

The kidney and urinary system main symptoms and syndromes. Methods of examination.

Prof. Maria Trekva, M.D.,PhD, DSc.

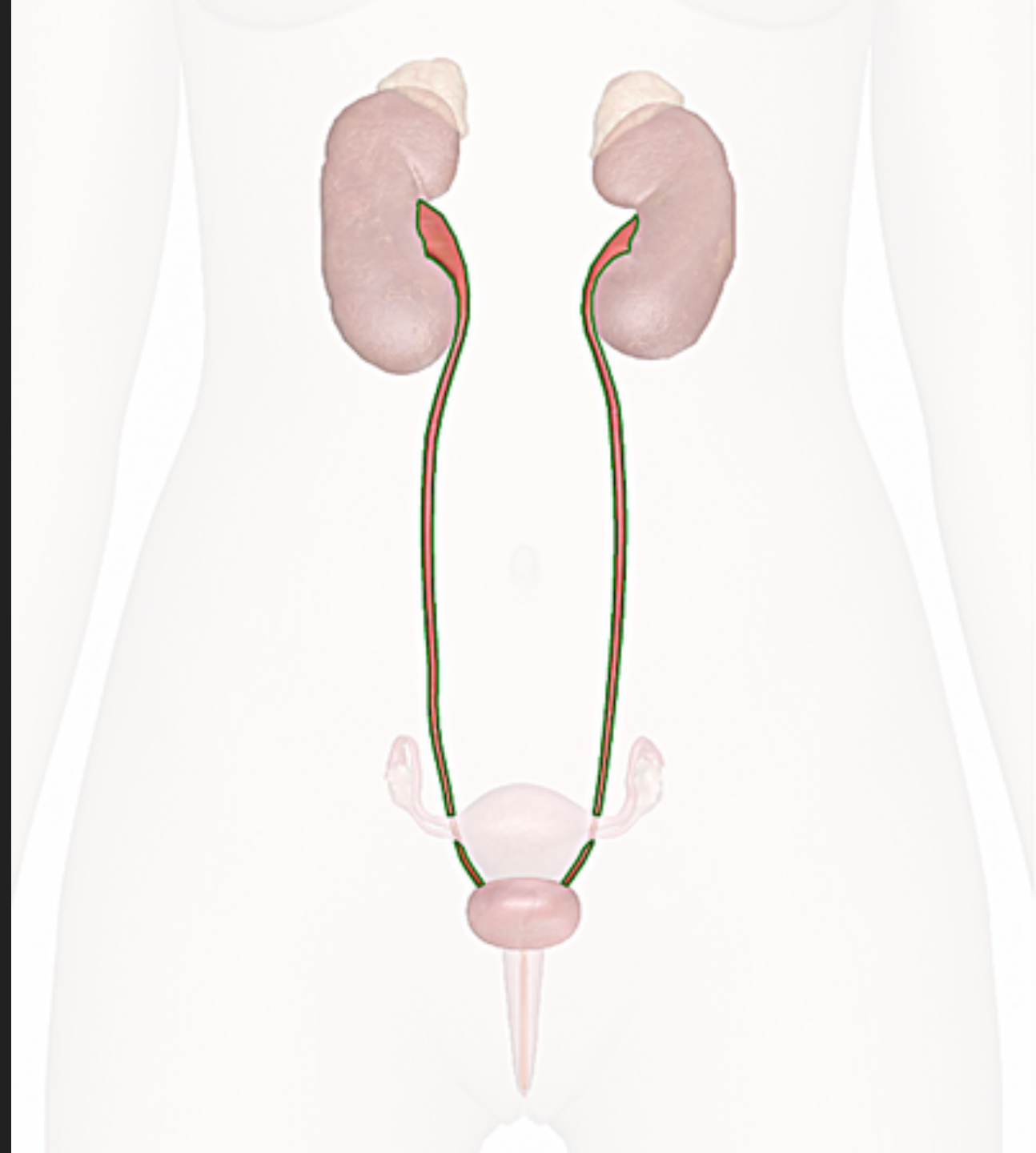
The kidney and urinary system

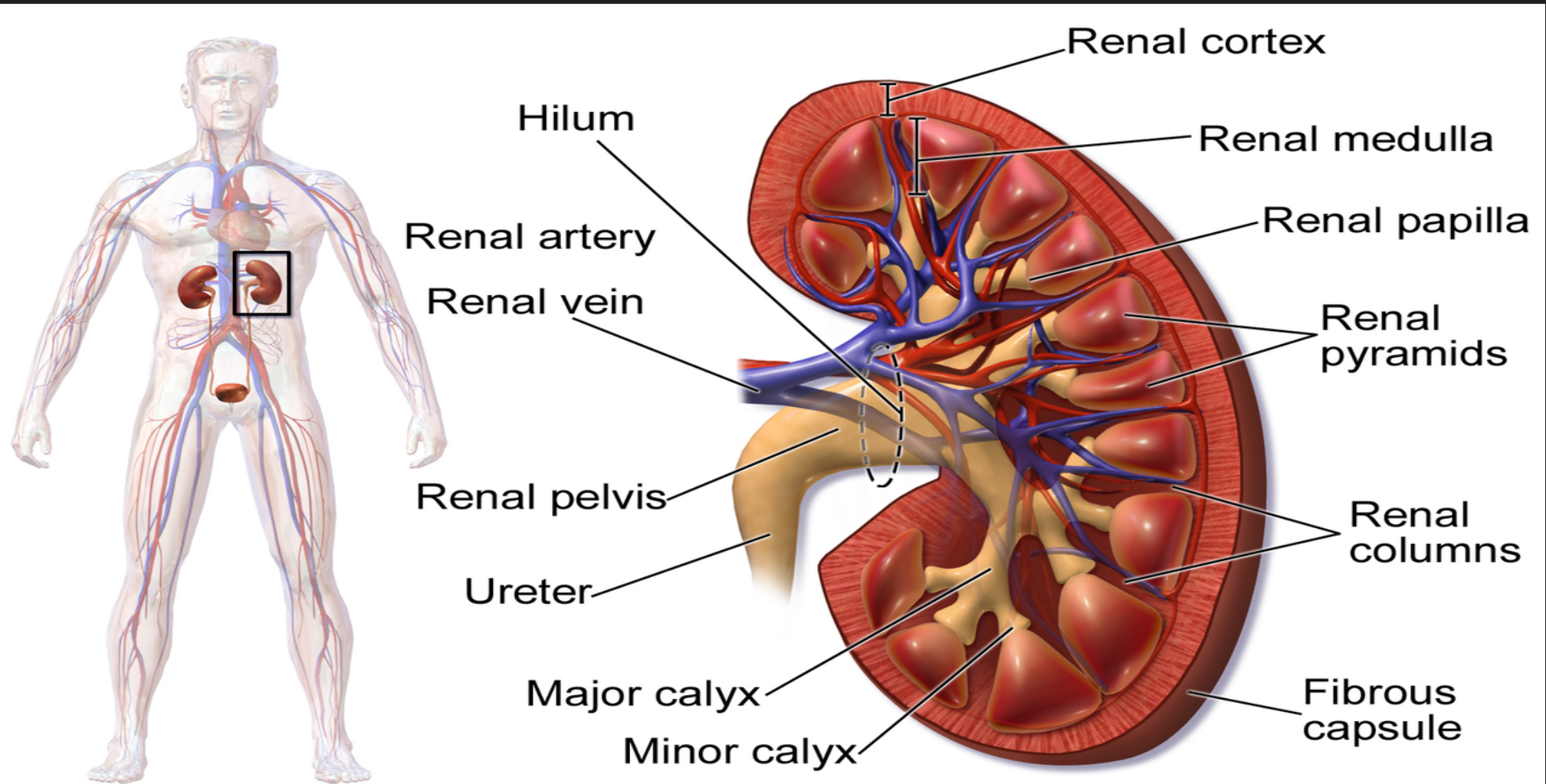
The kidneys are a pair of bean-shaped organs on either side of spine, below the ribs.

Each kidney is about 4 or 5 inches long, roughly the size of a large fist.

the kidneys filter the blood.

They remove wastes,
control the body's fluid balance,
and keep the right levels of electrolytes.





