

# McCance: Pathophysiology, 6th Edition

## Chapter 22: Structure and Function of the Reproductive Systems

### Key Points – Print

#### SUMMARY REVIEW

##### Development of the Reproductive Systems

1. Differentiation of female and male genitalia begins around weeks 7 to 8 of embryonic development, when the gonads of genetically male embryos begin to secrete male sex hormones, primarily testosterone. Until that time the primitive reproductive organs of males and females are homologous (the same).
2. The structure and function of male and female reproductive systems are controlled by the H-P-G axis, a set of complex neurologic and hormonal interactions that accelerate at puberty and lead to sexual maturation and reproductive capability.
3. Extrahypothalamic factors cause the hypothalamus to secrete GnRH, which stimulates the anterior pituitary to secrete gonadotropins—FSH and LH—that stimulate the gonads (ovaries or testes) to secrete female or male sex hormones. Paracrine hormones (inhibin, activin, and follistatin) influence the positive and negative feedback loops that occur along the H-P-G axis.
4. Production of primitive female gametes (ova) occurs solely during fetal life. From puberty to menopause, one female gamete matures per menstrual cycle. Production of the male gametes (sperm) begins at puberty; after that, millions are produced daily, usually for life.

##### The Female Reproductive System

1. The function of the reproductive system is to produce mature ova and, when fertilized, to protect and nourish them through embryonic and fetal life, and expel them at birth.
2. The external female genitalia are the mons pubis, labia majora, labia minora, clitoris, vestibule (urinary and vaginal openings), Bartholin glands, and Skene glands.
3. The internal female genitalia are the vagina, uterus, fallopian tubes, and ovaries.
4. The vagina is a fibromuscular canal that receives the penis during sexual intercourse and is the exit route for menstrual fluids and products of conception. The vagina leads from the introitus (its external opening) to the cervical portion of the uterus.
5. The uterus is the hollow, muscular organ in which a fertilized ovum develops. The uterine walls have three layers: the endometrium (lining), myometrium (muscular layer), and perimetrium (outer covering, which is continuous with the pelvic peritoneum). The endometrium proliferates (thickens) and sloughs off in response to cyclic hormonal changes. The cervix is the narrow, lower portion of the uterus that opens into the vagina.

6. The two fallopian tubes extend from the uterus to the ovaries. Their function is to conduct ova from the spaces around the ovaries to the uterus. Fertilization normally occurs in the distal third of the fallopian tubes.
7. From puberty to menopause, the ovaries are the site of (1) ovum maturation and release and (2) production of female sex (estrogen and progesterone) and male (androgens) hormones. Female sex hormones predominate and are involved in sexual differentiation and development, the menstrual cycle, pregnancy, and lactation. Androgens in women contribute to prepubertal growth spurt, pubic and axillary hair growth, and activation of sebaceous glands.
8. Developing ovarian follicles (structure that encloses the ovum) produce estrogen (primarily estradiol). The corpus luteum, the structure that develops from the ruptured ovarian follicle after ovulation or ovum release, produces progesterone. Androgens are produced within the ovarian follicle, adrenal glands, and adipose tissue.
9. The average menstrual cycle lasts 27 to 30 days and consists of three phases, which are named for ovarian and endometrial changes: the follicular/proliferative phase, the luteal/secretory phase, and menstruation.
10. Ovarian events of the menstrual cycle are controlled by gonadotropins. High FSH levels stimulate follicle and ovum maturation (follicular phase); then a surge of LH causes ovulation, which is followed by development of the corpus luteum (luteal phase).
11. Ovarian hormones control the uterine (endometrial) events of the menstrual cycle. During the follicular phase of the ovarian cycle, estrogen produced by the follicle causes the endometrium to proliferate (proliferative phase) and induces the LH surge and progesterone production in the granulosa layer. During the luteal phase, estrogen maintains the thickened endometrium and progesterone causes it to develop blood vessels and secretory glands (secretory phase). As the corpus luteum degenerates, production of both hormones drops sharply, and the “starved” endometrium degenerates and sloughs off, causing menstruation.
12. Cyclic changes in hormone levels also cause thinning and thickening of the vaginal epithelium, thinning and thickening of cervical secretions, and changes in basal body temperature.

### The Male Reproductive System

1. The function of the male reproductive system is to produce male gametes (sperm) and deliver them to the female reproductive tract.
2. The external male genitalia are the testes, epididymides, scrotum, and penis. The internal genitalia are the vas deferens, ejaculatory duct, prostatic and membranous sections of the urethra, seminal vesicles, prostate gland, and Cowper glands.
3. The testes (male gonads) are paired glands suspended within the scrotum. The testes have two functions: spermatogenesis (sperm production) and production of male sex hormones (androgens, chiefly testosterone).

