Reproductive Systems

OUTLINE:

- Gonads
- Male and Female Reproductive Roles
- Form and Function of the Male Reproductive System
- Form and Function of the Female Reproductive System
- Disorders of the Female Reproductive System
- Stages of the Human Sexual Response
- Birth Control

Gonads

- Two important functions:
  1. They produce the gametes, meaning the eggs and sperm—the cells that will fuse and develop into a new individual
  2. They produce the sex hormones
- Testes
  - Produce sperm and testosterone
- Ovaries
  - Produce eggs and estrogen and progesterone

Male and Female Reproductive Roles

- Males and females make an equal genetic contribution by contributing one copy of each chromosome to their offspring
- Reproductive strategies
  - Male
    - Produce millions of sperm and deliver them to the female reproductive system
  - Female
    - Produce one egg each month and nourish and protect developing offspring

Male and Female Reproductive Roles

- Each gamete contains one-half the number of chromosomes (23; haploid)
- When an egg and sperm fuse at fertilization, they form a zygote with a full set of chromosomes (46; diploid)

Form and Function of the Male Reproductive System

- Testes
- Duct system (epididymis, vas deferens, urethra)
- Accessory glands
  - Prostate gland
  - Seminal vesicles
  - Bulbourethral glands
- Penis

Testes

- Held outside the abdominal cavity in the scrotum: allows for temperature regulation
- Sperm develop in the seminiferous tubules

- Interstitial cells produce androgens, including testosterone

Testes

- Testicular cancer
  - Most common form of cancer among men 15–35 years of age
  - Does not usually cause pain, so monthly self-examinations are important
  - High cure rate when caught in early stages

Duct System

- Epididymis
  - Receives sperm from seminiferous tubules
  - Site of sperm maturation and storage
- Vas deferens
  - Conducts sperm from epididymis to urethra
- Urethra
  - Conducts urine from urinary bladder
  - Conducts sperm from vas deferens

Accessory Glands

- Semen
  - Fluid containing sperm and secretions of the accessory glands
  - Released through the urethra at sexual climax
- Accessory glands
  - Prostate gland
    - Surrounds upper portion of urethra
    - Produces alkaline secretions that activate sperm and reduce acidity of male and female reproductive tracts

Accessory Glands

- Two conditions of the prostate gland
  - Age-related enlargement: begins at middle age and may restrict flow of urine
  - Cancer: can be detected through rectal exam or blood test that measures prostate-specific antigen (PSA)
- Seminal vesicles
  - Paired glands
  - Secretions nourish sperm (fructose), thicken semen (amino acids), and assist movement of sperm in the female reproductive tract (prostaglandins)

Accessory Glands

- Bulbourethral glands
  - Paired glands
  - Release clear, slippery liquid before ejaculation that may rinse acidic urine from the urethra

Accessory Glands

- Penis
  - Delivers sperm to the female reproductive tract
  - Glans penis
    - Tip of the penis with many sensory nerve endings
    - Covered by the foreskin, which is sometimes surgically removed (circumcision)

- Contains three columns of spongy erectile tissue that fill with blood during an erection

Penis

- Erectile dysfunction (ED; impotence)
  - Inability to achieve or maintain an erection
  - Causes range from psychological issues to damaged nerves or blood vessels
  - Medications (Viagra, Levitra, and Cialis) prolong effects of nitric oxide, which promotes widening of arteries in the penis

Sperm Development

- Sperm development—spermatogenesis
  - Occurs within seminiferous tubules
  - Reduces number of chromosomes to one member of each pair
  - Changes shape of sperm so they can deliver chromosomes

Sperm Development

- Spermatogonia (undifferentiated diploid cells)
- Primary spermatocyte (diploid cell that undergoes two divisions of meiosis)
  - Secondary spermatocytes (after meiosis I)
  - Spermatids (after meiosis II; haploid)

Sperm Development

- Spermatozoa (exhibit structural changes necessary for reaching egg and fertilizing it)
- The mature sperm cell has three regions
  1. Head
  2. Midpiece
  3. Tail

Hormones

- Testosterone, secreted by the interstitial cells of the testes, is important for sperm production and development of male characteristics
  - Production is regulated by a negative feedback loop:
    - Hypothalamus releases gonadotropin-releasing hormone (GnRH)
    - GnRH stimulates anterior pituitary to secrete luteinizing hormone (LH)
    - LH stimulates production of testosterone by interstitial cells of testes
    - Rising testosterone levels then inhibit release of GnRH from hypothalamus, which decreases LH, which decreases testosterone secretion

