UROGENITAL SYSTEM

TULIN SEN ESMER,MD
PROFESSOR OF ANATOMY
ANKARA UNIVERSITY
SCHOOL OF MEDICINE

SENESMER

URINARY SYSTEM ORGANS

- Kidneys (2)
- Ureters (2)
- Urinary bladder
- Urethra

FUNCTIONS

- Filter blood plasma, eliminate wastes
- Regulate blood volume, pressure
- Regulate fluid osmolarity
- Secrete renin
- Secrete erythropoietin (EPO)
- Regulate P_{CO_2}, Acid-Base balance
- Synthesize calcitriol (Vitamin D)
- Detoxify free radicals, drugs
- Gluconeogenesis

KIDNEY ANATOMY

- Within the muscular wall of the back between T12-L3.
- Renal hilus

<u>Protected by three connective tissue layers</u>

- **Renal fascia**
  - Attaches to abdominal wall
- **Adipose capsule (perirenal fat)**
  - Fat cushioning kidney
- **Renal capsule (fibrous capsule)**
  - Fibrous sac
  - Protects from trauma and infection

Kidneys

- Renal Cortex
- Renal Medulla
  - Renal pyramids
  - Renal papillae
  - Renal columns
- Renal Sinus
  - With major calyces and minor calyces…renal pelvis

KIDNEY ANATOMY

Gross anatomy

- Renal sinus
- Renal parenchyma

Renal sinus

- Surrounded by renal parenchyma
- Contains blood & lymph vessels, nerves, urine-collecting structures
  - 2 – 3 minor calices → Major calyx
  - 2 – 3 major calices → Renal pelvis
  - Renal pelvis → Ureter

Renal parenchyma

- Forms urine
- Two zones
  - Outer cortex
  - Inner medulla (renal pyramids)

KIDNEY ANATOMY: NEPHRONS

Nephrons

- Functional units of kidney
- ~1.2 million per kidney
- Two main parts
  - Renal corpuscle
  - Renal tubule

Nephron Anatomy

- **Renal Corpuscle**
  - Glomerulus
  - Bowman's capsule
- **Renal Tubules**
  - Proximal convoluted tubule (PCT)
  - Loop of Henle
  - Distal convoluted tubule (DCT)

