endometrium:

-stratum functionalis or functional zone

cervical cancer: most common reproductive cancer in women 15-34

pap smear detects pre-cancerous changes

HPV associated with cervical cancer

smoking increases risk

Uterine or menstrual cycle: series of changes in the endometrium

Lasts 21 – 35 days: average is 28 days

Uterine Cycle responds to hormones of ovarian cycle

Menses & Proliferative Phases occur during ovarian follicular phase

Secretory Phase occurs during ovarian luteal phase

1. Menses (1-7 days)

The degeneration of the functional zone

Caused by constriction of arterioles

Endometrium is sloughed off

dysmenorrhea:

2. Proliferative phase

Epithelial cells multiply and spread across endometrial surface

Additional growth and revascularization

Occurs the same time as the enlargement of primary & secondary follicles

3. Secretory phase (aprx. 14 days)

Endometrial glands enlarge, increasing rate of secretion

Begins at ovulation and lasts as long as corpus luteum remains intact

Menarche – at age 11 or 12

amenorrhea (primary vs. secondary)

primary – failure to initiate menses (by age 16)

transient secondary – physical or emotional stresses, too little body fat

Menopause: ovulation & menstruation cease

Typically around 45 – 55 years of age

Circulating concentrations of estrogens & progesterone decline

Production of GnRH, FSH,

Perimenopause

Interval immediately preceding menopause

Ovarian & uterine cycles become irregular

Due to shortage of primordial follicles

Estrogen levels decline

Decline in Estrogen Levels leads to:

1. Reduction in

2. Thinning of urethral and vaginal epithelia

3. Reduction in bone deposition

C. Vagina (birth canal): elastic muscular tube

- extends between the cervix & vestibule

Cervix: projects into vaginal canal

- Fornix: shallow recess surrounding cervical protrusion

- Lies between the urethra & rectum

- 3 functions: 1.) eliminate menstrual fluid
2.) receive penis & sperm
3.) forms inferior portion of birth canal

- no glands within vagina: secretions from cervix or glands outside of the vagina
Vestibular glands (Bartholin glands)

- epithelial cells store glycogen --> lactic acid pH 3.5-4

contains some bacteria –
supported by nutrients in cervical mucus
help create acidic environment to restrict growth of pathogens

vaginitis:
fungi, bacteria or parasites

- hymen: elastic epithelial fold
Partially blocks entrance to vagina

3. External Genitalia (vulva): Area containing female external genitalia

- Mons pubis:

- Vestibule:
A central space surrounded by small folds (labia minora)
Covered with

Urethra opens into vestibule

- Labia Majora vs. Minora

- Clitoris: female counterpart of a penis
Vascular

Contains prepuce or hood

- Perineum:

4. Mammary Glands:

•found in both sexes

- Secrete milk to nourish an infant (**lactation**)
- Are specialized organs of integumentary system
- Are controlled by hormones of reproductive system and the placenta
- Lie in **pectoral fat pads** deep to skin of chest
- **Nipple** on each breast
 - Contains ducts from mammary glands to surface
- **Areola**
 - Reddish-brown skin around each nipple

•internally each gland has lobes which contain lobules
lactiferous duct drains lobules
lactiferous duct enlarges near nipple to form lactiferous sinus
aprx. 15-20 lactiferous sinuses open onto nipple

Breast cancer – leading cause of death in women 35-45 but is most common in women over 50
Risk factors include: family history (BRCA1 and BRCA2 – 10% of all breast cancers), 1st pregnancy after age 30, HRT, early menarche or late menopause, smoking, overweight, diet, sedentary lifestyle

Hormones and the Female Reproductive Cycle

ovarian and uterine cycles must be coordinated

GnRH – pulse frequency and amplitude (amount secreted per pulse) vary during cycle
hormones are released in response to different frequencies of GnRH

estrogens increase
progesterin decrease

Ovarian Cycle: 3 phases:

1. follicular phase: 1-10th day
2. ovulatory phase: 11th - 14th:
3. luteal phase: corpus luteum

Uterine Cycle: 3 phases

1. menses
2. proliferative
3. secretory

•typical cycle

GnRH triggers release of FSH:

FSH release triggers follicular development (follicular phase)

as follicle matures it produces estrogen

circulating estrogen – bound to albumin & some GBG
main form is estradiol

estrogen causes:

- 1.) bone & muscle growth
- 2.) female secondary sex characteristics

- 3.) CNS (increases sexual drive)
- 4.) maintaining accessory glands & organs
- 5.) repair & growth of endometrium

also increases pulse frequency of GnRH

increased pulse frequency of GnRh stimulates LH secretion

•when blood estrogen levels reach critical level causes sudden release of LH which triggers:

