

## **Chapter 19 - Reproductive Systems**

### **19.1 Introduction (p. 520)**

- A. Male and female reproductive systems are a series of glands and tubes that produce and nurture sex cells, and transport them to the site of fertilization.

### **19.2 Organs of the Male Reproductive System (p. 520; Fig. 19.1; Table 19.1)**

- A. The male sex organs are designed to transport sperm to eggs.
- B. Primary sex organs (gonads) produce sperm and hormones; accessory sex organs have a supportive function.
- C. Testes (p. 520)
  - 1. The testes are ovoid structures suspended by a spermatic cord in the scrotum.
  - 2. Structure of the Testes (p. 520; Fig. 19.2)
    - a. Each of the testes is made up of 250 lobules separated by connective tissue; each lobule holds one to four highly coiled seminiferous tubules.
    - b. Seminiferous tubules are lined with stratified epithelium that gives rise to sperm cells.
    - c. Interstitial cells lie between the seminiferous tubules and produce the male hormones.
    - d. Channels leading from the seminiferous tubules carry sperm to the epididymis and vas deferens.
  - 3. Formation of Sperm Cells (p. 521; Fig. 19.3)
    - a. A sperm cell has a head containing the haploid nucleus, a midpiece containing mitochondria, and a tail that is a flagellum.
    - b. At the tip of the head is the acrosome, a bag of digestive enzymes that helps to erode tissues surrounding the female egg cell.
  - 4. Spermatogenesis (p. 522; Figs. 19.4-19.5)
    - a. In the male embryo, the spermatogenic cells are undifferentiated and are called spermatogonia; each contains 46 chromosomes.
    - b. During spermatogenesis, spermatogonia to enlarge and become primary spermatocytes.
    - c. Primary spermatocytes undergo division by meiosis and form haploid secondary spermatocytes with 23 chromosomes.
    - d. Secondary spermatocytes divide again to form spermatids, each of which matures into a sperm cell.
- D. Male Internal Accessory Organs (p. 522)
  - 1. The accessory organs of the male reproductive tract include the epididymides, vasa deferentia, ejaculatory ducts, urethra, seminal vesicles, prostate gland, and bulbourethral glands.
  - 2. Epididymus (p. 522)
    - a. Each epididymus is a tightly coiled tube lying adjacent to the testis and leading from the testis to the vas deferens.
    - b. It is the site of sperm maturation.
  - 3. Vas Deferens (p. 522)
    - a. The vas deferens is a muscular tube 45 centimeters in length leading from the epididymus up into the body cavity to the ejaculatory duct, where it unites and empties its contents into the urethra.
  - 4. Seminal Vesicle (p. 522)
    - a. The seminal vesicle is a saclike structure attached to the vas deferens near the base of the urinary bladder.
    - b. During emission, seminal vesicles secrete an alkaline fluid containing fructose to nourish sperm and prostaglandins to cause muscular

- contractions in the female tract to help propel sperm to the egg cell.
5. Prostate Gland (p. 524)
    - a. The prostate gland is a chestnut-shaped structure surrounding the urethra at the base of the urinary bladder.
    - b. The prostate gland secretes a thin, milky alkaline fluid that both enhances the mobility of sperm cells and neutralizes the acidity of the by-products produced during spermatogenesis and the acidity of the female reproductive tract.
  6. Bulbourethral Glands (p. 524)
    - a. The bulbourethral glands are small structures located inferior to the prostate that secrete mucus to lubricate the tip of the penis during sexual arousal.
  7. Semen (p. 524)
    - a. Semen is a combination of sperm cells (120 million per milliliter) and the secretions of the seminal vesicles, prostate gland, and bulbourethral glands.
    - c. Sperm cells cannot fertilize an egg until they undergo capacitation within the female reproductive tract.
- E. Male External Reproductive Organs (p. 525)
1. The male external reproductive structures are the scrotum, which houses the testes, and the penis.
  2. Scrotum (p. 525)
    - a. The scrotum is a pouch of skin and subcutaneous tissue that houses the testes suspended from the lower abdomen, posterior to the penis.
  3. Penis (p. 525)
    - a. The penis is a cylindrical organ made up of specialized erectile tissue (corpora cavernosa and corpus spongiosum) and is designed to convey both urine and semen to the outside.
    - b. The corpus spongiosum enlarges at its distal end to form the glans penis.
- F. Erection, Orgasm, and Ejaculation (p. 526)
1. During sexual arousal, parasympathetic impulses trigger increased blood flow into the erectile tissues of the penis, producing an erection.
  2. The culmination of sexual stimulation is orgasm, which in the male consists of emission (movement of sperm cells and accessory gland secretions into the urethra) and ejaculation (forcing semen to the outside).
  3. After ejaculation, sympathetic impulses constrict the arteries and the penis returns to its flaccid state.