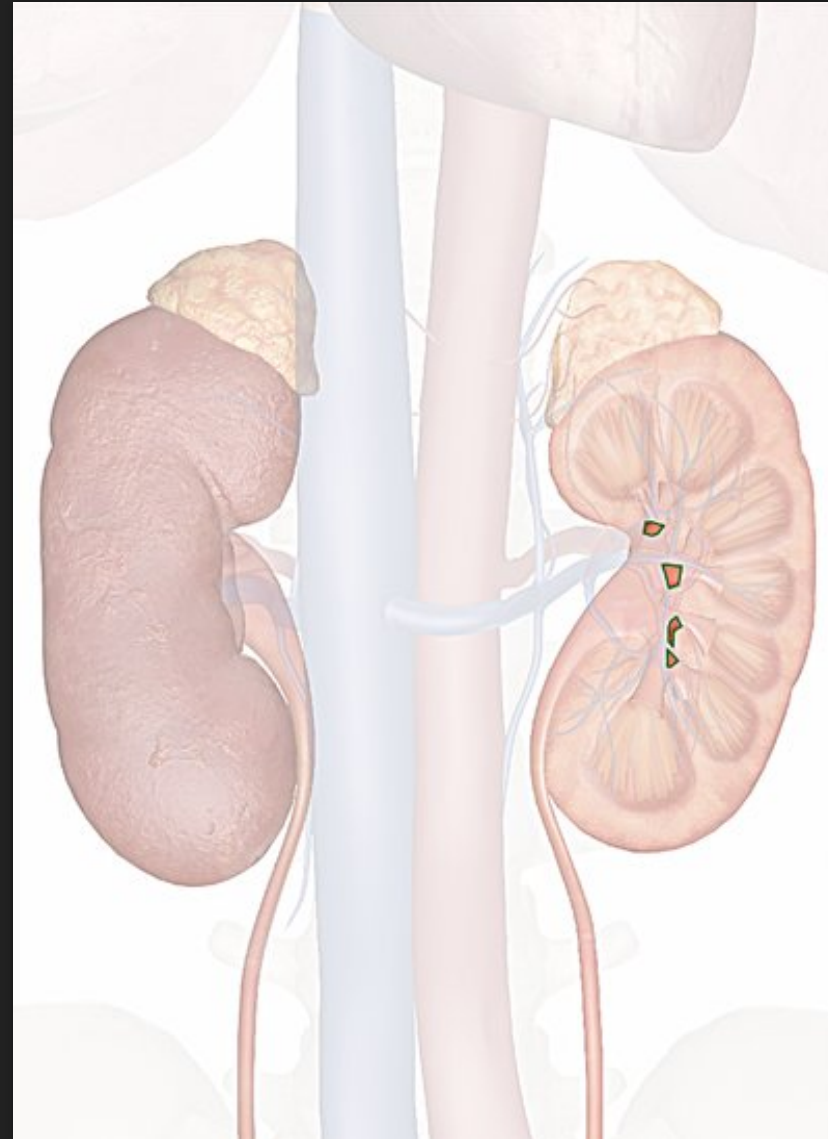
Kidney Anatomy

The kidney and urinary system

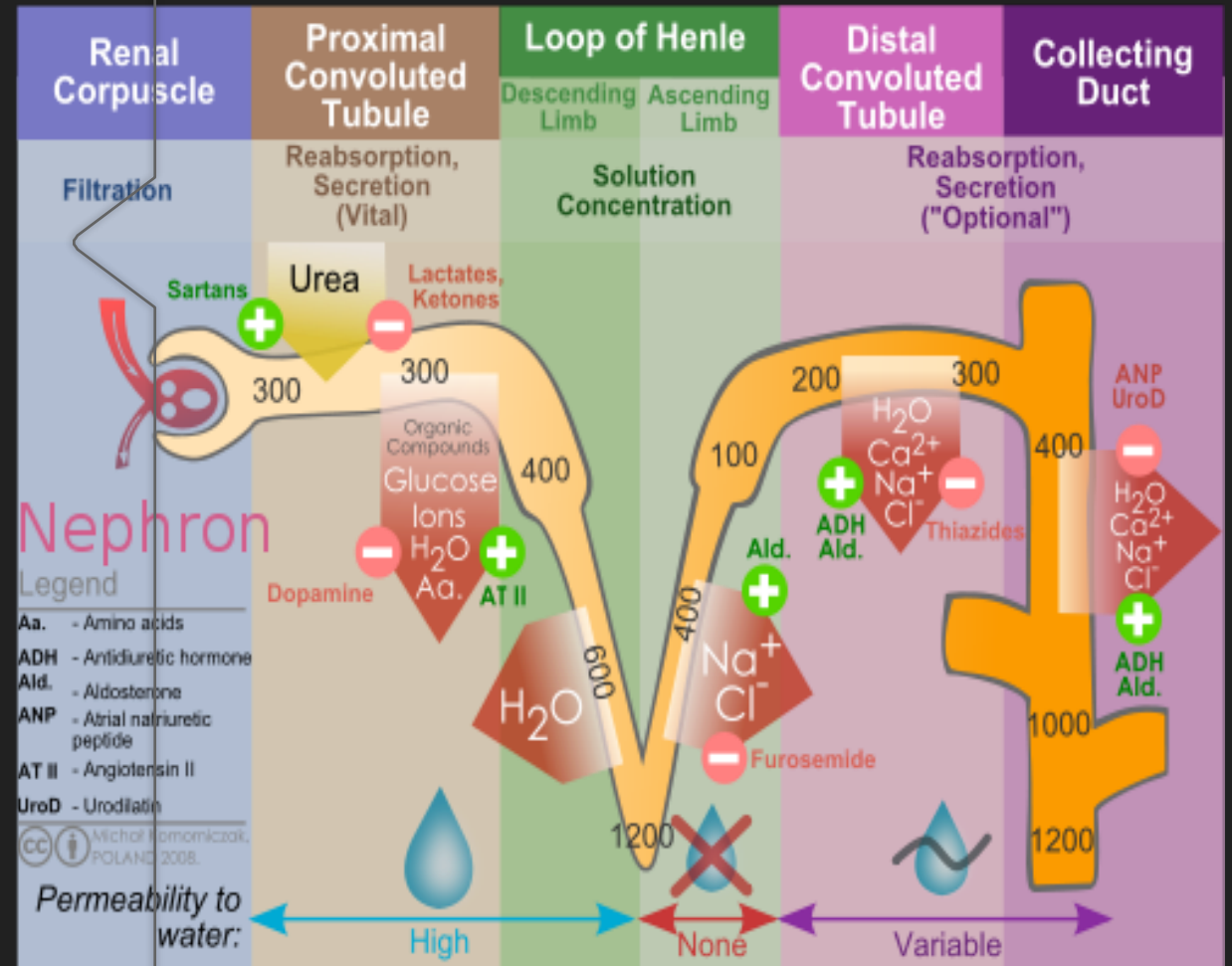
- **NEPHRON** • Each kidney contains approx. 1 million nephrons.
- In humans, formation of nephron is complete at 36-40 wks of gestation., but functional maturation with tubular growth & elongation continues during the 1st decade of life
- new nephrons can't be formed after birth, so any disease that results in progressive loss of nephrons can lead to renal insufficiency.

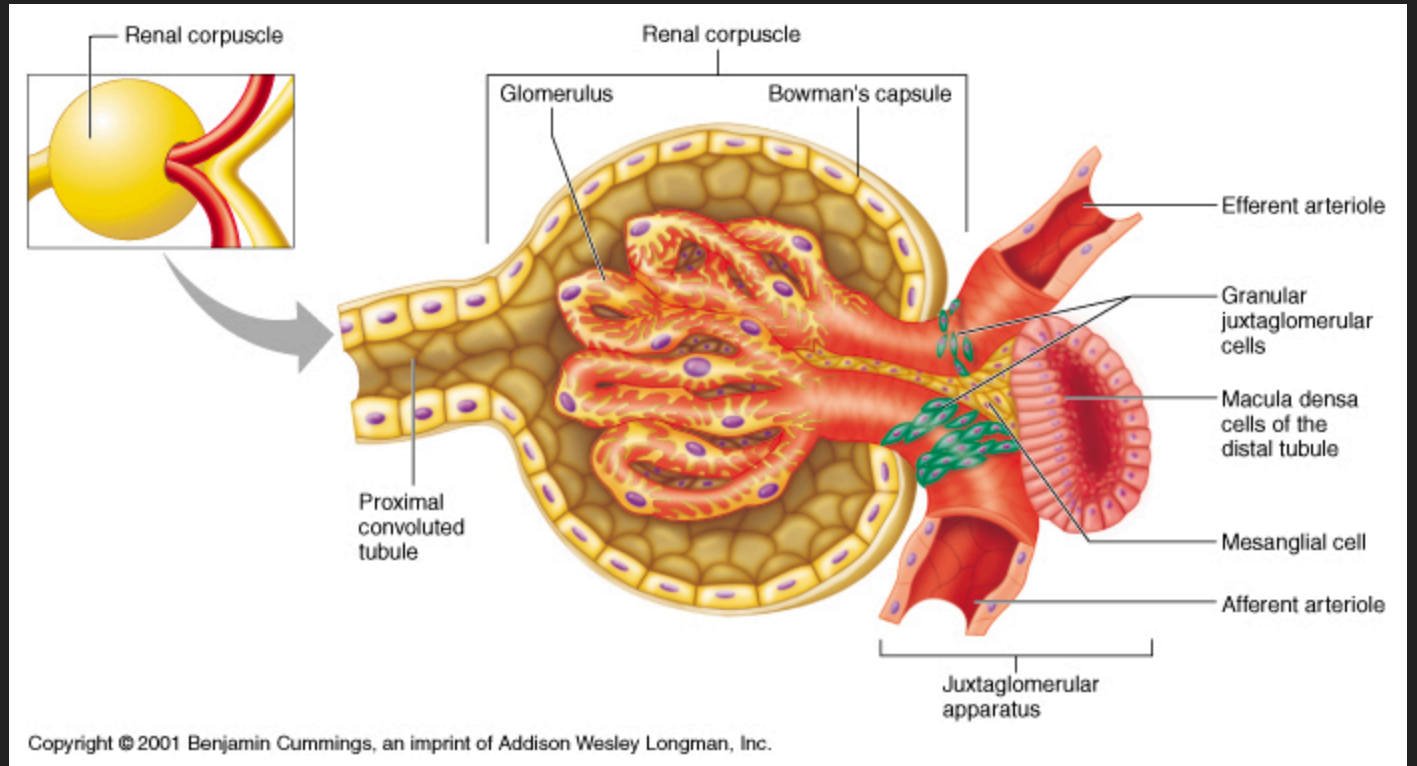
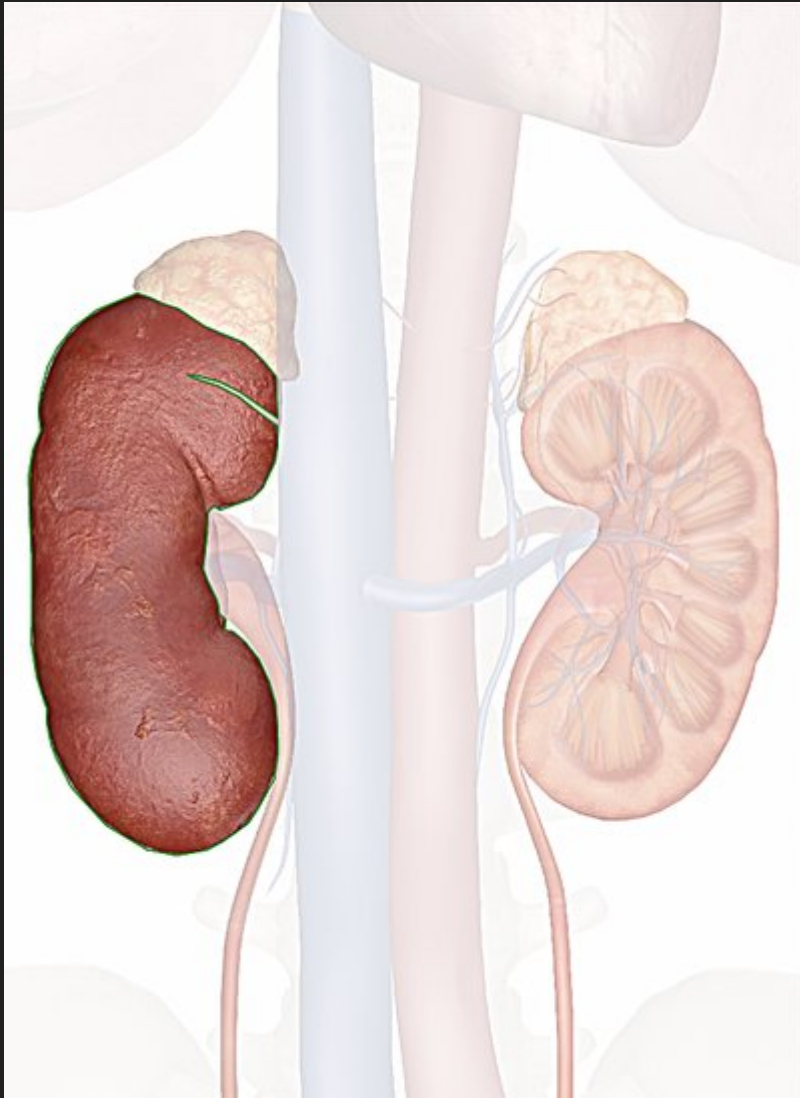
Kidney

- ✓ The patient could have only 10% of his or her kidneys working, and may not notice any symptoms or problems.

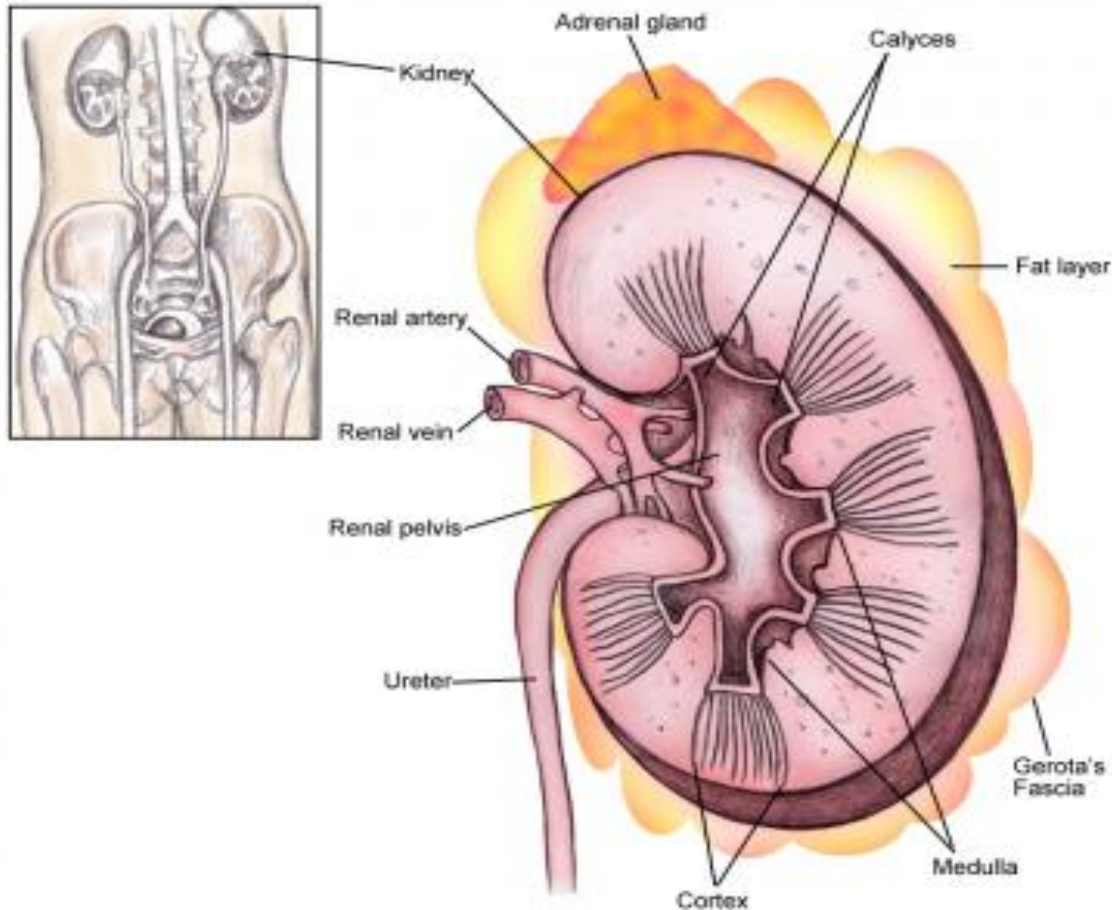


- ✓ Nephrons, the urine-producing functional structures of the kidney,
- ✓ span the cortex and medulla.
- ✓ The initial filtering portion of a nephron is the renal corpuscle which is located in the cortex.
- ✓ This is followed by a renal tubule that passes from the cortex deep into the medullary pyramids.





