Male Reproductive System

Dr. Mumaugh – Circa 1950
Reproductive System Basics

- Primary sex organs (gonads) – testes in males, ovaries in females
- Gonads produce sex cells called gametes (gametes means spouses) and secrete sex hormones
- Accessory reproductive organs – ducts, glands, and external genitalia
- Sex hormones – androgens (males), and estrogens and progesterone (females)
Reproductive System Basics

- Sex hormones play roles in:
  - The development and function of the reproductive organs
  - Sexual behavior and drives
  - The growth and development of many other organs and tissues
Reproductive System Basics

- Functioning of the reproductive system ensures the survival of the genetic characteristics of a species.
- Male reproductive system consists of organs whose functions are to produce, transfer, and introduce mature sperm into the female reproductive tract, where fertilization can occur.
Male Reproductive System

• The male gonads (testes) produce sperm and lie within the scrotum
• Sperm are delivered to the exterior through a system of ducts: epididymis, vas deferens, ejaculatory duct, and the urethra
• Accessory sex glands:
  ▫ Empty their secretions into the ducts during ejaculation
  ▫ Include the seminal vesicles, prostate gland, and bulbourethral glands
**Male Reproductive System**

**Testes (Gonads) Produce Sperm**

- Spermatogenesis

Sperm Delivered to Exterior via System of Ducts

1. **Epididymis**
   - **Vas Deferens**
   - **Ejaculatory Duct**
   - **Urethra**

**Accessory Glands** Empty Secretions into Ducts During Ejaculation

- Seminal Vesicles
- Prostate Gland
- Bulbourethral Glands
Male Reproductive System

- Peritoneum
- Seminal vesicle
- Ampulla of ductus deferens
- Ejaculatory duct
- Rectum
- Prostate gland
- Bulbourethral gland
- Anus
- Bulb of penis
- Epididymis
- Testis
- Scrotum
- Ureter
- Urinary bladder
- Ductus deferens
- Prostatic urethra
- Pubis
- Membranous urethra
- Urogenital diaphragm
- Corpus cavernosum
- Corpus spongiosum
- Spongy (penile) urethra
- Glans penis
- Prepuce
- External urethral orifice
Male Reproductive Organs

• Essential organs
  ▫ For production of gametes
  ▫ Gonads of male – testes

• Accessory organs
  ▫ Support the reproductive process
  ▫ Genital ducts convey sperm outside the body
    • pair of epididymides
    • paired vasa deferentia,
    • pair of ejaculatory ducts, and the
    • urethra
- Accessory glands
  - produce secretions that nourish, transport, and mature sperm
    - pair of seminal vesicles, the prostate, and pair of bulbourethral glands
- Supporting structures
  - Scrotum
  - Penis
  - Pair of spermatic cords
SPERM TRAVEL

VASECTOMY
VS.
VASOVASOTOMY (SOB)

1. EPIDIDYMIS →
2. VAS DEFERENS →
3. EJACULATORY DUCT →
4. URETHRA
Male – Perineum

- Roughly diamond-shaped area between thighs
- Extends from pubic symphysis to coccyx
- Lateral boundary is the ischial tuberosity bilateral
  Divided into the urogenital triangle and the anal triangle
The Scrotum

- Sac of skin (scrotum = “pouch”) and superficial fascia that hangs outside the abdominopelvic cavity at the root of the penis
- Divided into two compartments - contains paired testicles separated by a midline septum
- Contains testis, epididymis, and lower part of a spermatic cord
- Dartos and cremaster muscles elevate the scrotal pouch
- Its external positioning keeps the testes 3°C lower than core body temperature (needed for sperm production)
The Scrotum

- Internal oblique muscle
- Aponeurosis of external oblique muscle (cut)
- Suspensory ligament of penis
- Penis (cut)
- Middle septum of scrotum
- Cremaster muscle
- External spermatic fascia
- Scrotum containing dartos muscle
- Skin
- Superficial inguinal ring (end of inguinal canal)
- Spermatic cord
- Ductus (vas) deferens
- Autonomic nerve fibers
- Pampiniform plexus of testicular veins
- Testicular artery
- Epididymis
- Tunica vaginalis (from peritoneum)
- Tunica albuginea of testis
- Internal spermatic fascia
Penis & Scrotum
Penis & Scrotum - Cutaway
The Testes