### **19.3 Hormonal Control of Male Reproductive Functions (p. 528)**

- A. Hormones secreted by the hypothalamus, the anterior pituitary, and the testes control male reproduction and development of secondary sexual characteristics.
- B. Hypothalamic and Pituitary Hormones (p. 528)
1. At the time of puberty, the hypothalamus controls the many changes that lead to the development of a reproductively functional adult.
  2. The hypothalamus releases gonadotropin-releasing hormone (GnRH), which triggers the production of the gonadotropins, luteinizing hormone (LH), and follicle-stimulating hormone (FSH) from the anterior pituitary.
    - a. LH promotes the development of interstitial cells of the testes and they, in turn, secrete male hormones (testosterone).
    - b. FSH stimulates the supporting cells of the seminiferous tubules.
    - c. FSH and testosterone stimulate spermatogenesis.
- C. Male Sex Hormones (p. 528)
1. The male sex hormones are called androgens, of which testosterone is the most abundant.

2. Testosterone is secreted in a fetus until birth, and then not again until puberty, after which it is continuously secreted.
3. Actions of Testosterone (p. 528)
  - a. Testosterone stimulates the development of the male reproductive organs and causes the testes to descend.
  - b. Testosterone is also responsible for male secondary sexual characteristics (deep voice, body hair, thickening of the skin, and so forth).
4. Regulation of Male Sex Hormones (p. 528; Fig. 19.6)
  - a. A negative feedback system involving the hypothalamus regulates the quantity of testosterone.
    - i. As the concentration of blood testosterone increases, the hypothalamus becomes inhibited, and its stimulation of the anterior pituitary declines.
    - ii. As the amount of LH drops in response, the amount of testosterone is reduced.

#### **19.4 Organs of the Female Reproductive System** (p. 529; Table 19.2)

- A. The organs of the female reproductive system are specialized to produce and maintain the eggs cells, to transport these cells to the site of fertilization, to provide a favorable environment for a developing fetus, to give birth, and to produce female sex hormones.
- B. The primary sexual organs (gonads) are the ovaries; the other parts of the system comprise the external and internal accessory organs.
- C. Ovaries (p. 529; Fig. 19.7)
  1. The ovaries are solid, ovoid structures located within the lateral pelvic cavity.
  2. Ovary Structure (p. 529)
    - a. The ovaries are subdivided into a medulla and an outer cortex.
    - b. The medulla is made up of connective tissue, blood vessels, lymphatic vessels, and nerves.
    - c. The cortex contains follicles and is covered by cuboidal epithelium.
  3. Primordial Follicles (p. 530)
    - a. During prenatal development, small groups of cells form millions of primordial follicles, each of which consists of a primary oocyte surrounded by follicular cells.
    - b. Early in development, the primary oocytes begin to undergo meiosis, but the process halts and does not resume until puberty.
    - c. Only 400,000 oocytes remain at puberty, and only 400 to 500 will be released from the ovary during the reproductive life of the female.
  4. Oogenesis (p. 530; Fig. 19.8)
    - a. Beginning at puberty, some oocytes are stimulated to continue meiosis.
    - b. When a primary oocyte undergoes meiosis, it gives rise to a large, haploid secondary oocyte and a polar body.
    - c. A second, unequal cytoplasmic division gives rise to an egg cell and another polar body.
  5. Follicle Maturation (p. 531; Figs. 19.9-19.10)
    - a. At puberty, FSH initiates follicle maturation during which the follicle enlarges, follicular cells proliferate, and a fluid-filled cavity forms the secondary follicle.
    - b. The mature follicle contains the secondary oocyte and is surrounded by the zona pellucida, attached to the corona radiata.
  6. Ovulation (p. 532; Fig. 19.11)
    - a. A process called ovulation releases the secondary oocyte from the surface of the ovary; the oocyte is surrounded by layers of follicular cells.