4. The epididymis is a long, coiled tube arranged in a comma-shaped compartment that curves over the top and rear of the testis. The epididymis receives sperm from the testis and stores them while they develop further. Sperm travel the length of the epididymis and then are ejaculated into the vas deferens.
5. The scrotum is a skin-covered fibromuscular sac that encloses the testes and epididymides, which are suspended within the scrotum by the spermatic cord. The scrotum keeps these organs at optimal temperatures for sperm survival (about 1° to 2° C lower than body temperature) by contracting in cold environments and relaxing in warm environments.
6. The penis is a cylindrical organ consisting of three longitudinal compartments (two corpora cavernosa and one corpus spongiosum) and the urethra. The urethra runs through the corpus spongiosum. The corpora cavernosa and corpus spongiosum consist of erectile tissue. Externally the penis consists of a shaft and a tip, which is called the *glans*. The glans contains sebaceous glands and the opening of the urethra and is covered by a flap of skin (the foreskin).
7. The penis has two functions: delivery of sperm to the female vagina and elimination of urine. These two fluids are never in the urethra at the same time.
8. Sexual intercourse is made possible by the erectile reflex, in which tactile or psychogenic stimulation of the parasympathetic nerves causes arterioles in the corpora cavernosa and corpus spongiosum to dilate and fill with blood, causing the penis to enlarge and become firm.
9. Emission, which occurs at the peak of sexual arousal, is the movement of semen from the epididymides to the penis. Ejaculation, which is a continuation of emission, is the pulsatile ejection of semen from the penis. Both emission and ejaculation involve rhythmic contractions of smooth muscle within the internal glands and ducts.
10. Spermatogenesis is a continuous process because spermatogonia, the primitive male gametes, undergo continuous mitosis within the seminiferous tubules of the testes. Some of the spermatogonia develop into primary spermatocytes, which divide meiotically into secondary spermatocytes and then spermatids. The spermatids develop into sperm with the help of nutrients and hormonal signals from Sertoli cells.
11. Production of the male sex hormones is controlled (like production of the female sex hormones) by the H-P-G axis and by complex feedback mechanisms. The male hormones are produced steadily, with diurnal variations.

### Structure and Function of the Breast

1. Until puberty the female and male breasts are similar, consisting of a small underdeveloped nipple, some fatty and fibrous tissue, and a few ductlike structures under the areola. At puberty, however, a variety of hormones (estrogen, progesterone, prolactin, growth hormone, insulin, cortisol) cause the female breast to develop into a system of glands and ducts that is capable of producing and ejecting milk.
2. The basic functional unit of the female breast is the lobe, a system of ducts that branches from the nipple to milk-producing units called *lobules*. The lobules contain alveolar cells, which are

convoluted spaces lined with epithelial cells that secrete milk and subepithelial cells that contract, moving the milk into the system of ducts that leads to the nipple.

3. Each breast contains 15 to 20 lobes, which are separated and supported by Cooper ligaments.
4. Milk production occurs in response to prolactin, a hormone that is secreted in larger amounts after childbirth. Milk ejection is under the control of oxytocin, another hormone of pregnancy and parturition.
5. During the reproductive years, breast tissue undergoes cyclic changes in response to hormonal changes of the menstrual cycle.

### Tests of Reproductive Function

1. Diagnostic tests are performed to evaluate fertility or presence of tumors, infection, or sexually transmitted infections.
2. Tests, stains, cultures, and serologic tests are used to diagnose infections. These tests specifically identify microorganisms or types of infections.
3. Tissue biopsy can be performed by resection or needle aspiration. Specimen analysis permits identification of abnormal cells.
4. The Pap test is a cytologic examination of cells taken from body fluids and tissues. Although cells can be obtained from many sites, the test is most commonly used (with endocervical cells) for diagnosis of cervical carcinoma.
5. Mammography is a low-dose radiographic examination of the breast for cancer detection.
6. Evaluation of fertility includes reproductive hormone assays and assessment of structural alteration or infections and the determination of normal ovulation or adequate sperm motility and count.

### Aging and Reproductive Function

1. In women the transition from fertility to menopause (perimenopause) starts about 2 to 8 years before the last menstrual period and ends the following year. During this transition period, the ovaries produce erratic and high levels of estrogen that contribute to such symptoms as hot flashes, breast tenderness and nodularity, and migraine headaches. Menstrual cycles shorten and then become irregular as anovulation occurs. Menstruation ceases, and women move into menopause.
2. Menopause is defined as 1 year after the cessation of menstruation and occurs at the average age of 51.4 years. Levels of sex hormones decrease with the last menstrual cycle.
3. In response to reduced levels of female sex hormones, the reproductive organs atrophy, the vaginal epithelium thins, and glandular secretions diminish and become more alkaline. Continued sexual activity and orgasm reduce vaginal changes.
4. Nonreproductive effects of reduced estrogen levels may include increased risk of osteoporosis and coronary artery disease.

5. Male reproductive function diminishes with age, but it does not cease in healthy men.
6. The testes atrophy and produce less testosterone, and some seminiferous tubules may degenerate and become fibrotic. These changes affect sex drive (libido) and sperm morphology. Although sperm count remains normal, the semen tends to contain more defective and nonmotile sperm.
7. The erectile reflex is somewhat diminished and occurs more slowly as age advances.
8. Reduced testosterone levels cause some loss of function in the internal genitalia and enlargement (hypertrophy) of the prostate gland.