- Located in scrotum, one testis in each of two scrotal compartments
- Each testis is surrounded by two tunics or layers
  - Tunica vaginalis – outer layer that is an outpocket of the peritoneum
  - Tunica albuginia – “white coat” is deep serous layer
- Septa (walls) divide the testis into 250-300 lobules, each containing 1-4 seminiferous tubules
  - Produce and carry the sperm
• The microscopic structure of the seminiferous tubules contains interstitial cells called Leydig cells
  ▫ The interstitial cells produce androgens
• The seminiferous tubules are encased in fibrous capsule called the tunica albuginea
• Seminiferous tubules in testis open into a plexus called rete testis
• From the rete testis, the sperm:
  ▫ Leave the testis via efferent ductules
  ▫ Enter the epididymis
Brain Testicular Axis

**Hormonal regulation of spermatogenesis and testicular production**
- Involves hypothalamus, ant pituitary and testis

**Involves three hormones**
- **GnRH** – gonadothrophic releasing hormoned stimulates testes
- **FSH** – causes tubules to produce sperm. Produces sertolli cells which supply nutrients and maintains hormone levels for developing sperm
- **LH** – acts on interstitial cells to produce testosterone

**Maturation of the brain-testicular axis takes about 3 years and then stays fairly constant throughout life**
The Testes

- Head of epididymis
- Efferent ductule
- Ductus (vas) deferens
- Rete testis
- Tubulus rectus
- Body of epididymis
- Tail of epididymis
- Spermatic cord
- Blood vessels and nerves
- Seminiferous tubule
- Lobule
- Septum
- Tunica albuginea
- Tunica vaginalis
- Cavity of tunica vaginalis
Functions of Testes

- **Spermatogenesis** - formation of mature male gametes (spermatozoa) by seminiferous tubules
  - stimulated by FSH from the anterior pituitary

- **Secretion of hormones** by interstitial cells
  - Testosterone
  - Inhibin
  - Estrogen
• Testicular androgenic hormones
  ▫ Testosterone
    • Type of androgen: maleness hormone
    • Secondary male sexual characteristics
    • Regulated by LH from anterior pituitary
  ▫ Inhibin
    • Inhibits release of FSH by anterior pituitary
    • Allows the testis some control over spermatogenesis
  ▫ Estrogen
    • Small amounts secreted by interstitial cells, liver, and other organs
    • Role in males uncertain but may influence spermatogenesis and other functions
Testicular Cancer

- Very rare cancer (<1% of all cancers), but most common cancer of young men
- Most common risk factor – cryptorchidism (undesended testicle)
- 7000 cases per year with 300 death per year
- 90% success rate with orchidectomy
Fig. 31-16. Descent of the testes. Prior to birth, the testes move from their retroperitoneal location near the kidneys and through the inguinal canal to the scrotum.
Testes & Spermatic Cord
Spermatogenesis

- The sequence of events that produces sperm in the seminiferous tubules of the testes
- Each cell has two sets of chromosomes (one maternal, one paternal)
- Humans have 23 pairs of chromosomes
- Spermatogenesis begins at puberty and continues throughout life
- Healthy adult male produces 400 million sperm per day
**Acrosome**
- Burroughs into egg

**Head**
- Contains DNA
- Represents nucleus

**Body**
- Contains mitochondria
- Provides energy for tail movement

**Tail**
- Propels sperm
- 3 mm per hour
Spermatogenesis

- Sperm have three major regions
  - Head – contains DNA and has a helmetlike acrosome containing hydrolytic enzymes that allow the sperm to penetrate and enter the egg
  - Midpiece – contains mitochondria spiraled around the tail filaments
  - Tail – a typical flagellum produced by a centriole
Spermatogenesis
Takes 64 to 72 Days
Sperm Formation & Travel

Seminiferous Tubules

Tubulus Rectus

Rete Testes

Efferent Ductule

Epididymis "upon Testis"
- 20" long & wound up 1/3
- stores & nourishes sperm

Vas Deferens - Ductus Deferens
- 18" long
- strong muscular tube that contracts with ejaculation

Ejaculatory Duct

Prostatic Urethra
Male Secondary Sex Characteristics

- Male hormones make their appearance at puberty and induce changes in nonreproductive organs, including
  - Appearance of pubic, axillary, and facial hair
  - Enhanced growth of the chest and deepening of the voice
  - Skin thickens and becomes oily
  - Bones grow and increase in density
  - Skeletal muscles increase in size and mass
- Testosterone is the basis of libido in both males and females
I take it you haven't had sex for a while.

