Test Prep 3

Male Reproductive Anatomy

What are the 6 basic components of the male reproductive tract?

- Scrotum - Testes - Excurrent duct system - Spermatic cord - Accessory sex glands - Penis

Scrotum layers:

Layer	Definition
Scrotal Skin	Heavily populated with sweat glands
Tunica Dartos	Mesh-like smooth muscle layer just beneath the scrotal skin
Scrotal Fascia	Fatty and membranous layer
Parietal Vaginal Tunic	First peritoneum layer taken into the scrotum

What are some ways that thermoregulation occurs?

- Sweat glands and hair on the scrotal skin
- Tunica Dartos Muscle (sustained contractions) = change in testis location, change in scrotal surface area
- Cremaster Muscle (cannot sustain contractions)= Hot temp - relaxes, Cool temp – contracts
- Panpiniform Plexus = counter current heat exchange causing the cooling of arterial blood supply

Testis Layers:

Structure	Definition
Testicular Capsule	Consists of the visceral vaginal tunic and tunica albuginea
Parenchyma	Seminiferous tubules and interstitial tissue
Mediastinum	Connective tissue core
Rete Tubules	Tubules within the mediastinum that transports sperm to the efferent ducts

The Parenchyma is composed of two parts, what are they and what do they contain?

- Interstitial Compartment
    - Leydig Cells (testosterone), capillaries, lymphatic vessels, and connective tissues
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- Tubule Compartment
    - Seminiferous tubules (highly convoluted tubules network)
    - Sertoli Cells (provide support to developing germ cells and form blood-testes barrier)

Epididymis:

Structure	Function
Caput (Head)	MOVEMENT, fertilization factors added
Corpus (Body)	MORPHOLOGICAL CHANGES, decapitation factors added
Cauda (Tail)	METABOLIC ACTIVITY DECREASED, eligible for ejaculation, swimming factors added

What three things make up the spermatic cord?

Ductus deferens, cremaster muscle, panpiniform plexus

What are the two parts of the penis?

- Corpus Cavernosum (blood filled spaces lined by endothelium surrounded by smooth muscle)
- Corpus Spongiosum (spongy erectile tissue surrounding penile urethra)

What are the two types of penis and what species have them?

- Fibroelastic = bulls, boars, and rams (sigmoid flexure)
- Musculovascular = stallion and human

What are the accessory sex glands?

- Seminal vesicles (produce nutrient energy for sperm)
- Prostate (produce simple sugars)
- Cowpers (Bulbourethral) (secretions contribute to about 5% of the ejaculate, helps lubricate penile tissue)

What are the identifying qualities of a fibroelastic penis?

- Limited erectile tissue
- Contains a sigmoid flexure which allows the penis to be retracted inside the body until erection occurs
- Erection results in increased length of penis
- Bulls, Rams, Boars

What is the identifying quality of a musculovascular penis?

- Contains a lot of erectile tissue and little connective tissue
- Erection results in increased circumference
- Stallions, Humans, Dogs

What are the muscles associated with the penis?

- Bulbocavernosus: empties the extra-pelvic part of urethra

- Ischiocavernosus: paired muscles that compresses the crura and stops return of blood through veins
- Retractor Penis: paired muscle that maintains the sigmoid flexure in a fibroelastic penis

How does spermatozoa travel through the male reproductive tract?

Seminiferous tubules → rete tubules → mediastinum → efferent duct →caput epididymis → corpus epididymis → cauda epididymis → vas deferens → ampulla (except boar) → colliculus seminalis (where sperm mix with seminal plasma) → urethra

Spermatogenesis

What are the different phases that make up spermatogenesis and what occurs in each?

1. Proliferation Phase (generates A, I, B spermatogonia in the basal layer of the seminiferous tubules)
2. Meiosis Phase (Primary spermatocyte formed by mitotic division of B spermatogonia, secondary spermatocyte formed by first meiotic division, second meiotic division makes spermatids)
3. Differentiation Phase (morphological change in shape spherical cells → spermatozoon)
    a. Golgi phase = acrosomic vesicle forms
    b. Cap phase = acrosomic vesicle spreads
    c. Acrosomal phase = elongation of the head
    d. Maturation phase = final assembly

Compartments of the seminiferous tubules:

Basal	Mitosis - spermatogonia (A,I,B) - primary spermatocytes
Adluminal	Meiosis & Spermatogenesis - primary spermatocytes - secondary spermatocytes - spermatids
Luminal	Spermiation

Which kind of sperm is the most sensitive to heat stress?