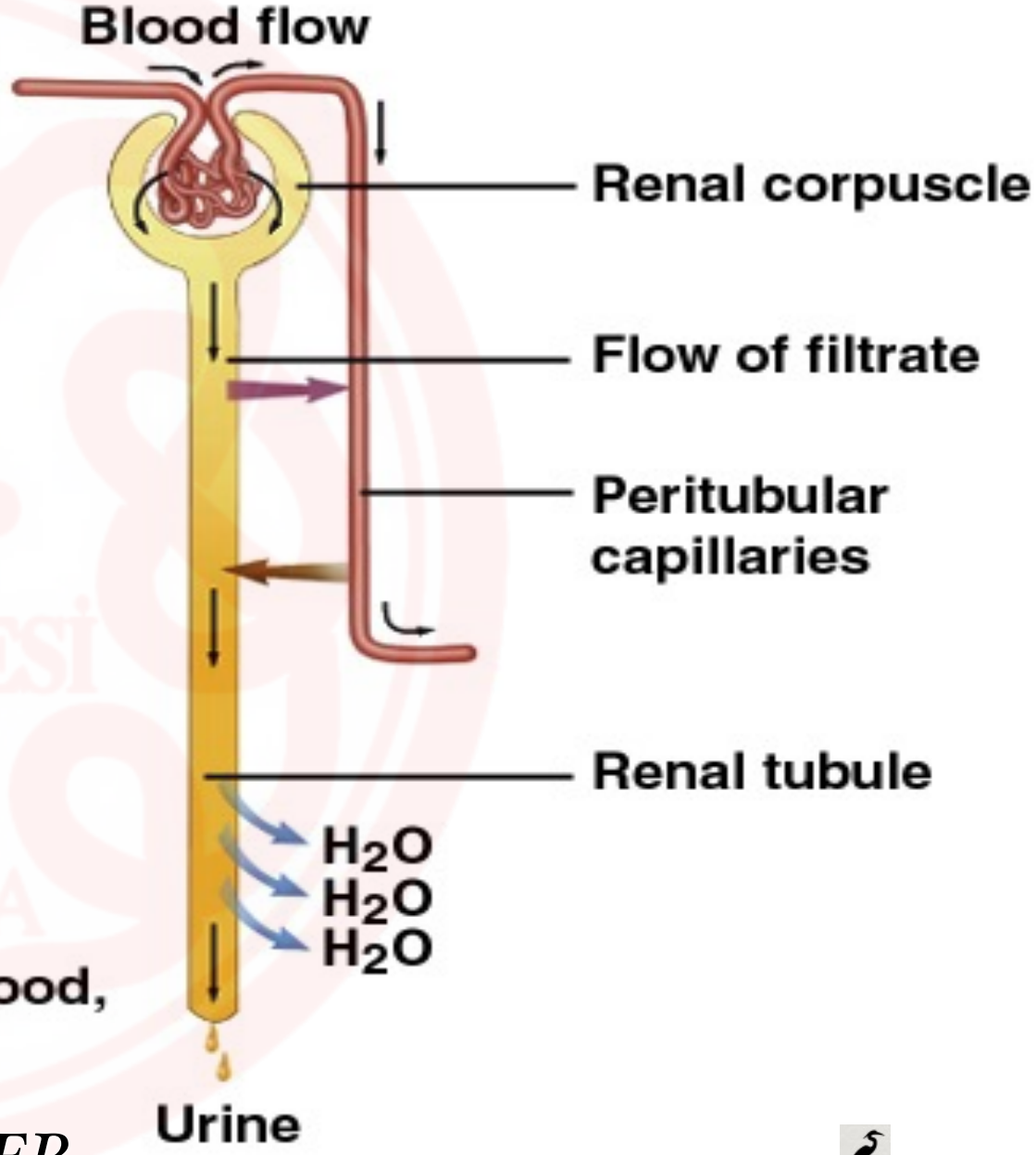
Urine Formation

① **Glomerular filtration**
Creates a plasmalike filtrate of the blood

② **Tubular reabsorption**
Removes useful solutes from the filtrate, returns them to the blood

③ **Tubular secretion**
Removes additional wastes from the blood, adds them to the filtrate

④ **Water conservation**
Removes water from the urine and returns it to blood, concentrates wastes



URINE STORAGE

Ureters

- Carry urine from kidneys to urinary bladder via peristalsis
  - Rhythmic contraction of smooth muscle
- Enter bladder from below
- Pressure from full bladder compresses ureters and prevents backflow
- Small diameter
- Easily obstructed or injured by kidney stones (renal calculi)

URINE STORAGE

Urinary bladder

- Muscular sac
- Wrinkles termed **rugae**
- Openings of ureters common site for bladder infection

Bladder- structure of

- 3 layers
  - Outer layer
    - Loose connective tissue
  - Middle layer
    - Smooth muscle and elastic fibres
  - Inner layer
    - Lined with transitional epithelium

URINE ELIMINATION

Urethra

- Conveys urine from body
- **Internal urethral sphincter**
  - Retains urine in bladder
  - Smooth muscle, involuntary
- **External urethral sphincter**
  - Provides voluntary control over voiding of urine

URINE ELIMINATION

Urethra

- 3 – 4 cm long in **females**
  - Bound by connective tissue to anterior wall of vagina
  - Urethral orifice exits body **between vaginal orifice and clitoris**

- ~18 cm long in **males**
  - **Prostatic urethra**
    - ~2.5 cm long, urinary bladder → prostate
  - **Membranous urethra**
    - ~0.5 cm, passes through floor of pelvic cavity
  - **Penile urethra**
    - ~15 cm long, passes through penis

Genital System

- The **reproductive system** becomes active after puberty. During puberty the reproductive organs mature to create a fertile individual capable of reproducing. The **primary sex organs** produce the **sex cells (egg/sperm) and sex hormones**. The **accessory sex organs** are all the components involved in maintaining the sex cell and assisting in the process of fertilization.