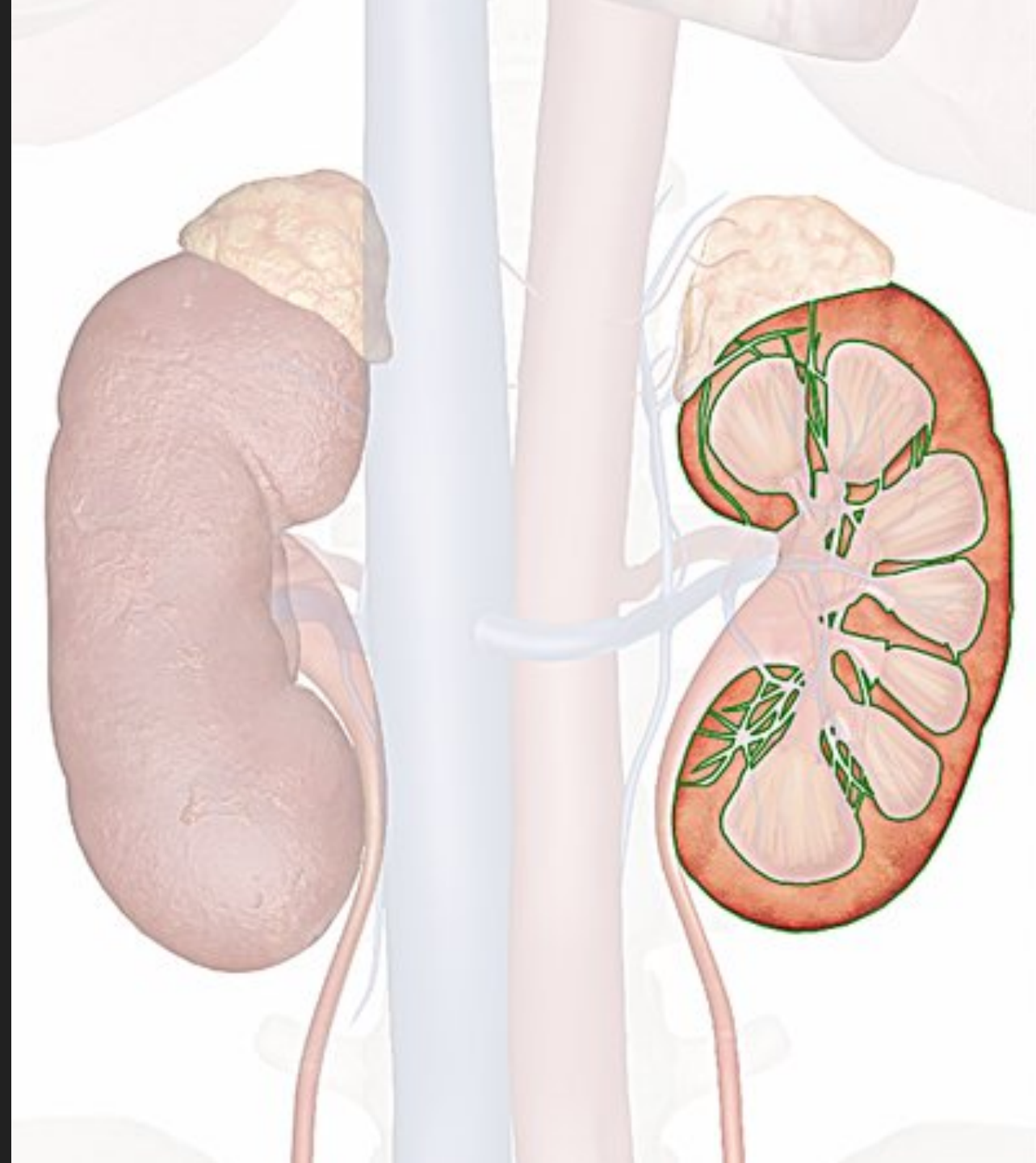
The kidney and urinary system



- The kidneys serve important functions, including:
- filtration and excretion of metabolic waste products (urea and ammonium);
- regulation of necessary electrolytes, fluid,
- and acid-base balance;
- and stimulation of red blood cell production.

They also serve:

- ✓ to regulate blood pressure via the renin-angiotensin-aldosterone system,
- ✓ controlling reabsorption of water and maintaining intravascular volume.
- ✓ The kidneys also reabsorb glucose
- ✓ and amino acids
- ✓ and have hormonal functions via erythropoietin, calcitriol, and vitamin D activation

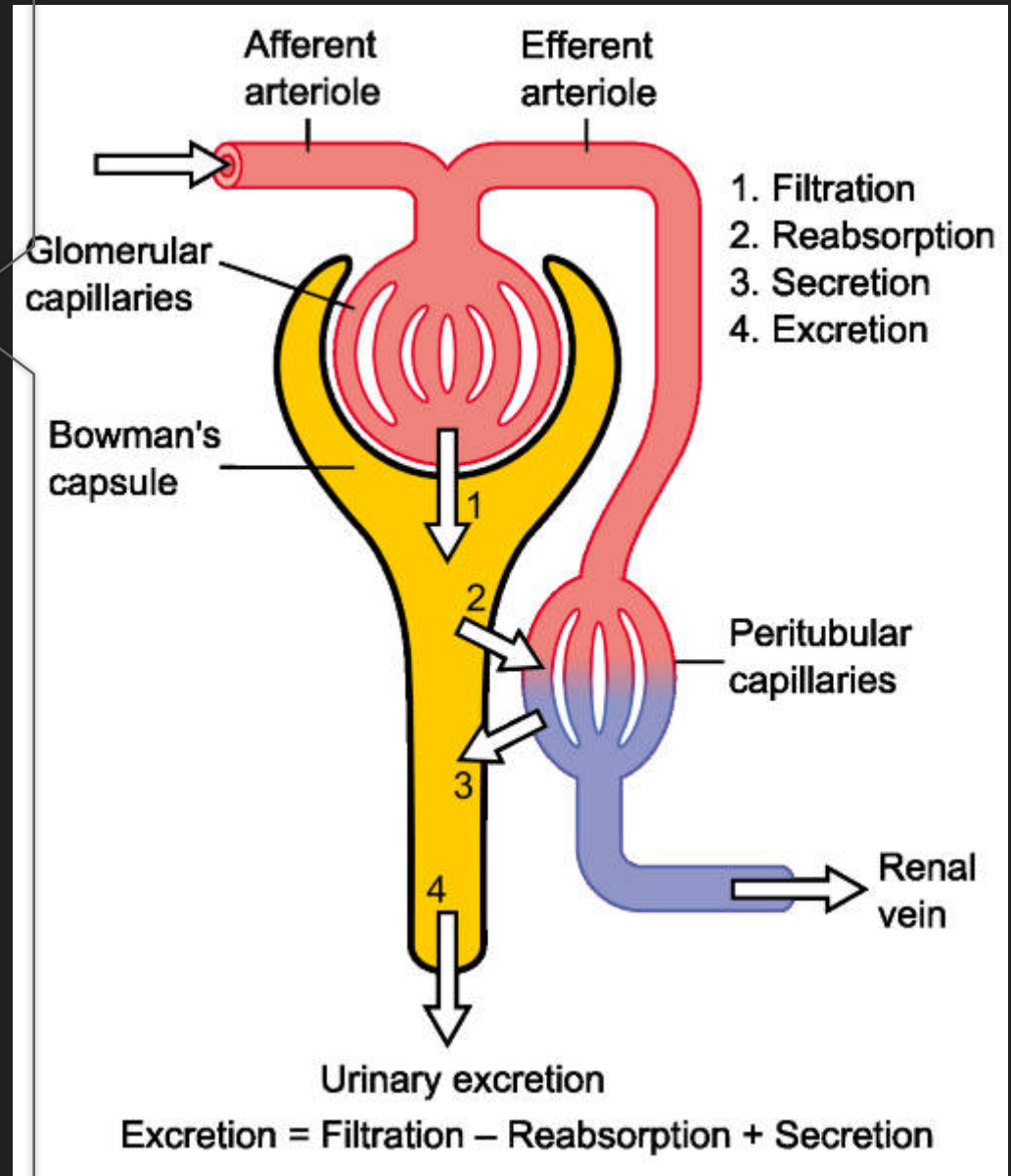


Blood comes into the kidney,
waste gets removed,
and salt, water,
and minerals are adjusted, if
needed.

The filtered blood goes back
into the body.

Waste gets turned into urine,
which collects in the kidney's
pelvis -- a funnel-shaped
structure

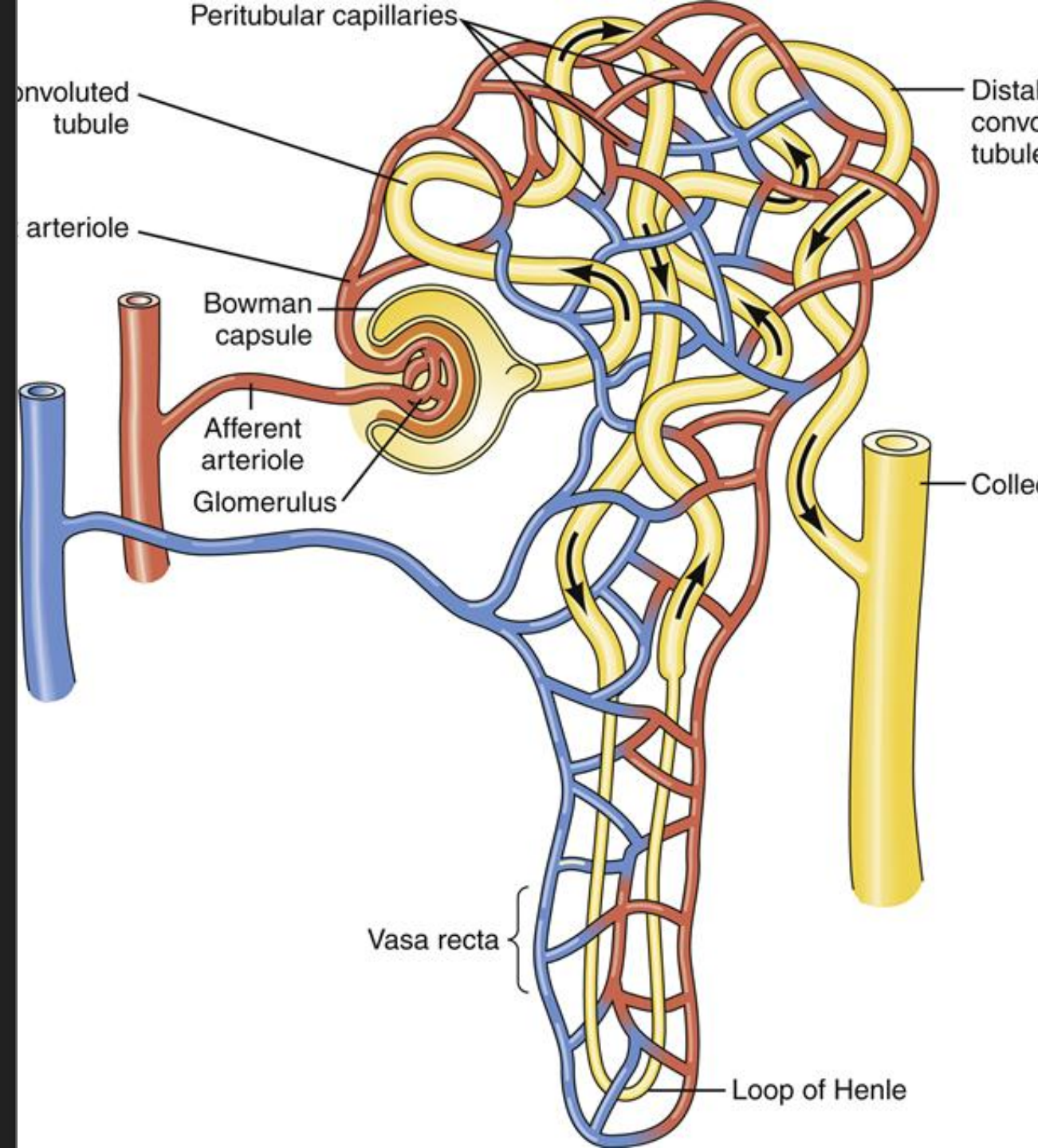
that drains down a tube called
the ureter to the bladder.