- 1.) completion of meiosis I by primary oocyte
- 2.) ovulation (usually basal body temp. drops)

Increased LH also increases progesterone secretion and formation of corpus luteum

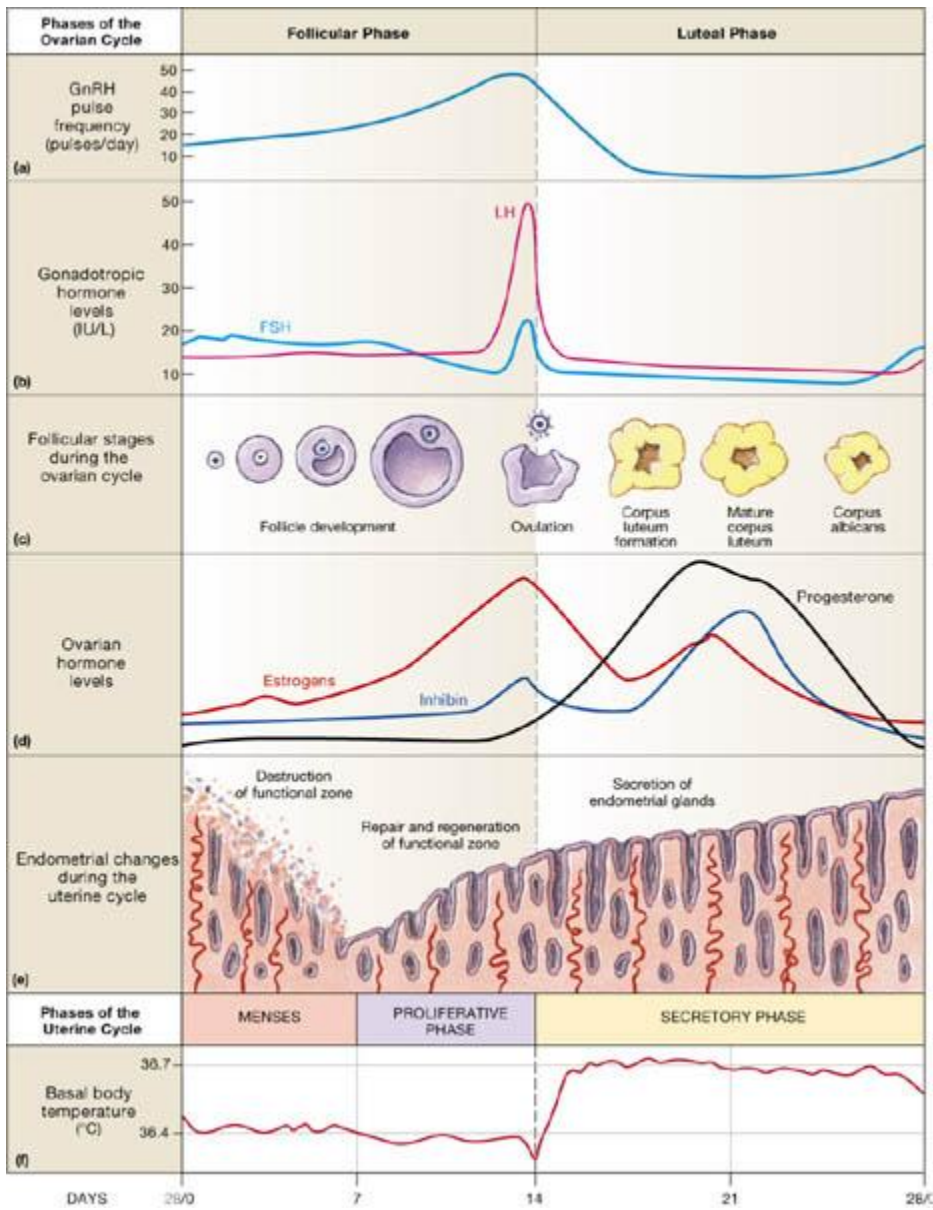
Luteal Phase

- Progesterone levels remain high for 1 week
- Unless pregnancy occurs, corpus luteum begins to degenerate
- Progesterone and estrogen levels drop
- GnRH pulse frequency increases
 - Stimulating FSH secretion
 - Ovarian cycle begins again

progesterone –prepares uterus for pregnancy – increases blood supply

Hormones and the Uterine Cycle

- Corpus luteum degenerates
- Progesterone and estrogen levels decline
 - Resulting in menses
- Endometrial tissue sheds several days
 - Until rising estrogen stimulates regeneration of functional zone
- Proliferative phase continues
 - Until rising progesterone starts secretory phase
- Increase in estrogen and progesterone
 - Causes enlargement of endometrial glands
 - And increase in secretory activities



Hormones & Body Temperature

Upon ovulation basal body temperature drops

Day after ovulation