UNIT 12 - REPRODUCTIVE SYSTEM

LECTURE NOTES

12.01 GENERAL FUNCTIONS OF THE REPRODUCTIVE SYSTEM

A. Production of offspring to continue the species.

B. Sexual reproduction is the process by which genetic material is combined and passed from generation to generation.

C. Produces and secretes hormones involved in the development and maintenance of the male and female reproductive organs as well as many other metabolic and physiological processes throughout the body.
   1. Gonads
      The organs (testes and ovaries) in the body which produce the sex cells and hormones.
   2. Gametes
      Sex cells
      a. Male
         Testes produce sperm cells and the hormone testosterone.
      b. Female
         Ovaries produce ova or egg cells and the hormones estrogens and progesterone.

12.02 DESCRIBE THE ANATOMY OF THE MALE GENITALIA

A. Testes:
   1. Description
      The testes are the male gonads and are egg-shaped structures enclosed in a dense fibrous capsule called the tunica albuginea. They are suspended within the scrotum by the spermatic cord. The testes are divided into sections called lobules which contain the seminiferous tubules.
   2. Functions
      a. Spermatogenesis or the production of sperm occurs in the seminiferous tubules.
      b. Production of the male hormone testosterone occurs in the interstitial cells.

B. Epididymis
   1. Description
      The epididymis is an almond shaped organ that lies along the posterior border of the testes. It consists mostly of a tightly coiled tube called the ductus epididymis which measures about 20 feet in length.
   2. Function
      It is the site of sperm maturation.
C. Ductus Deferens (Vas Deferens)
   1. Description
      The ductus deferens is a long duct (18 inches) which connects the epididymis to the ejaculatory duct posterior to the urinary bladder. The ductus deferens is composed of smooth muscle and is lined with epithelial tissue. The ductus deferens helps to form the spermatic cord and passes through the inguinal canal.
   2. Function
      The ductus deferens serves as a passageway for sperm from the epididymis to the urethra.

D. Seminal Vesicles
   1. Description
      The seminal vesicles are two tubular glands located on the posterior surface of the urinary bladder. It will unite with the ductus deferens to form the ejaculatory duct.
   2. Function
      The seminal vesicles produce an alkaline fluid rich in fructose to help nourish the sperm and neutralize the acid created by the sperm's waste products. It helps to form about 60% of the fluid or semen.

E. Ejaculatory Duct
   1. Description
      The ejaculatory duct lies posterior to the urinary bladder and is formed by the union of the duct from the seminal vesicle and the ductus deferens. It will lead into the urethra.
   2. Function
      The ejaculatory duct ejects sperm into the prostatic urethra just prior to ejaculation.

F. Prostate Gland
   1. Description
      The prostate gland is a single donut shaped gland about the size of a chestnut located inferiorty to the urinary bladder and surrounds the urethra. It is a common cancer site for adult males.
   2. Function
      The prostate gland secretes a very weak acidic fluid rich in citric acid, prostatic acid, phosphates, and prostaglandins. It makes up 30% of the fluid found with sperm.

G. Urethra
   1. Description
      The urethra is located from the base of the bladder, through the penis and ends in the urethral meatus. It measures about 8 inches in length.
2. Function
The urethra serves as the passageway for urine or spermatozoa to the external environment

H. Bulbourethral Glands (Cowper’s Glands)
1. Description
The bulbourethral glands are pea sized glands located inferior to the prostate gland on either side of the urethra.
2. Function
The bulbourethral glands secrete an alkaline substance to neutralize the acidic environment of the urethra. The fluid is the first released to also help provide lubrication for sexual intercourse.

I. Semen (Seminal Fluid)
Semen is a mixture of sperm and the secretions of the seminal vesicles, prostate gland, and bulbourethral glands. The average volume of semen for ejaculation is 2.5 to 5 ml. There are about 50 to 150 million spermatozoa per ml of semen. If the semen contains less than 20 million spermatozoa per ml the male is considered infertile.

J. Scrotum
1. Description
The scrotum is a cutaneous sac of the abdomen consisting of loose skin, skeletal muscle, and superficial fascia.
2. Function
The scrotum encloses and protects the testes. It maintains a constant temperature about 2 to 3 degrees below normal body temperature for optimal sperm production.

K. Penis
1. Description
The penis is a cylindrical organ which surrounds the urethra. It consists of a body, root, and glans penis.
   a. Body
   The body is composed of three cylindrical masses of tissue each bound by fibrous tissue.
   i. Corpora Cavernosa Penis: the two most dorsal and lateral masses of the penis
   ii. Corpus Spongiosum Penis: the smaller, mid ventral mass of the penis that the urethra passes through
   iii. All three masses are enclosed by fascia and skin and consist of erectile tissue permeated by blood sinuses
   iv. When sexual stimulation (visual, tactile, auditory, olfactory, and imaginative) occurs, the arteries supplying the penis dilate and large quantities of blood enter the sinuses, and an erection occurs.
b. Root
The root is the portion of the penis attached to the pelvic area.

c. Glans Penis
The glans penis is made up of a slightly enlarged, distal end of the corpus spongiosum. It is separated from the body of the penis by a marginal area called the corona. It is covered by loose fitting skin called the foreskin or prepuce.