- c. If the oocyte is not fertilized shortly after its release, it will degenerate.
- D. Female Internal Accessory Organs (p. 533)
  - 1. The female internal accessory organs consist of a pair of uterine tubes, a uterus, and a vagina.
  - 2. Uterine Tubes (p. 533)
    - a. The uterine tubes (oviducts) are suspended by the broad ligament and lead to the uterus.
    - b. Near each ovary, the uterine tube expands to form an infundibulum with fimbriae on its margins.
    - c. The cells lining the tubes bear cilia, which beat in unison, drawing the egg cell into the uterine tube.
  - 3. Uterus (p. 533; Fig. 19.12)
    - a. The upper two-thirds of the uterus, the body, has a dome-shaped top.
    - b. The lower one-third of the uterus is the cervix that extends into the vagina.
    - c. The uterine wall has three layers: an inner, glandular endometrium, a muscular wall or myometrium, and an outer perimetrium.
  - 4. Vagina (p. 533)
    - a. The vagina is a fibromuscular tube that extends from the uterus to the outside.
    - b. The vaginal orifice is partially covered by a membrane called the hymen.
    - d. The vaginal wall consists of three layers: the inner mucosal layer, a middle muscular layer, and an outer fibrous layer.
- E. Female External Reproductive Organs (p. 534)
  - 1. The external organs of the female reproductive system (vulva) include the labia majora, labia minora, clitoris, and vestibular glands.
  - 2. Labia Majora (p. 534)
    - a. The labia majora enclose and protect the other external reproductive organs; they correspond to the scrotum of the male.
  - 3. Labia Minora (p. 534)
    - a. The labia minora are flattened, longitudinal folds between the labia majora that form a hood around the clitoris.
    - b. Many blood vessels cause the labia minora to appear pink.
  - 4. Clitoris (p. 534)
    - a. The clitoris is a mass of erectile tissue at the anterior end of the vulva between the labia minora.
    - b. The clitoris corresponds to the penis and has a similar structure.
  - 5. Vestibule (p. 534)
    - a. The vestibule is a space enclosed by the labia minora into which the vagina opens posteriorly.
    - b. A pair of vestibular glands lie on either side of the vaginal opening; these correspond to bulbourethral glands.
  - 6. Erection, Lubrication, Orgasm (p. 534)
    - a. During periods of sexual stimulation, the erectile tissues of the clitoris and vestibular bulbs become engorged with blood.
    - b. The vestibular glands secrete mucus into the vestibule and vagina.
    - c. During orgasm, the muscles of the perineum, uterine wall, and uterine tubes contract rhythmically.

### 19.5 Hormonal Control of Female Reproductive Functions (p. 535)

- A. Hormones secreted by the hypothalamus, the anterior pituitary, and the ovaries control female reproduction and development of secondary sexual characteristics.
- B. Female Sex Hormones (p. 535)

1. At about 10 years of age, the hypothalamus begins to secrete more GnRH, which in turn stimulates the anterior pituitary to produce LH and FSH.
  2. At puberty, the ovaries synthesize estrogens in response to FSH.
    - a. Estrogens are responsible for the female secondary sexual characteristics, such as breast development, increased adipose tissue deposition, and increased vascularization of the skin.
    - b. Ovaries also secrete progesterone, which triggers uterine changes during the menstrual cycle.
- C. Female Reproductive Cycle (p. 535; Fig. 19.13; Table 19.3)
1. The menstrual cycle is characterized by monthly changes in the uterine lining that lead to menstrual flow as the endometrium is shed.
  2. A menstrual cycle is started by FSH, which stimulates the maturation of a follicle in the ovary.
  3. Follicular cells surrounding the developing oocyte secrete estrogen, which is responsible for maintaining secondary sexual characteristics as well as the thickening of the uterine lining.
  4. Ovulation is triggered by a mid-cycle surge in LH.
  5. Following ovulation, follicular cells turn into a glandular corpus luteum that secretes increasing amounts of estrogen and progesterone.
  6. If pregnancy does not occur, the corpus luteum degenerates, hormone levels decline, and the uterine lining disintegrates and is shed.
  7. During the cycle, estrogen and progesterone inhibit the increased release of FSH and LH; when estrogen and progesterone levels fall, the secretion of FSH and LH increases.
- D. Menopause (p. 536)
1. Menstrual cycles continue throughout middle age until menopause, when the cycles cease.
  2. The cause of menopause is the aging of the ovaries when follicles no longer mature and estrogen levels decline.