Hormones

- Sperm production is also controlled by a negative feedback loop
  - Follicle-stimulating hormone (FSH) produced by the anterior pituitary makes the cells that will become sperm more sensitive to testosterone
    - This stimulates sperm production
  - High sperm numbers then prompt the seminiferous tubules to produce inhibin, which inhibits production of GnRH and FSH

Hormones

Form and Function of the Female Reproductive System

- Structures of the female reproductive system
  - Ovaries
  - Oviducts
  - Uterus
  - Vagina
  - External genitalia
  - Breasts

Ovaries and Oviducts

- Ovaries
  - Produce eggs through oogenesis
  - Produce estrogen and progesterone
- Oviducts
  - Also known as fallopian or uterine tubes
  - Transport immature egg from the ovaries to the uterus
  - Most commonly the site of fertilization

Uterus

- **Uterus**: hollow, muscular organ that receives and nourishes developing embryo
  - Wall has two layers
    - Smooth muscle
    - Endometrium
      - Site of implantation of the embryo (if outside uterus, then ectopic pregnancy)
      - If no embryo, then shed as menstrual flow

Uterus

- **Cervix**: narrow neck of the uterus that extends into the vagina
- **Vagina**: receives the penis during intercourse and serves as the birth canal during delivery

External Genitalia

- External genitalia (vulva)
  - Female reproductive structures that lie outside the vagina
  - Include
    - Labia majora
    - Labia minora
    - Clitoris
      - Contains erectile tissue and many nerve endings

Breasts

- Mammary glands
  - Present in both sexes, but only in females produce milk to nourish newborn
    - Contain milk-secreting glands and ducts, which drain through the nipple
    - Connective tissue supports breasts, which are mostly fatty tissue

Breasts

Ovarian Cycle

- Events leading to the release of an egg
- About one month in length

Ovarian Cycle

- Timing of egg development across a female's lifetime
  - Before birth, all of a woman's primary oocytes (immature eggs) have formed
    - Primary oocyte plus surrounding flattened cells— primary follicle
  - Eggs remain in immature state until puberty
  - At puberty, one primary follicle each month resumes development

Ovarian Cycle

- Steps of the ovarian cycle
  - Follicle maturation
    - Primary follicle matures into secondary (Graafian) follicle
    - Primary oocyte completes its first meiotic division, forming a secondary oocyte and first polar body
  - Ovulation
    - Secondary oocyte released from ovary
    - If fertilization occurs, then the second round of meiosis occurs, forming an ovum (mature egg) and second polar body

Ovarian Cycle

- Steps of the ovarian cycle (cont'd)
  - Formation of the corpus luteum
    - Luteinizing hormone (LH) transforms cells of the Graafian follicle into the corpus luteum
      - Endocrine structure that secretes estrogen and progesterone
      - Degenerates unless pregnancy occurs

Coordination of the Ovarian and Uterine Cycles

- At monthly intervals
  - An egg matures and is released from the ovary (ovarian cycle)
  - The uterus is readied to receive and nurture the embryo (uterine or menstrual cycle)
    - If fertilization does not occur, then uterine provisions are discarded as menstrual flow
    - If fertilization occurs, human chorionic gonadotropin (HCG) produced by the embryo maintains the corpus luteum
      - Hormones of the corpus luteum maintain the endometrium (keep it from shedding)

Coordination of the Ovarian and Uterine Cycles

- Hormones that control female fertility
  - Anterior pituitary gland
    - Follicle-stimulating hormone (FSH)

        - Stimulates follicle development
    - Luteinizing hormone (LH)
        - Triggers ovulation

Coordination of the Ovarian and Uterine Cycles

- Hormones that control female fertility (cont'd)
    - Ovary
        - Estrogen
            - Development of endometrium and female reproductive structures
        - Progesterone
            - Maintains the endometrium

Coordination of the Ovarian and Uterine Cycles

Menopause

- Cessation of ovulation and menstruation
- Usually occurs between 45 and 55 years of age

Menopause

- Physiological effects caused by drop in estrogen associated with menopause
    - Loss of fat layer leads to wrinkles
    - Disruption of thermostat causes hot flashes
    - Vaginal dryness
    - Growth of facial hair
    - Increased risk of heart and blood vessels diseases
    - Osteoporosis