A Nephron consist :

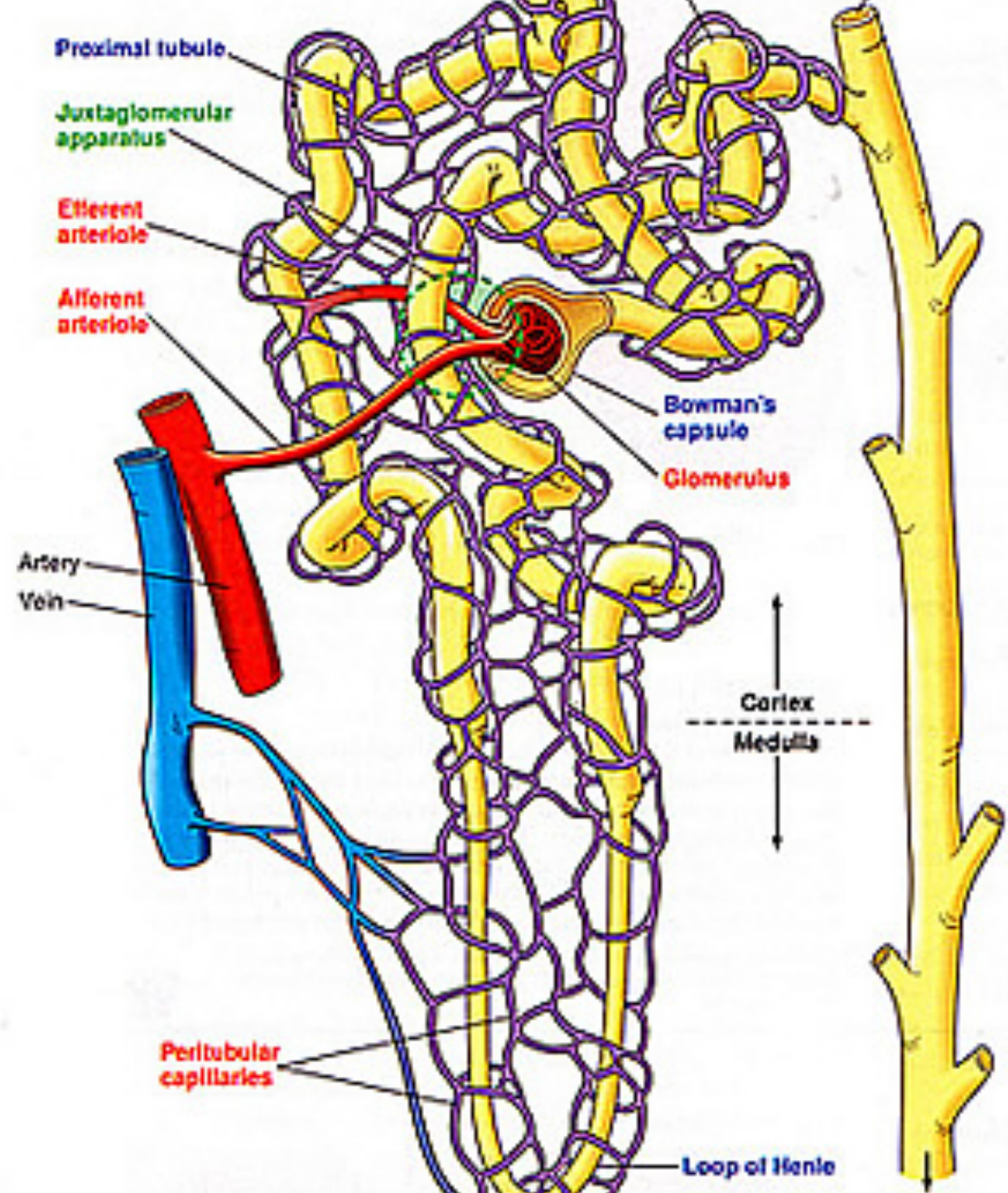
**- OUTER LAYER (the cortex) -
glomeruli -PCT & DCT -CD•**

**- INNER LAYER (the medulla) -
Straight portion of tubules -
LOH -vasa recta -terminal
CD**



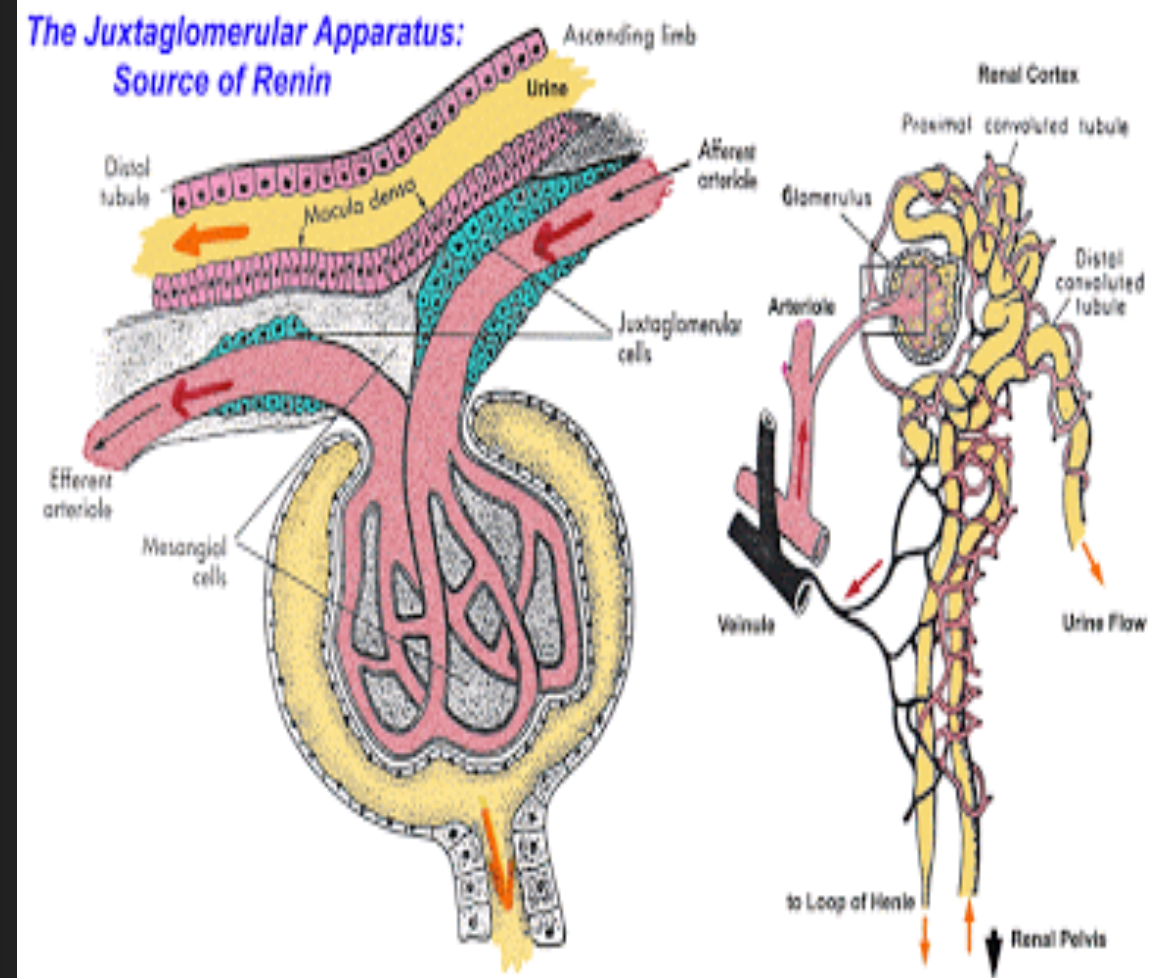
RENAL VASCULATURE

- ✓ The renal artery arising from aorta divides into fine Segmental Arteries. •
- ✓ The latter divides into the Interlobar Arteries, which branch into Arcuate Arteries near the junction of the Cortex & medulla. •
- ✓ Interlobar arteries provide the afferent arterioles for the glomeruli. •
- ✓ The glomerular capillaries join to form the efferent arteries that leaves the glomerulus & form an extensive network of peritubular capillaries that surround the tubules, mostly in the cortex, forming Vasa Recta.
- ✓ VR along with LOH are responsible for the urine concentration



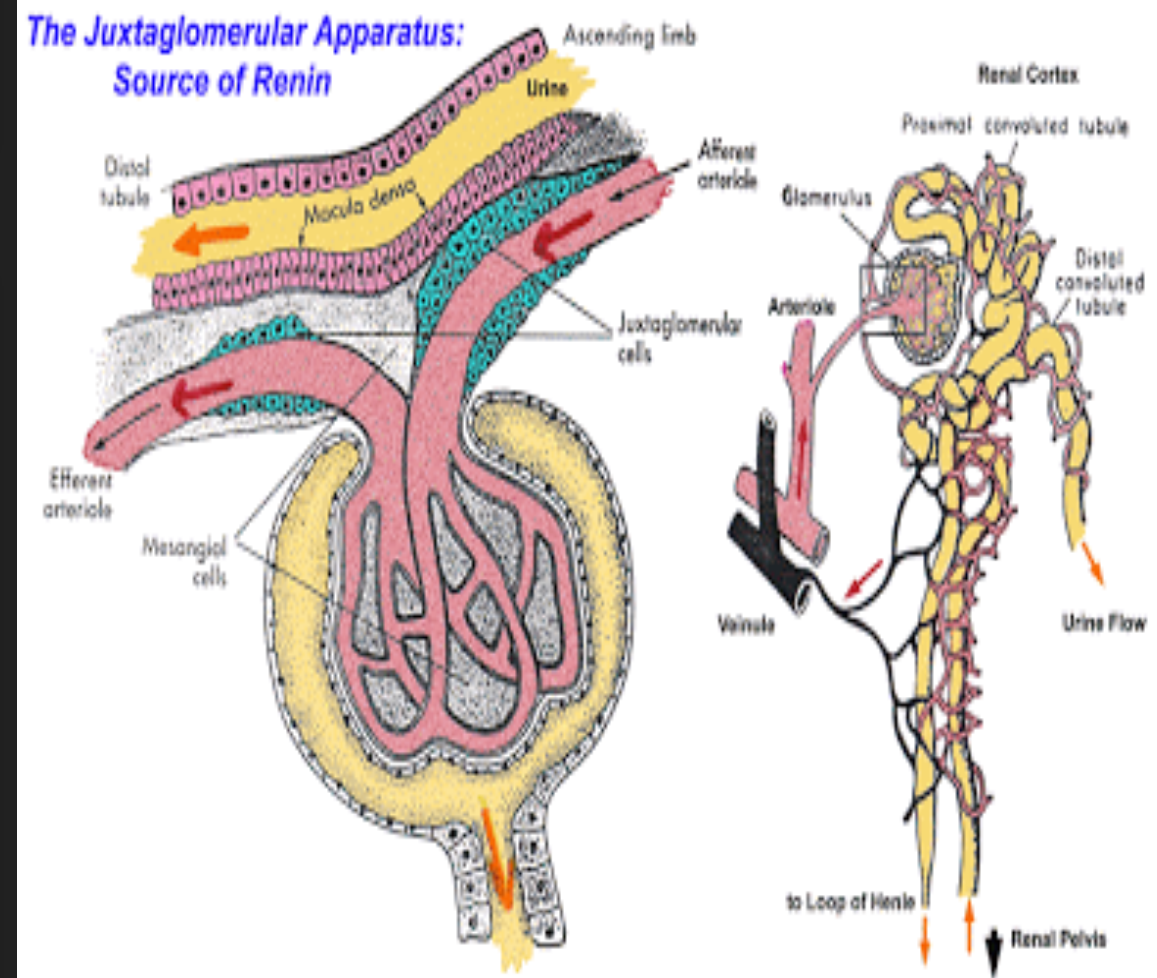
- The juxtaglomerular apparatus (JGA) is located between the afferent arteriole and the returning distal convoluted tubule of the same nephron.