### 19.6 Mammary Glands (p. 537; Fig. 19.14)

- A. The mammary glands are accessory organs of the female reproductive system that are specialized to produce and secrete milk after pregnancy.
- B. The mammary glands are located within the breasts on the anterior thorax.
- C. A nipple is located at the tip of each breast surrounded by an area of pigmented skin called the areola.
- D. A mammary gland is composed of irregularly shaped lobes containing glands and a lactiferous duct leading to the nipple.
- E. Dense connective tissue and fat separate the lobes.

### 19.7 Birth Control (p. 539)

- A. Birth control refers to the voluntary regulation of the number of offspring produced, requiring the use of contraception.
- B. Coitus Interruptus (p. 539)
  1. Coitus interruptus is the withdrawal of the penis prior to ejaculation, preventing entry of sperm into the female reproductive tract.
  2. This method may be difficult for the male to carry out, and since some sperm cells are present in the secretions of the penis prior to ejaculation, this method might lead to pregnancy.
- C. Rhythm Method (p. 539)
  1. The rhythm method requires abstinence from intercourse during the days of the month in which the female is fertile.

2. The accurate determination of the days when the female is fertile is sometimes difficult.
- D. Mechanical Barriers (p. 539; Fig. 19.15)
1. Mechanical barriers include the male condom, the female condom, a diaphragm worn by the female, or a cervical cap worn by the female.
  2. These barriers must be properly applied before intercourse to be effective.
- E. Chemical Barriers (p. 539)
1. Chemical barriers are spermicides in the form of creams, foams, and jellies.
  2. Chemical barriers are more effective when used with a diaphragm.
- F. Oral Contraceptives (p. 540)
1. Oral contraceptives (birth control pills) contain estrogen-like and progesterone-like substances that disrupt the normal cycle of hormones and prevent ovulation.
  2. If used correctly, oral contraceptives are nearly 100% effective, but may have side effects in some people.
- G. Injectable Contraception (p. 541)
1. An intramuscular injection of Depo-Provera can suppress the release of a secondary oocyte for up to three months.
  2. Side effects occur in some people, and this method of birth control may not be suitable for many women.
- H. Contraceptive Implants (p. 541)
1. A contraceptive implant is a set of small progesterone-containing capsules or rods inserted surgically under the skin.
  2. An implant may be effective for up to five years.
- I. Intrauterine Devices (p. 542)
1. An intrauterine device (IUD) is a small, solid object inserted into the uterine cavity that interferes with implantation.
  2. Serious health problems have been reported with the use of IUDs.
- J. Surgical Methods (p. 542; Fig. 19.16)
1. Surgical methods of sterilization include vasectomy (severing the vasa deferentia) in the male and tubal ligation (severing the uterine tubes) in the female.
  2. These methods provide the most reliable methods of birth control and may be reversible using microsurgery.

### **19.8 Sexually Transmitted Diseases (p. 543)**

- A. There are twenty recognized sexually transmitted diseases (STDs), which are often silent or go unnoticed, especially in females.
- B. One possible complication of the STDs gonorrhea and chlamydia is pelvic inflammatory disease, which may lead to infection and sterility in females.
- C. Acquired immune deficiency syndrome (AIDS) is a sexually transmitted disease most frequently transmitted during unprotected intercourse or by sharing needles.

#### *Topics of Interest:*

Prostate Enlargement (p. 525; Table 19A)

Male Infertility (p. 527; Fig. 19A; Table 19B)

Breast Cancer Update (pp. 540-541; Fig. 19B; Table 19C)