- Spermatids because they are going through the most morphological changes

What is the blood-testis barrier?

- When sertoli cells form tight junctions with other sertoli cells (FSH), sertoli cells govern the environment around primary spermatocytes

- Destruction of tight junctions causes impairment of meiosis

Cell Type	Produce	Receptor(s)
Sertoli	Androgen binding protein, Dihydrotestosterone (DHT), sulfated glycoproteins, Transferin, Inhibin, Estrogen, Spermatids	FSH & Testosterone
Leydig	Testosterone	LH

Phases of spermatogenesis

Phase	Sperm type in Phase
Proliferation	- A spermatogonia - I spermatogonia - B spermatogonia
Meiosis - Meiosis 1 & 2	- Primary spermatocytes - Secondary spermatocytes
Differentiation - Golgi Phase - Cap Phase - Acrosomal Phase - Maturation Phase	- Spermatozoa - Spermatids

What 4 phases make up the differentiation phase?

1. Golgi phase
    a. Acrosomic vessel forms and fuses to the nucleus
    b. Centrioles migrate to opposite end of acrosomic vessel
2. Cap phase
    a. Acrosomic vessel flattens to form a “cap” over the anterior portion of the nucleus
    b. Tail begins to form and project towards the lumen of the seminiferous tubule
3. Acrosomal phase
    a. Sperm head takes shape -> nucleus begins to elongate
    b. Acrosome continues to spread
    c. Chromatin condenses
    d. Mitochondria migrates toward neck
4. Maturation phase
    a. Cytoplasm shrink wraps around cell

Reproductive Behavior

What is the ultimate goal of reproduction?

Pregnancy, successful embryogenesis and parturition

Why is it important to expose young males to mating?

Male mating is a learned behavior

Negative experience will reduce the male's desire for reproducing

Phase	**What happens?**
Precopulatory	- Search for sexual partner - Courtship - Sexual arousal - Erection - Penile protusion
Copulatory	- Mounting - Intromission - Ejaculation
Postcopulatory	- Dismount - Refractory period - Memory

What is the difference between satiation and exhaustion?

Satiation- further stimuli will not cause immediate responsiveness

Exhaustion- no further sexual behavior can be induced even if sufficient stimuli are present

What is the refractory period influenced by?

Sexual rest, age, species, female novelty, and number of previous ejaculations

Sperm in the FRT

What are the two types of sperm transport?

- Rapid transport: occurs within minutes of copulation and sperm can be found in the oviduct

- Sustained transport: delivers more sustained and uniformed sperm to the ampulla

What are two ways we 'lose' sperm?

- Retrograde loss (flows back out of vagina)

- Phagocytosis (spermatozoa are foreign to the female and are attacked by leukocytes)

Do sperm have catabolic or anabolic metabolism?

- Catabolic (cannot repair themselves, breakdown substrates for energy = when substrate is gone they die)

What is capacitation?

- Removal of decapacitation factors to allow for the acrosome reaction to penetrate the zona pellucida

What is the true acrosome reaction?

- Successful Fertilization

What enzymes are used during the acrosome reaction and what do they do?

- Hyaluronidase: breaks down cumulus oorphous mass

- Acrosin: digests ZP

Where does the acrosome reaction occur?

- Oviduct

What is polyspermy?

- Multiple sperm penetrating + fertilizing oocyte = embryo death

What Happens After Ejaculation?

1. Immediate Transport
    a. Retrograde loss
    b. Phagocytosis
    c. Entrance into cervix/uterus

2. Transverse the cervix
    a. Sialomucin/sulfomucin
    b. Removal of non-motile sperm
3. Travel through the uterus to oviduct
    a. Uterus
        i. Capacitation initiated
    b. Oviduct
        i. Docking to oviductal cells
        ii. Capacitation completed
        iii. Hyperactive motility
4. Fertilization
    a. Bind to oocyte
    b. Undergo acrosome reaction
    c. Penetrate ZP
    d. Fuse with the oocyte plasma membrane