- It is responsible for regulating both intrarenal (tubuloglomerular feedback) and extrarenal (renin-angiotensin-aldosterone) mechanisms necessary to maintain both renal and entire body volume status.



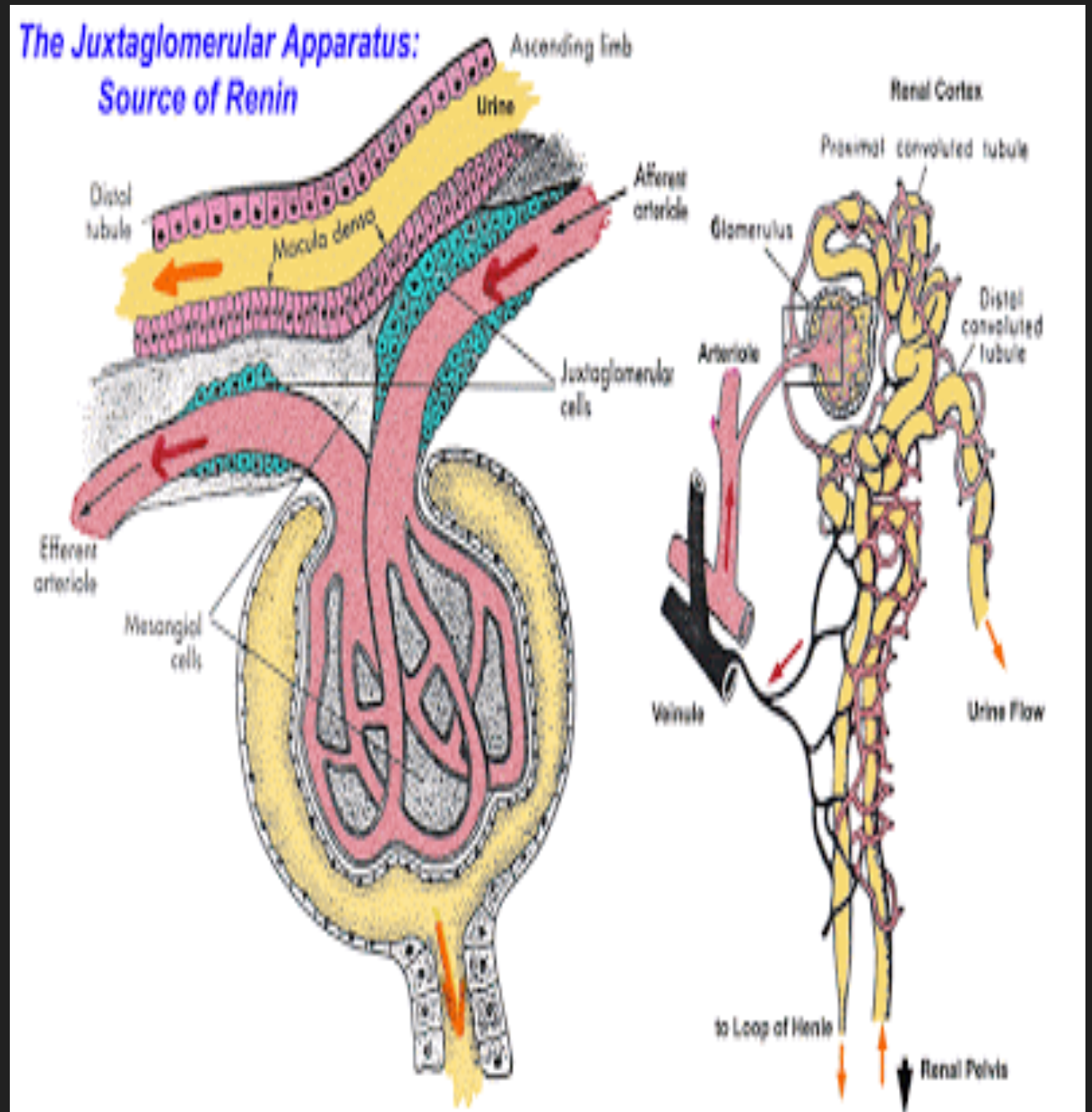
The three components of the JGA are the following:

(1) the juxtaglomerular cells of the afferent arteriole, synthesize and store renin, which is secreted in response to specific stimuli (e.g., low blood flow, decreased NaCl delivery). The juxtaglomerular cells could be considered the "effector arm" of the renin-angiotensin-aldosterone axis.

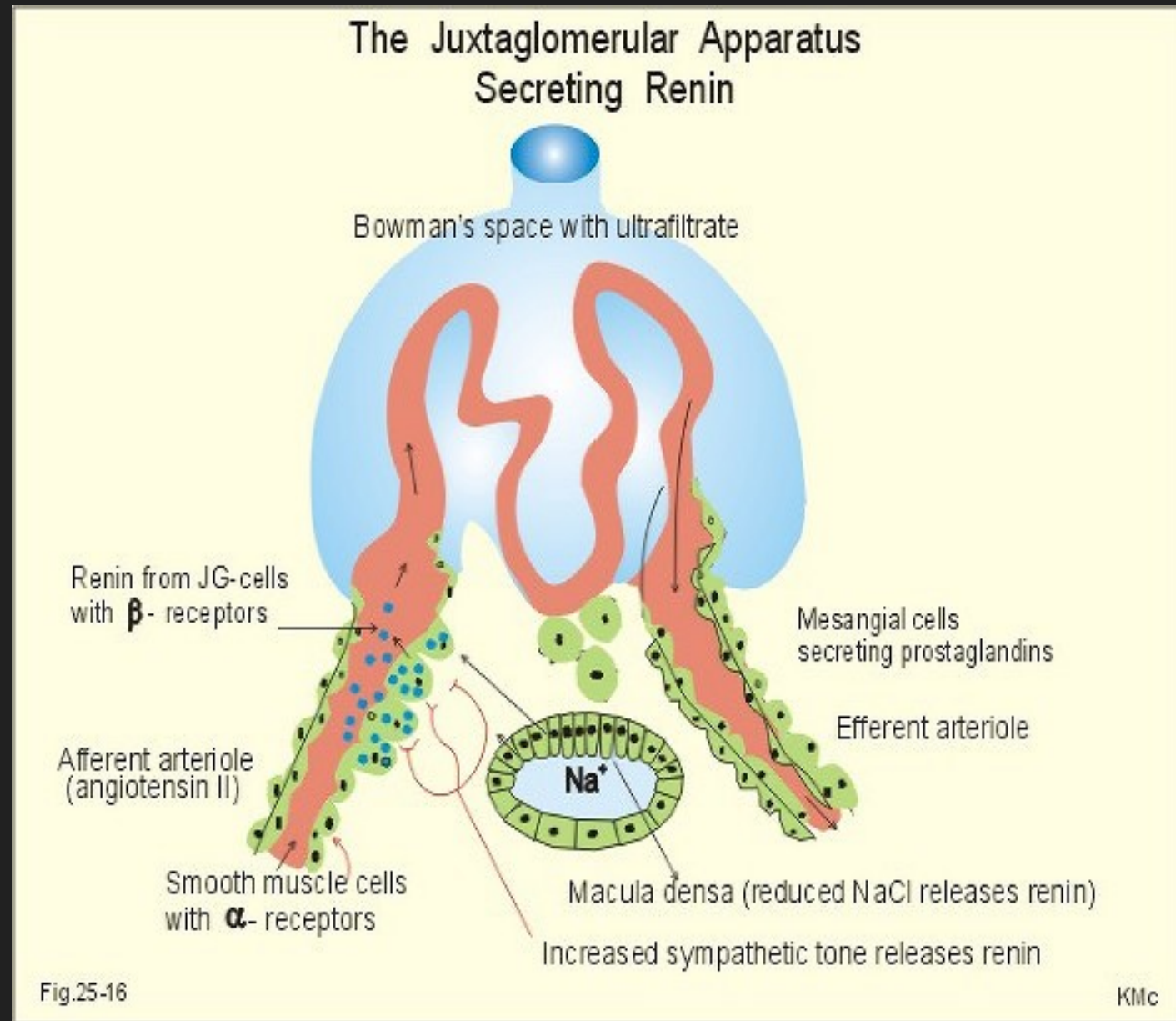


(2) the macula densa, a region of the distal convoluted tubule characterized by tubular epithelial cells which are more densely-packed .

- ✓ The macula densa can be considered the "sensory arm" of the renin-angiotensin-aldosterone axis
- ✓ in that these are the cells which sense decreased Na Cl delivery which determines downstream function.
- ✓ They are also involved in the mechanism of tubuloglomerular feedback.