- **I. The male reproductive system**:
- This system is simpler than the female reproductive system.
- **Scrotum**: a sac located outside of the abdominal cavity, made up of a thin layer of smooth and skeletal muscle and skin. It is divided into left and right by a septum to form different compartments for the testicles. The scrotum keeps the testicles outside the body so they can be 3 degrees cooler than normal core temperature.
- The muscles of the scrotum contract to bring the testicles closer to the body in cooler conditions. In warm conditions they relax to allow the skin to stretch and maximize cooling.

- **Testes**: Oval shape organs made up of thousands of seminiferous tubules where the sperm is produced. It responds to follicle stimulating hormone that signals sperm production. When the sperm is in its last stages of maturation it moves to the epididymus.

- Gross anatomy: complete surrounded by a fibrous capsule and partially enclosed by a serous membrane that develop when the testes traveled outside the body into the scrotum. The fibrous capsule divides the testicles into wedge-like compartments called lobules that are filled with seminiferous tubules.

- They are innervated by an abundant about of visceral sensory nerves that make them very sensitive to pain. The high sensitivity serves for protection and in sexual arousal.

- **<u>Reproductive duct system is males</u>**: the tubules which sperm travel to exit the body.
- **1. <u>Epididymis:</u>** organ that arches over the posterior lateral side of the testis. If you uncoil the epididymis is can be as long as 6meters! During days the sperm spend here they complete maturation and gain the ability to swim and fertilize. During ejaculation smooth muscle contracts to send mature sperm to the ductus deferns.

2. <u>Ductus deferens</u>: also known as the vas deference, it runs superior to the testicles, enters the abdominopelvic cavity, runs posterior to the bladder, passes by the seminal vesicle, form the ampulla and ejaculatory duct, and finally leads into the prostatic urethra (Ductus deferens+duct of the seminal vesicle= ejaculatory duct).

3. <u>Urethra</u>: men carries both sperm and urine in urethra. During ejaculation the sphincter muscles close off the bladder so urine is not released into the semen. The urethra is divided into the prostatic urethra (section passing through prostrate gland), the membranous urethra (urogenital diaphragm) and the spongy urethra (penile). Urethral glands along the spongy urethra secrete a lubricating solution before ejaculation.

- **Accessory glands**: These glands produce substances that increases the chances of sperm survival once it is outside the body. These secretions in addition to sperm form semen.
- **1. Seminal vesicles:** paired glands located posterior to the bladder. During ejaculation smooth muscle contract to help secrete a fluid that contains fructose (sugar), nutrients, prostagladins to stimulate the urethra to contract, substances that suppress the immune system against sperm in females, enzymes the enhance sperm mobility, and enzymes that thicken the ejaculate.
- **2. Prostate gland:** the size of a chestnut, also has smooth muscle that contracts to assist in the release of prostatic secretion. This is a milky white fluid that has substances to enhance sperm mobility and thicken ejaculate. It is largest accessory gland of male reproductive system.
- **3. Bulbourethral glands:** secrete a mucus substances that lubricates and neutralizes the acid from urine in the male urethra.

Penis: Designed to deliver semen into the female reproductive tract.

- It originates at the root, expends through the body, and ends at the glans penis.
- The penis contains : corpora spongiosum (cointains urethra), corpora cavernosa (erectile part), and others consisting of smooth muscle and connective tissue.
- It is a spongy network surrounded by a high amount of blood vessels that dilate during arousal and engorge with blood.
- The parasymphatetic branch causes the penis to become erect by stimulating vasodilation.
- The symphatetic branch cause ejaculation by stimulating contraction of smooth muscle along the reproductive tract.