2. Function
It conducts urine to the exterior and is the portion of the male anatomy used to introduce the sperm into the female vagina during intercourse.

12.03 IDENTIFY THE FUNCTION OF THE TESTES
The testes are responsible for production of sperm cell (spermatogenesis) and for the production of testosterone, the principle male hormone.

12.04 FUNCTIONS OF TESTOSTERONE

A. Controls growth and development
B. Maintenance of the male sex organs
C. Stimulates bone growth
D. Stimulates protein anabolism
E. Responsible for closure of the epiphyseal plate
F. Influences sexual behavior
G. Supports final maturation of sperm
H. Stimulates development of secondary male sex characteristics
   1. muscular and skeletal development
   2. development of pubic, axillary, and chest hair
   3. facial hair growth
   4. temporal hairline recession
   5. deepening of the voice

12.05 THE FEMALE REPRODUCTIVE SYSTEM

A. Ovaries
   1. Description
      The ovaries are the paired female gonads about the size and shape of almonds located within the pelvic cavity. There is an outer cortex and an inner medulla. The outer cortex contains follicles which support the ova or eggs.
      a. Ovarian Follicles
         Ovarian follicles contain oocytes (mature ova) and their surrounding tissues in various stages of development.
b. Vesicular Ovarian (Graafian) Follicle
The vesicular ovarian follicles is a large, fluid-filled follicle containing an immature ovum and its surrounding tissue. It secretes the female hormones called estrogens.

c. Corpus Luteum
The corpus luteum is the glandular body which develops from the vesicular ovarian follicle after the release of a secondary oocyte. It secretes the hormone progesterone as well as others.

d. Corpus albicans
The corpus albicans is a fibrous, connective tissue remnant of a degenerated corpus luteum.

2. Functions
The ovaries are responsible for producing eggs (ova) and hormones, including estrogens and progesterone.

B. Uterine Tubes
1. Description
The uterine tubes (Fallopian tubes or oviducts) measure about five inches in length. At one end, there is an expanded infundibulum or the funnel-shaped, open, distal end of the uterine tube near the ovaries. The infundibulum contains the fimbriae or finger-like projections at the end of the infundibulum to draw the ova, which have been released from the ovaries, into the uterine tubes.

2. Functions
The uterine tubes help to transport ova from the ovaries to the uterus. It is also the site of fertilization.

C. Uterus
1. Description
The uterus is an inverted pair shaped muscular organ located in the pelvic cavity. It is divided into three sections - the fundus, body, and the cervix.

   a. fundus: the superior dome-shaped area the uterus above the openings to the uterine tubes.

   b. body: the major, tapering, central portion of the uterus. It contains the hollow interior uterine cavity.

   c. cervix: the narrow, thick muscular area that opens into the vagina.
   A common site of cancer in women.
   The uterus also contains three layers. From the outer layer to the inner layer they are the perimetrium, the myometrium, and the endometrium.

   d. perimetrium: the outermost layer of the uterus which provides a small amount of protection to the uterus. The perimetrium is actually part of the visceral peritoneum.

   e. myometrium: the middle, smooth muscle layer of the uterus. It makes up the majority of the uterus.

   f. endometrium: the innermost layer of the uterus
i. stratum functionalis is the layer of the endometrium lining the uterine cavity which is shed during menstruation.

ii. stratum basalis is the permanent, basement layer of the endometrium which functions to generate a new layer of the stratum functionalis following menstruation.

2. Function
The function of the uterus is to serve as the site of gestation or pregnancy for the developing embryo/fetus.

C. Vagina
1. Description
The vagina is a tubular fibromuscular organ lined with mucous membrane. It contains has several functional features including the fornix, rugae, vaginal orifice, and the hymen.

a. fornix: the proximal area in vagina that surrounds the vaginal attachment to the cervix.

b. rugae: transverse, connective tissue folds in the vagina.

c. vaginal orifice: the distal end of the vagina that opens into the external environment.

d. hymen: a thin fold of vascular mucus membrane that forms a border around the vaginal orifice partially closing it.

2. Functions
The vagina functions as passageway for the spermatozoa and the menstrual flow, as well as the lower portion of the birth canal. It also functions as a receptacle for the penis during sexual intercourse.