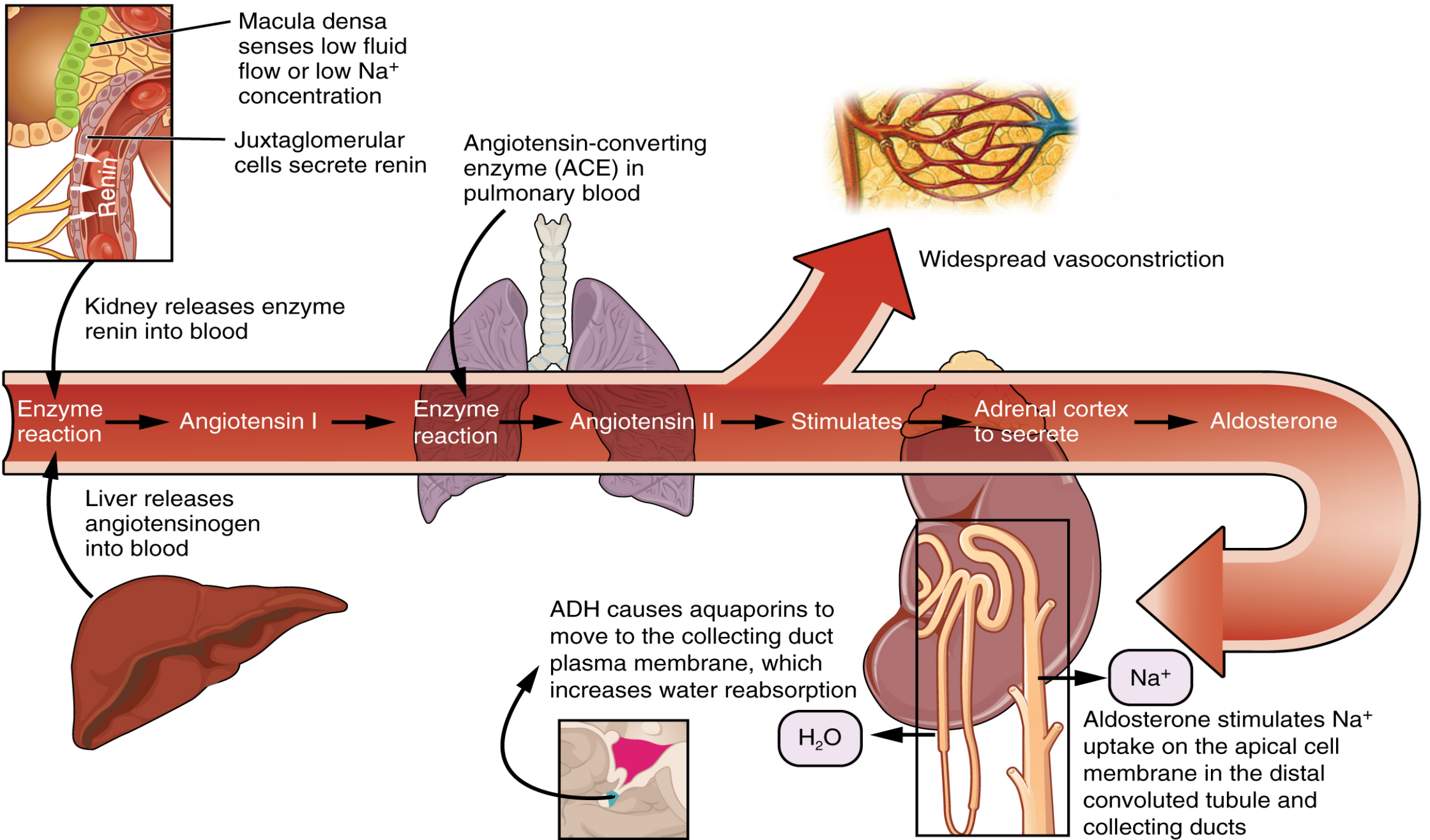


(3) mesangial cells, which form connections via actin and microtubules which allow for selective vasoconstriction/vasodilation of the renal afferent and efferent arterioles with mesangial cell contraction.



JUXTAGLOMERULAR APPARATUS •

- The cells of the distal tubule in the part that comes in contact with the afferent arterioles of the glomerulus are more dense than the cells in the rest of tubule are called **MACULA Densa**
- The smooth muscle cells of afferent arterioles that approximate macula densa contain prominent secretory cytoplasmic granules which are the site of renin activity.



Macula densa senses low fluid flow or low Na^+ concentration

Juxtaglomerular cells secrete renin

Angiotensin-converting enzyme (ACE) in pulmonary blood

Widespread vasoconstriction

Kidney releases enzyme renin into blood

Enzyme reaction

Angiotensin I

Enzyme reaction

Angiotensin II

Stimulates

Adrenal cortex to secrete

Aldosterone

Liver releases angiotensinogen into blood

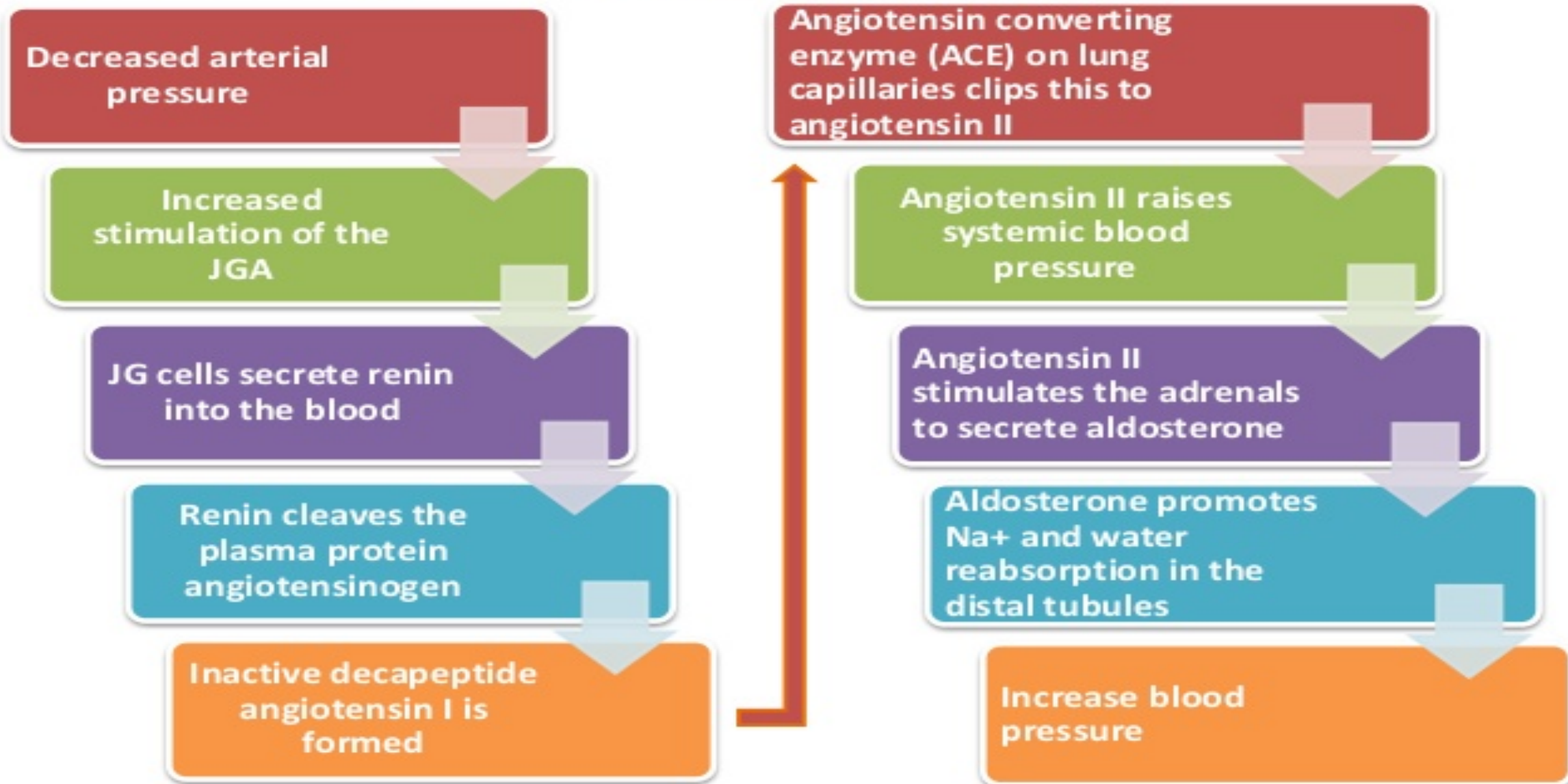
ADH causes aquaporins to move to the collecting duct plasma membrane, which increases water reabsorption

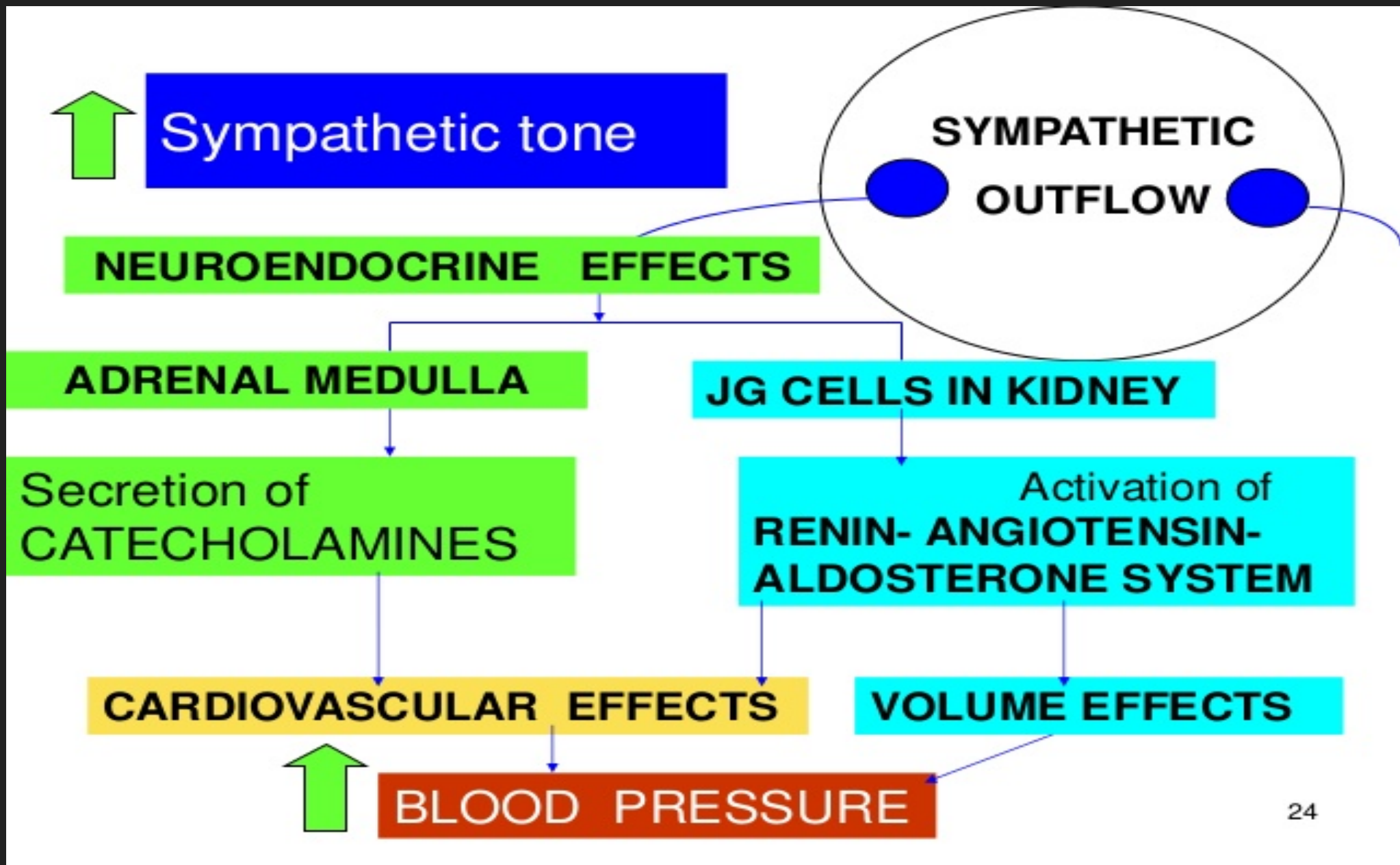
H_2O

Na^+

Aldosterone stimulates Na^+ uptake on the apical cell membrane in the distal convoluted tubule and collecting ducts

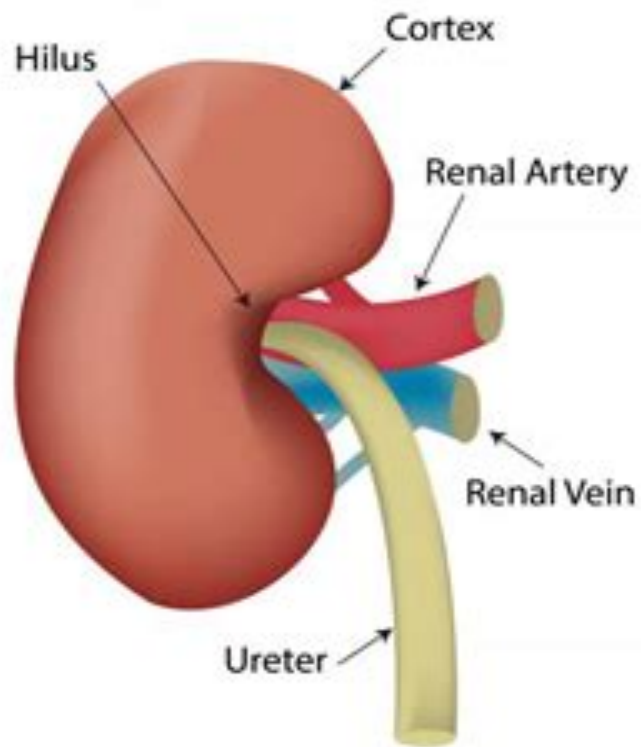
Aldosterone and the Renin-Angiotensin System