- **<u>II. The female reproductive system</u>**: These organs produce the ova (eggs), sex hormones, and provide an environment for internal fertilization and development of the fetus. They undergo changes according to the menstrual cycle.

- **The ovaries**: the size of an almond, this paired organ is suspended by mesenteries and ligaments.
- It is surrounded by a fibrous capsule and can be divided into a cortex and medulla.
- The cortex houses the developing ova and the medulla holds vascular tissue.
- The ovary is the site of oogenesis and female sex hormone production.
- It responds to follicle-stimulating hormone that signals the maturation of an ovum.
- Typically only one egg is released from an ovary every month, the ovaries alternate in releasing the egg.
- Hormones that affect the menstrual cycle and female sex organs are also released by the ovaries; estrogen and progesterone.

- **<u>Ovarian cycle</u>:** this concerns the changes in the ovary during the menstrual cycle.
- Females are born with all the potential ova they can produce in a life time.
- These are called the primordial follicles which consist of a single immature oocyte and a single layer of follicular cells.
- These cells respond to FSH and being the maturation of an oocyte.

- **Uterine tubes**: also called fallopian tubes, they take the oocyte and provide a site for fertilization.
- The tube is lined with ciliated epithelium that gently guides the oocyte towards the uterus.
- There are also peristaltic waves caused by smooth muscle contraction to aide the movement of the oocyte.
- Sometimes a fertilized egg can implant in a uterine tube and cause a life threatening ectopic pregnancy.
- Its parts; isthmus, ampulla (ovaries usually are fertilized here!!!) infindubulum and fimbriae.

- **The uterus**: a thick muscular pouch about the size of a pear that lies in the pelvic cavity superior to the bladder.
- The function of the uterus is to receive an embryo and provide an environment for its development. During pregnancy it stretches to accommodate the growth of the fetus.
- When there is no pregnancy the cavity within the uterus is small. The opening of the uterus is at the cervix, during child birth it dilates to allow the child to pass by.
- 1**. <u>Supports of the uterus</u>**: The uterus, cervix, and vagina are supported by ligaments and mesenteries. Most uterine support is provided by muscles of the pelvic floor. Sometimes these muscles are torn during child birth and the unsupported uterus results in a prolapsed uterus. In this condition the tip of the cervix protrudes through the opening of the external vagina.
- 2. **<u>Uterine wall</u>**: composed of three layers: perimetrium (outer= serous membrane), myometrium (middle= layers of smooth muscle), and endometrium (inner= simple columnar epithelium).

✓ Body of uterus
✓ Fundus of uterus
✓ Uterin horn
✓ Isthmus
✓ Cervix
✓ Lumen (cavity) of uterus

- **<u>The vagina</u>**: also known as the birth canal.
  - It is the canal that leads into the cervix and its opening is located anterior to the anus but posterior to the clitoris and urethral opening.
  - The vagina is also the site where sperm is deposited.
  - It also has ruggae to stimulate the penis during intercourse and stretch out during childbirth.
  - The mucosa is made up of stratified squamous epithelium. It secretes glycogen to maintain healthy beneficial bacteria that produce lactic acid. This creates an acidic environment that is not beneficial to other bacteria or sperm.

- **External genitalia**: also called the vulva and often incorrectly referred to as the vagina. It includes;
- The mons pubis (fatty rounded pad over the pubic symphisis),
- The labia majora (thick skin fold analogous to the scrotum),
- The labia minora,
- The clitoris (erectile tissue analogous to the penis),
- The bulb of vestibule
- The greater vestibular gland .

➢ The vestibule (the vaginal and urethral orifice and vestibule glands) are protected by the labia minora.

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