NORMAL SPERM

YOUR SPERM
The Penis

- Composed of three cylindrical masses of erectile tissue, one of which contains urethra
- Functions
  - Contains the urethra, the terminal duct for both urinary and reproductive tracts
  - Penetrating copulatory organ during sexual intercourse
The Penis

- Consists of an attached root and a free body that ends in the glans penis or head
- Prepuce, or foreskin – cuff of skin covering the distal end of the penis
- Internal penis – the urethra and three cylindrical bodies of erectile tissue
- Erectile tissue – spongy network of connective tissue and smooth muscle riddled with vascular spaces
- Corpus spongiosum – surrounds the urethra and expands to form the glans and bulb of the penis
The Penis

- Ureter
- Seminal vesicle
- Ejaculatory duct
- Bulbourethral gland and duct
- Urogenital diaphragm
- Bulb of penis
- Crus of penis
- Bulbourethral duct opening
- Ductus deferens
- Corpora cavernosa
- Epididymis
- Corpus spongiosum
- Testis

**Section of (b)**
- Spongy (penile) urethra
- Glans penis
- Prepuce (foreskin)
- External urethral orifice
- Corpora cavernosa
- Urethra
- Tunica albuginea of erectile bodies
- Corpus spongiosum

**Shaft (body) of penis**
- Urinary bladder
- Prostate gland
- Prostatic urethra
- Orifices of prostatic ducts
- Membranous urethra
- Root of penis

**(a)**
- Dorsal vessels and nerves
- Skin
- Deep arteries
1. **CORPORA CAVERNOSA**
   - with deep artery of penis

2. **CORPORA Spongiosum**
   - with lumen of urethra

**Parasympathetic Stimulation**

\[ \geq 50 \text{ cc blood} \]
MALE DUCT SYSTEM

SEMINAL VESICLES
- ON POSTERIOR BLADDER
- 60% OF SEMEN
- PROVIDES FRUCTOSE TO NOURISH SPERM

PROSTATE GLAND
- SIZE OF WALNUT
- SURROUNDS PROSTATIC URETHRA
- 15% - 30% OF SEMEN
- ACTIVATES SPERM

BULBOURETHRAL GLANDS
- PEASIZED
- NEUTRALIZES ACID IN URETHRA

SEMEN IS MADE FROM 3 GLAND SECRETIONS:
Epididymis

- Structure and location
  - Single tightly coiled tube enclosed in fibrous casing
  - Lies along top and side of each testis
  - Anatomical divisions include head, body, and tail

- Functions
  - Duct for seminal fluid
  - Also secretes part of seminal fluid
  - Sperm become capable of motility while they are passing through the epididymis
Epididymis

- Its head joins the efferent ductules and caps the superior aspect of the testis
- Nonmotile sperm enter, pass through its tubes and become motile (it takes about 20 days)
- If the epididymus ducts were uncoiled, it would be about 20 feet long
- Upon ejaculation the epididymis contracts, expelling sperm into the vas deferens
Vas Deferens
Ductus Deferens

- Runs from the epididymis through the inguinal canal into the pelvic cavity then joins the duct of the seminal vesicle to form the ejaculatory duct
- Is approximately 18 inches long
- Propels sperm from the epididymis to the urethra
- Vasectomy – cutting and ligating the ductus deferens, which is a nearly 100% effective form of birth control
  - Vasovasotomoy – vasectomy reversal
Vas Deferens

- **Vas deferens (ductus deferens)**
  - **Structure and location**
    - Tube, extension of epididymis
    - Extends through inguinal canal, into abdominal cavity, over top and down posterior surface of bladder
    - Enlarged terminal portion called ampulla; joins duct of seminal vesicle
  - **Function**
    - Excretory duct for seminal fluid
    - Connects epididymis with ejaculatory duct
Urethra