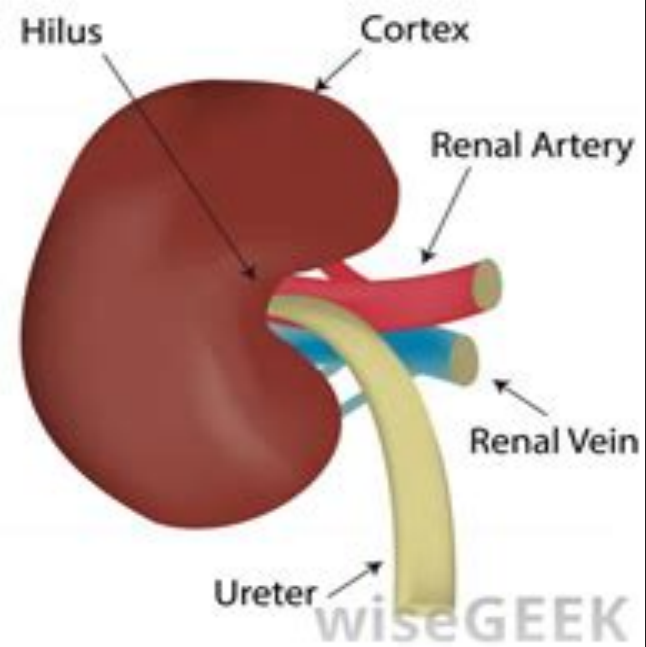


Kidney Disease

Normal Kidney



Diseased Kidney



PALPATION OF THE KIDNEYS

- this technique is best performed by an advanced practitioner, because it involves deep palpation. In addition, the kidneys are difficult to palpate.
- Assist the patient to the supine position and stand at the right side of the patient.
- To palpate the left kidney, reach across the patient and place your left hand under the patient's left flank with your palm upward.
- Elevate the left flank with your fingers, displacing the kidney upward.
- Ask the patient to take a deep breath and use the palmer surface of your right hand to palpate the kidney .
- Repeat the technique for the right kidney.

PALPATION OF THE KIDNEYS

- An attempt should be made to palpate both the right and left kidneys.
- The ballottement method is normally used.
- Keep your anterior hand steady in the deep palpation position in the right upper quadrant lateral and parallel to rectus muscle.
- Attempt to ballot the kidney with the other hand in costophrenic angle.
- An enlarged kidney should be palpable by the anterior hand.
- Repeat the same maneuver for the left kidney.

- Normal:
- In an adult, the kidneys are not usually palpable, except occasionally for the inferior pole of the right kidney. The left kidney is rarely palpable. An easily palpable or tender kidney is abnormal. However, the right kidney is frequently palpable in very thin patients and children.

- ✓ **Alternate method for the right kidney:**
- ✓ **Place your left hand behind the patient between the rib cage and iliac crest and**
- ✓ **place your right hand below the right costal margin.**
- ✓ **While pressing your hands firmly together, ask the patient to take a deep breath.**
- ✓ **Attempt to feel the lower pole of the right kidney.**
- ✓ **Repeat the same maneuver for the left kidney.**



When the kidney is easily palpable,
note whether it is bilateral or unilateral.
If a mass is identifiable, note the:

Size

Unilateral enlargement:
(Hydronephrosis, tumor, cyst)

Bilateral enlargement: (Polycystic
kidney)

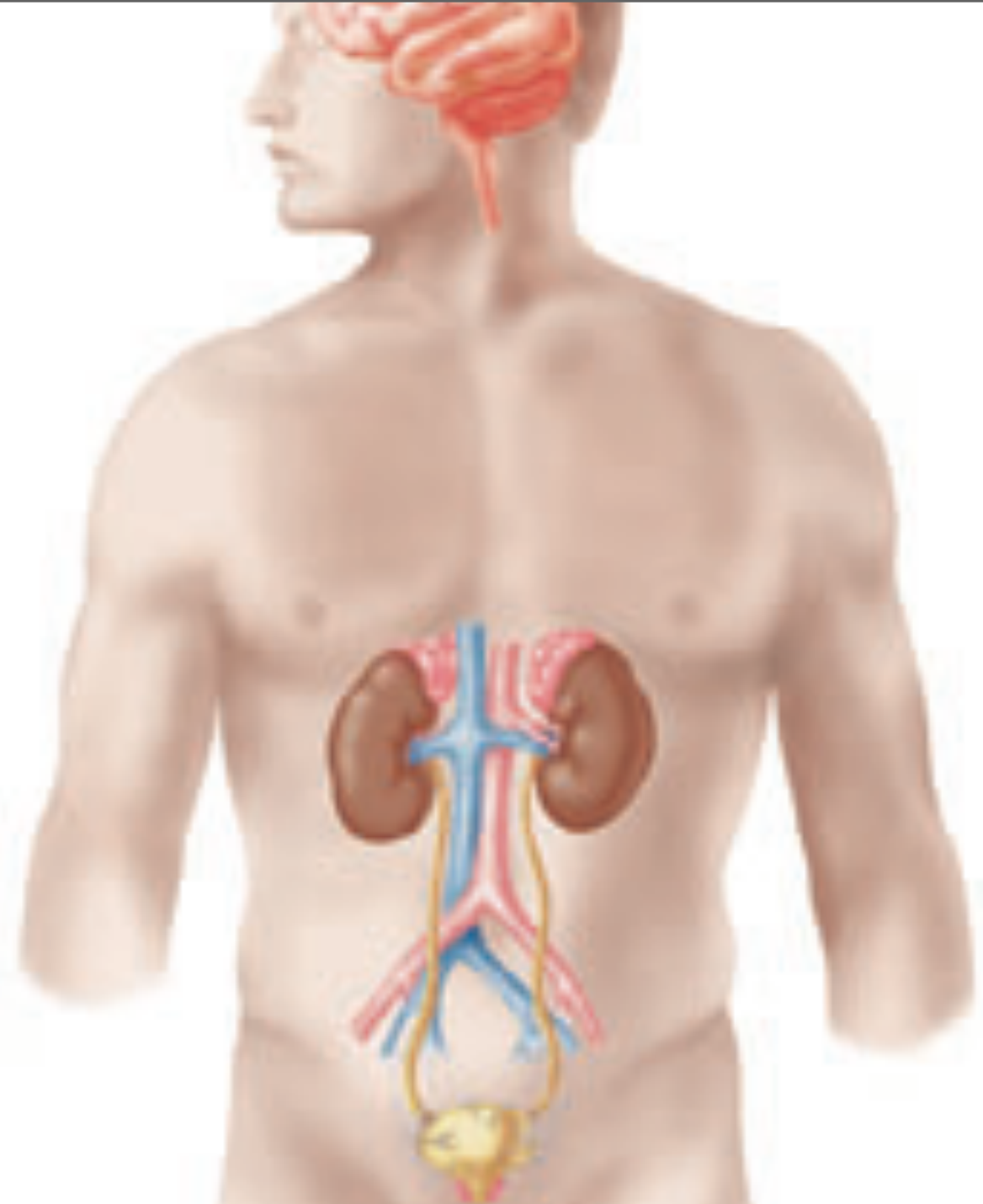
Tenderness

Acute pyelonephritis

Acute glomerulonephritis

Renal or perirenal abscess

Acute hydronephrosis



PERCUSSION OF THE KIDNEYS

- Percussion of the kidneys helps assess pain or tenderness. Assist the patient to a sitting position, and stand behind the patient .
- For in- direct percussion, place the palm of your nondominant hand over the costovertebral angle.
- Strike this area with the ul-nar surface of your dominant hand, curled into a fist
- For direct percussion, also strike the area over the costovertebral angle with the ulnar surface of your dominant hand, curled into a fist.
- Repeat the technique for the other kidney.
- You should do percussion of the kidneys with only enough force so the client feels a gentle thud.
- Percussion is usually done at the end of the assessment.

PERCUSSION OF THE KIDNEYS

Percussion of the kidneys helps assess pain or tenderness. Assist the client to a sitting position, and stand behind the client. For indirect percussion, place the palm of your nondominant hand over the costovertebral angle (see Figure A). Strike this area with the ulnar surface of your dominant hand, curled into a fist (see Figure B). For direct percussion, also strike the area over the costovertebral angle with the ulnar surface of your dominant hand, curled into a fist. Repeat the technique for the other kidney.

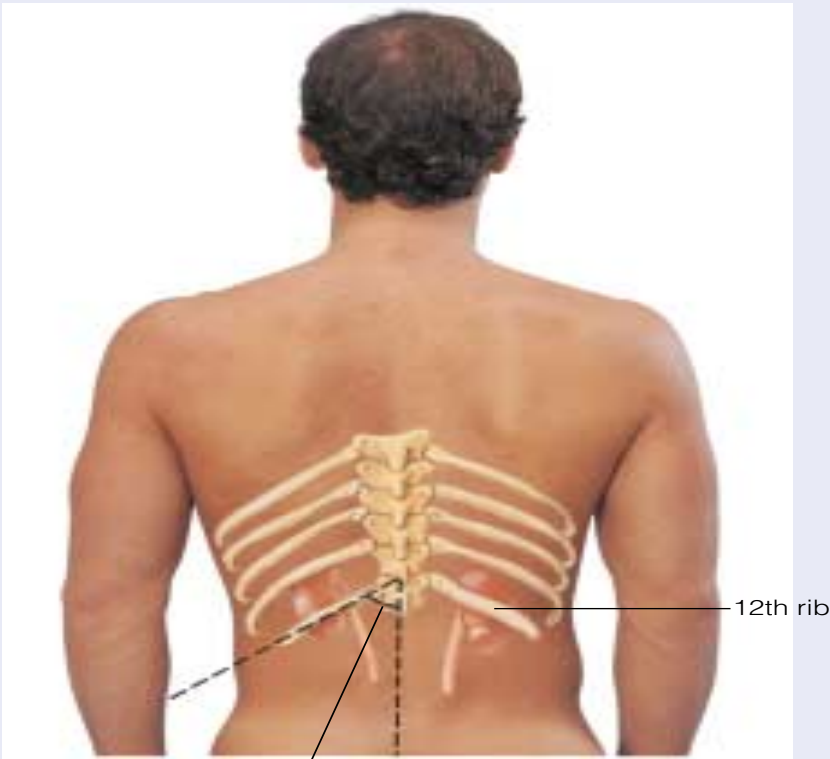
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PALPATION OF THE KIDNEYS

Although the technique of palpation of the kidneys is outlined here, this technique is best performed by an advanced practi-

tioner, because it involves deep palpation. In addition, the kidneys are difficult to palpate.

Assist the client to the supine position and stand at the right side of the client. To palpate the left kidney, reach across the client and place your left hand under the client's left flank with your palm upward. Elevate the left flank with your fingers, displacing the kidney upward. Ask the client to take a deep breath and use the palmer surface of your right hand to palpate the kidney (see Figure C). Repeat the technique for the right kidney.



A Location of the kidneys and the costovertebral angle.



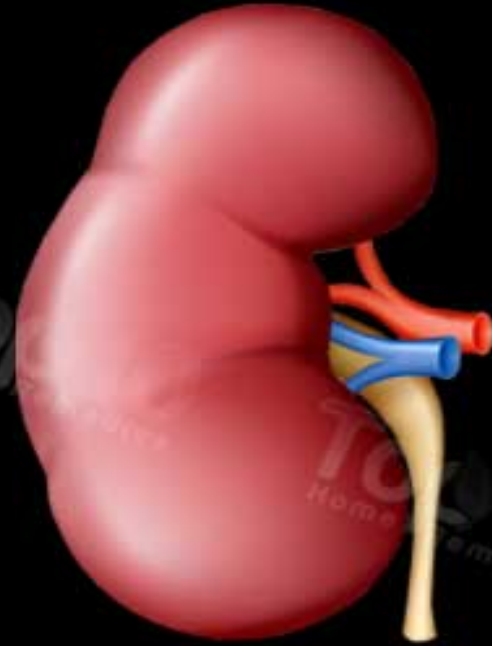
B Percussing the kidney.