D. Vulva
The vulva is the term used to describe the external genitalia of the female.

1. Mons Pubis
The mons pubis is an elevation of adipose tissue covered by skin and coarse pubic hair.

a. Labia Majora: an area of lateral longitudinal folds extending inferiorly and posteriorly.

i. contains an abundance of adipose tissue, sebaceous glands, and sudoriferous glands

ii. covered by pubic hair

iii. homologous to the male scrotum

b. Labia Minora: the medial longitudinal folds of the vulva.

i. very few sudoriferous glands

ii. no adipose tissue or pubic hair

iii. numerous sebaceous glands

c. Clitoris: a small, cylindrical mass of nervous and erectile tissue.

d. Vestibule: the cleft between the labia minora

i. Bulb of the Vestibule: two elongated masses of erectile tissue located on the sides of the vaginal orifice.
ii. Greater Vestibular Glands: glands on the sides of the vaginal orifice that produce a mucoid secretion that supplements lubrication during sexual intercourse.

E. Mammary Glands
1. Description
The mammary glands are actually modified sudoriferous (sweat) glands. Each gland consists of 15 to 20 lobes or compartments separated by adipose tissue. The amount of adipose tissue between the lobes determines the size of the breast. Breast size is not related to the ability to produce milk. Each lobe is broken down into smaller compartments called lobules which contain milk secreting glandular cells called alveolar glands (Milk producing glands of the breast).

The areola is the dark, circular, pigmented area that encircles the nipple. The nipple is the raised area on the breast that an infant suckles to receive milk and stimulate lactation or the process of milk production, secretion, and ejection.

12.06 FUNCTIONS OF THE OVARIIES
Ovaries are responsible for producing ova (eggs) and several hormones including estrogens, progesterone, and relaxin.

12.07 STRUCTURE AND FUNCTIONS OF THE UTERINE TUBES
A. Description
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12.08 UTERUS
A. Description
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2. body: the major, tapering, central portion of the uterus. It contains the hollow interior uterine cavity.
3. cervix: the narrow, thick muscular area that opens into the vagina. A common site of cancer in women.
4. The uterus also contains three layers. From the outer layer to the inner layer they are the perimetrium, the myometrium, and the endometrium.
   a. perimetrium: the outermost layer of the uterus which provides a small amount of protection to the uterus.
      a. The perimetrium is actually part of the visceral peritoneum.
   b. myometrium: the middle, smooth muscle layer of the uterus. It makes up the majority of the uterus.
   c. endometrium: the innermost layer of the uterus
      i. stratum functionalis is the layer of the endometrium lining the uterine cavity which is shed during menstruation.
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B. Function
   The function of the uterus is to serve as the site of gestation or pregnancy for the developing embryo/fetus.

12.09 THE MENSTRUAL CYCLE
A. Ovarian Cycle
   The ovarian cycle is the monthly changes in the ovary associated with the maturation of an ovum.

B. Menstrual Cycle
   The menstrual cycle is the monthly changes in the endometrium of the uterus.

C. Endocrine Influence
   The changes associated with the ovarian cycle and the menstrual cycle in the female reproductive system are controlled by hormones.
   1. Hypothalamus
      Produces and releases Gonadotropin Releasing Hormone (GnRH) which stimulates the pituitary gland to produce and release Follicle Stimulating Hormone (FSH) and Luteinizing Hormone (LH).
   2. Anterior Pituitary Gland (Adenohypophysis)
      a. FSH
         Follicle stimulating Hormone (FSH) stimulates the initial development of the ovarian follicles and secretion of estrogens by the follicles.
      b. LH
         Luteinizing Hormone (LH) stimulates further development of the ovarian follicles, stimulates ovulation, and the production of estrogens, progesterone, and relaxin by the ovarian cells of the corpus luteum.
   3. Ovaries
      Ovaries produce the hormones estrogen, progesterone, and relaxin.
D. Description of The Events
1. The first day of the menstrual cycle is the day the period or menstrual flow is noted.
2. GnRH is released from the hypothalamus and stimulates the anterior pituitary gland to release FSH.
3. Under the influence of FSH, follicular development occurs within the ovaries. Some of the primordial follicles begin their development into primary follicles.
4. The follicular cells enlarge and multiply and release the estrogens.
5. The rising level of estrogens inhibits the production of GnRH from the hypothalamus which reduces the further amount of FSH being produced.
6. The amount of LH released from the anterior pituitary gland helps follicular development and maturation.
7. The amount of estrogen begins a sharp upturn which means a larger amount is being secreted. The endometrium starts to rebuild.
8. At about day 14, estrogen level peak and the follicle is matured. This high estrogen level triggers a massive release of LH from the anterior pituitary gland which causes ovulation or the rupture of the follicular wall and the release of the ovum.
9. LH helps to stimulate the formation of the corpus luteum from the scar of the ruptured follicle.
10. The corpus luteum produces the hormone progesterone which helps to thicken the endometrium as well as increase the blood supply to that layer. This preparation get the endometrium ready to receive a fertilized egg should conception occur.
11. Progesterone levels will stay high for about the next week.
12. If conception does not occur, the corpus luteum begins to shrink in size and the level of progesterone drops.
13. The endometrium sloughs off during the period (menses or menstrual flow).
14. The release of GnRH from the hypothalamus stimulates the release of FSH and LH from the anterior pituitary gland. The ovarian follicles begin to develop and the cycle begins once again.