Disorders of the Female Reproductive System

- Premenstrual syndrome (PMS)
    - Symptoms appear 7–10 days before period
        - Include depression, irritability, fatigue, headaches
    - Possibly caused by progesterone deficiency
    - Treatments
        - Medications that raise serotonin
        - Changes in diet
        - Aerobic exercise

Disorders of the Female Reproductive System

- Menstrual cramps
    - Caused by high levels of prostaglandins produced by endometrial cells
    - Prostaglandins cause smooth muscle cells of uterus to contract
    - Muscle spasms may cause pain by reducing blood supply to uterine muscles

Disorders of the Female Reproductive System

- Endometriosis
    - Condition in which tissue from the uterine lining is found outside the uterine cavity
        - Often on oviducts, ovaries, outside surface of uterus, or bladder
    - Endometrial tissue grows and breaks down in response to hormones, which may cause severe pain

Disorders of the Female Reproductive System

- Breast cancer
  - May begin in cells lining milk ducts or in milk glands
  - Detection
    - Monthly breast self-exam
    - Mammograms
  - Risk factors (increased exposure to estrogen)
    - Young age at first menstruation
    - Menopause after age 55
    - Childlessness and late age at first pregnancy
    - Obesity
  - Breast-feeding may reduce risk

Stages of the Human Sexual Response

- In both men and women, sexual arousal and sexual intercourse involve two physiological changes
  - Vasocongestion: certain tissues fill with blood
  - Myotonia: certain muscles show sustained or rhythmic contractions
- Four stages of the sexual response cycle
  1. Excitement
  2. Plateau
  3. Orgasm
  4. Resolution

Birth Control

- Prevents pregnancy
- In some cases can reduce the risk of spreading sexually transmitted diseases (STDs)
- Abstinence: refraining from sexual contact
  - Reliably avoids both pregnancy and spread of STDs

Birth Control

- Sterilization: cutting and sealing gamete transport tubes to permanently prevent fertilization
  - Offers no protection against STDs
  - Vasectomy in males: vas deferens cut to prevent sperm from leaving the body (reversible soon after)
  - Tubal ligation in females: oviducts cut to prevent egg and sperm from meeting (irreversible)

Hormonal Contraception

- Currently available only to females
- Does not protect against STDs, and may even increase risk of transmission
- Two basic approaches
  - Combination estrogen and progesterone
  - Progesterone only

Combination Estrogen and Progesterone Contraception

- Uses synthetic forms of estrogen and progesterone to suppress release of FSH and LH
- Prevents maturation of egg and its release from the ovary

- Examples: “the pill,” skin patch, vaginal ring

Progesterone-Only Contraception

- Uses synthetic progesterone
- May prevent ovulation, thicken cervical mucus (making it difficult for sperm to reach egg), and keep endometrium unprepared for implantation
- Examples: injection every 3 months, “minipill,” rod-shaped implants

Progesterone-Only Contraception

Intrauterine Devices

- Small device inserted into the uterus by a physician
- Prevent the union of sperm and egg and/or implantation
- Do not protect against STDs

Barrier Methods

- Prevent fertilization
- Examples
  - Diaphragm
  - Cervical cap
  - Contraceptive sponge
  - Male and female condoms
- Vary in degree of protection offered against STDs
  - No protection (cervical cap) to good protection (latex condom)

Spermicidal Preparations

- Kill sperm and therefore prevent fertilization
  - Effective for only about one hour once activated
- Forms include foam, cream, jelly, or tablet
- Also kill organisms responsible for STDs but may damage cells of vagina and increase susceptibility

Fertility Awareness

- The avoidance of intercourse when fertilization is likely to occur
- Also called “natural family planning” or “rhythm method”
- Challenging to determine the four days in each cycle when fertilization might occur
  - Methods include calendar, body temperature, cervical mucus

Emergency Contraception

- Morning-after pills
  - Hormones taken within the first few days after unprotected intercourse
  - Two types
    - Preven combines estrogen and progesterone
    - Plan B contains only progesterone

You Should Now Be Able To:

- Define and describe gonads
- Understand male and female reproductive roles
- Know the form and function of both male and female reproductive systems
- Understand the possible disorders of the female reproductive system
- Understand the stages of the human sexual response
- Know the choices available regarding birth control