- Conveys both urine and semen
- Consists of three regions
  - Prostatic – portion surrounded by the prostate
  - Membranous – lies in the urogenital diaphragm
  - Spongy, or penile – runs through the penis and opens to the outside at the external urethral orifice
URETHRA
- CONVEYS BOTH URINE & SEMEN

BLADDER

EJACULATORY DUCT

PROSTATIC URETHRA

MEMBRANOUS URETHRA
- LIES IN UROGENITAL DIAPHRAGM

SPONGY OR PENILE URETHRA
- THROUGH PENIS TO EXTERNAL URETHRAL ORIFICE
Accessory Glands

• Seminal Vesicles
  ▫ Secrete 60% of the volume of semen
  ▫ Join the vas deferens to form the ejaculatory duct
  ▫ Sperm and seminal fluid mix in the ejaculatory duct and enter the prostatic urethra during ejaculation

• Prostate Gland
  ▫ Encircles part of the urethra inferior to the bladder
  ▫ Doughnut shaped
  ▫ Plays a role in the activation of sperm
  ▫ Function: adds slightly acidic, watery, milky-looking secretion to seminal fluid (30% of semen volume)
Accessory Glands

- Bulbourethral Glands (Cowper’s Glands)
  - Structure and location
    - Small, pea-shaped structures with approximately 2.5-cm long (1 inch) ducts leading into urethra
    - Lie below prostate gland
  - Function: secrete alkaline fluid that is part of semen (5% of semen volume)
    - Produce thick, clear mucus prior to ejaculation that neutralizes traces of acidic urine in the urethra
Fig. 31-12. **Prostate and related structures.** Cadaver dissection showing the prostate gland and other male reproductive structures viewed from behind. The prostate has been sectioned on the left side to reveal the ejaculatory duct.
Fig. 31-11. The male reproductive system. Illustration shows the testes, epididymis, vas (ductus) deferens, and glands of the male reproductive system in an isolation/dissection format.
Semen

- Provides a transport medium and nutrients, protects and activates sperm, and facilitates their movement
- Prostaglandins in semen:
  - Decrease the viscosity of mucus guarding the cervix
  - Stimulate reverse peristalsis in the uterus
  - Facilitate the movement of sperm through the female reproductive tract
  - The relative alkalinity of semen neutralizes the acid environment found in the male urethra and female vagina
- Only 2-5 ml of semen are ejaculated, but it contains 50-130 million sperm/ml
Erection

- Engorgement of spongy erectile bodies with blood during stimulation
- Under the control of parasympathetic control which releases nitrous oxide (NO₂), which relaxes vascular smooth muscle causing the arterioles to dilate
  - Cavernous bodies fills with 50 cc blood
  - The erection blocks the venous flow from the penis after the cavernous bodies engorge
Hey, Lover Boy! You dropped a Viagra on the floor again!
That’s odd. This bottle of Viagra was full two days ago.
Ejaculation

• The propulsion of semen from the male duct system
• At ejaculation, sympathetic nerves serving the genital organs cause:
  ▫ Reproductive ducts and accessory organs to contract and empty their contents
  ▫ The bladder sphincter muscle to constrict, preventing the expulsion of urine
  ▫ Bulbospongiosus muscles to undergo a rapid series of contractions
  ▫ Propulsion of semen from the urethra
Composition and Course of Seminal Fluid

- Consists of secretions from testes, epididymides, seminal vesicles, prostate, and bulbourethral glands
- Each milliliter contains millions of sperm
- Passes from testes through epididymis, vas deferens, ejaculatory duct, and urethra
Male Fertility

- Relates to many factors: number, size, shape, and motility of sperm
- Infertility may be caused by antibodies some men make against their own sperm
- Male fertility begins at puberty and extends into old age
Cycle of Life: Male Reproductive

- Reproductive functions begin at time of puberty
- Development of organs begins before birth; immature testes descend into scrotum before or shortly after birth
- Puberty: high levels of hormones stimulate final stages of development
- System operates to permit reproduction until advanced old age
- Late adulthood: gradual decline in hormone production may decrease sexual appetite and fertility