12.10 DESCRIBE THE EFFECTS OF ESTROGENS, PROGESTERONE, AND RELAXIN

A. Estrogens:
1. There at least 6 different types of estrogens.
2. Responsible for the development and maintenance of the female reproductive system. Initiates the growth of the endometrium of the uterus.
3. Helps control fluid and electrolyte balance.
4. Maintains blood calcium levels and bone density.
5. Increase protein anabolism.
B. Progesterone
   1. Works in conjunction with estrogen to prepare the endometrial lining for implantation of a fertilized ovum.
   2. Stimulates milk secretion.
   3. Maintains the uterine linings during pregnancy.

C. Relaxin:
   1. Produced by the corpus luteum during pregnancy.
   2. Most prominent during the final trimester of pregnancy.
   3. Relaxes the pubic symphysis.
   4. Helps dilate the uterine cervix to facilitate delivery of the fetus.

12.11 COMPARE SPERMATOGENESIS WITH OOGENEISIS

Spermatogenesis and oogenesis are two processes associated with meiosis. Meiosis is the specialized form of cell division which reduces the number of chromosomes in half. In humans, this means reducing the diploid (full set) number of chromosomes (46) to the haploid number or 23. Meiosis only occurs in the gonads, the testes and ovaries.

A. Spermatogenesis:
   The formation of four haploid sperm cells in the male testes.

B. Oogenesis:
   The formation of a single haploid egg cell in the female ovaries. (The other 3 "eggs" become polar bodies and disintegrate)

12.12 EVENTS ASSOCIATED WITH HUMAN DEVELOPMENT

Human Development is the continuous process of body changes that begin at the moment of fertilization and continue to the death of the individual.

A. Prenatal Development
   Prenatal development describes all the changes that occur prior to birth. A dramatic period of rapid changes in which a single fertilized egg is transformed into a complex individual. It is divided into two periods: the embryo (from implantation to 8 weeks) and the fetus (from 8 weeks until birth)

B. Fertilization
   Fertilization or conception is the union of a sperm cell with an oocyte (ovum). It occurs in the uterine tubes. It results in a diploid zygote, or a cell which contains 46 chromosomes. The first divisions of the zygote are called cleavage. Cleavage is a specialized form of mitosis in which the number of cells increases, but the overall size does not. It eventually forms a small ball sixteen cells called a morula.
C. Blastocyst
   As the morula grows, it differentiates into a fluid-filled sac which has two sections.
   1. The outer portion is trophoblast which differentiates into two layers -- the chorion: which eventually forms the placenta and the amnion which forms a protective sac around the fetus.
   2. The inner portion becomes the trophoblast.

D. Implantation:
   1. The trophoblast contacts the endometrium about 6 days after fertilization and embeds itself into the endometrium.
   2. As implantation proceeds, the blastocyst differentiates into the endoderm, mesoderm, and ectoderm germ layers which will form the body systems.
   3. Layers such as the chorion, amnion, and yolk sac begin to form around the embryo.

E. Growth of the Fetus:
   1. The fetal period begins eight weeks after fertilization.
   2. It is distinguished by ossification of the bones.
   3. It is marked by rapid growth of all organs and tissues by mitosis.
   4. The fetus is covered by soft white hair called lanugo and a waxy coat of epithelial cells (vernix caseosa) that protects the fetus from waste products in the amniotic fluid.
   5. A 38 week old fetus is considered full-term and ready for birth, although full term is considered to be 40 weeks.

12.13 THE THREE STAGES OF LABOR

Labor is the movement of the fetus through the birth canal in response to uterine contractions.

A. First Stage - Dilation and Effacement of the Cervix
   1. Contractions of the myometrium increase in frequency and strength pushing the fetus against the cervix.
   2. Early in this period the amnion or water bag surrounding the fetus typically ruptures.
   3. The opening to the cervix dilates in response to pressure from the fetus.
   4. Positive feedback mechanisms promotes stronger and more frequent contractions.
   5. Once the cervix thins and the opening dilates to 10 cm, the second stage of labor begins.
B. Second Stage - Birth and Delivery
   The fetus is pushed through the birth canal to the outside.

C. Third Stage - Placental Expulsion
   1. Uterine contractions push the placenta out of the uterus.
   2. The uterus contracts to prevent bleeding.