C Palpating the left kidney.

Symptoms of Kidney Disease That You Must Know

Severe Fatigue and Weakness



Skin Breakouts and Itching



Ammonia Breath



Nausea or Vomiting



Changes in the Urinary Function

- Getting up at night a few times to urinate.
- Urge to urinate more often but not able to do so when using the restroom.
- Urine that is darker than usual.
- Urine that is foamy or bubbly.
- Urine that contains blood.
- Feeling pressure or having difficulty urinating.
- Pain or a burning sensation during urination.



Unexplained

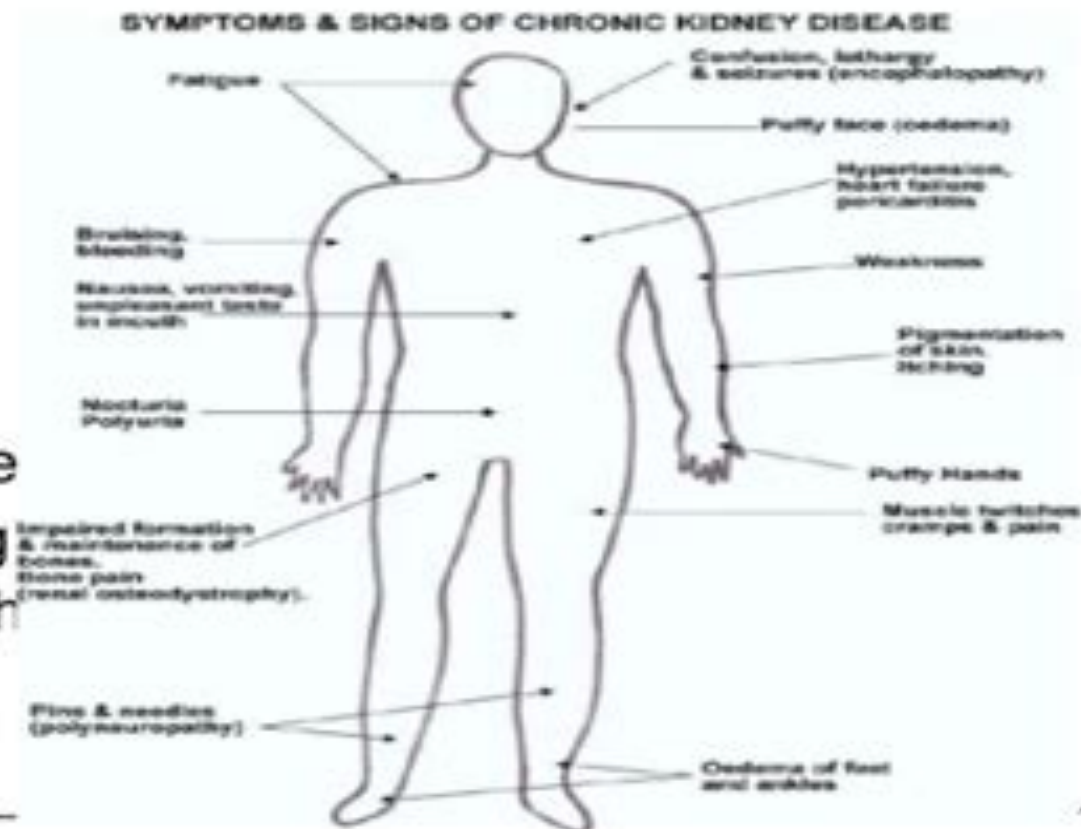
Top10

Causes and symptoms of kidney disease

- An infection ,damage ,tumor or side effect of certain medication can cause kidney disease.

➤ Symptoms

- Fatigue
- Nausea
- Loss of appetite
- Itching
- High blood pressure
- Difficulty in sleeping
- Shortening of breath



Kidney and urinary tract disorders

- Kidney and urinary tract disorders can involve
- one or both kidneys,
- one or both ureters,
- the bladder, or the urethra,
- and in men, the prostate, one or both testes, or the epididymis.

Symptoms of kidney diseases

- Back pain radiating to the abdomen
- Burning on urination
- urgency on urination
- **Nocturia** (Getting up during the night to make urine)
- Foamy or bubbly urine.
- Brown, red, or purple urine
- Haematuria
- Swollen or puffy face

Symptoms of kidney diseases

- Nausea.
- Vomiting.
- Loss of appetite.
- Fatigue and weakness.
- Sleep problems.
- Changes in how much the patient urinate.
- Decreased mental sharpness.
- Muscle twitches and cramps.
- Feeling faint, dizzy, or weak
- Food tastes like metal
- Ammonia breath

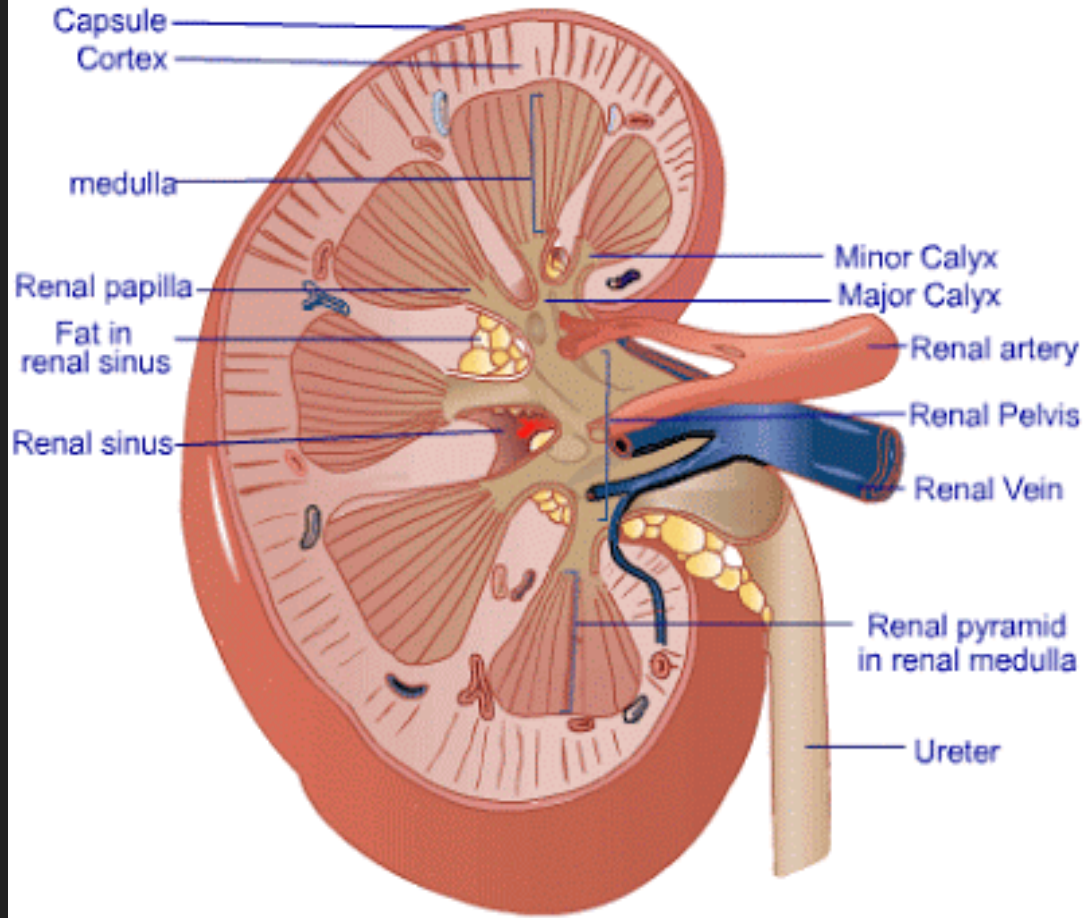
Symptoms of kidney diseases

- Swelling of feet and ankles
- Persistent itching
- Chest pain, if fluid builds up around the lining of the heart
- Shortness of breath, if fluid builds up in the lungs
- High blood pressure (hypertension) that's difficult to control
- Signs and symptoms of kidney disease are often nonspecific, meaning they can also be caused by other illnesses.
- Because the kidneys are highly adaptable and able to compensate for lost function, signs and symptoms may not appear until irreversible damage has occurred.

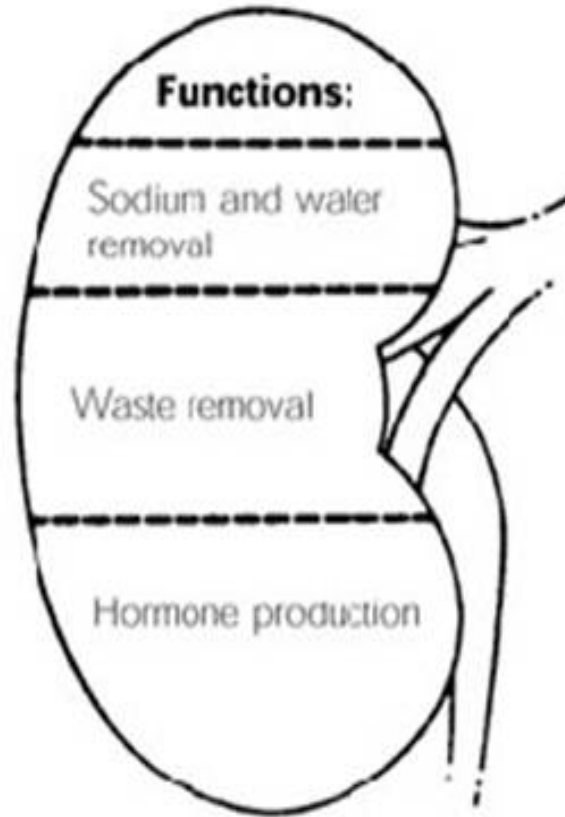
Risk factors for kidney diseases

- Factors that may increase the risk of chronic kidney disease include:
- Diabetes
- High blood pressure
- Heart and blood vessel (cardiovascular) disease
- Smoking
- Obesity
- Being African-American, Native American or Asian-American
- Family history of kidney disease
- Abnormal kidney structure
- Older age

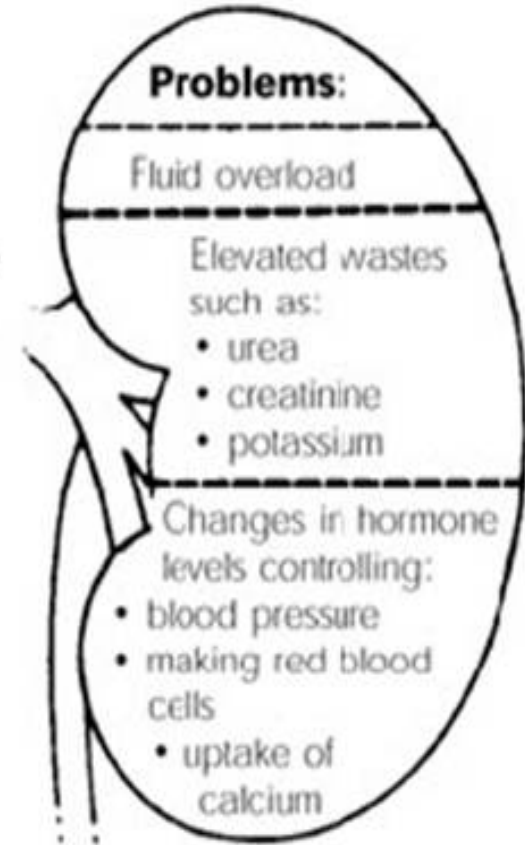
Cut Section of Kidney



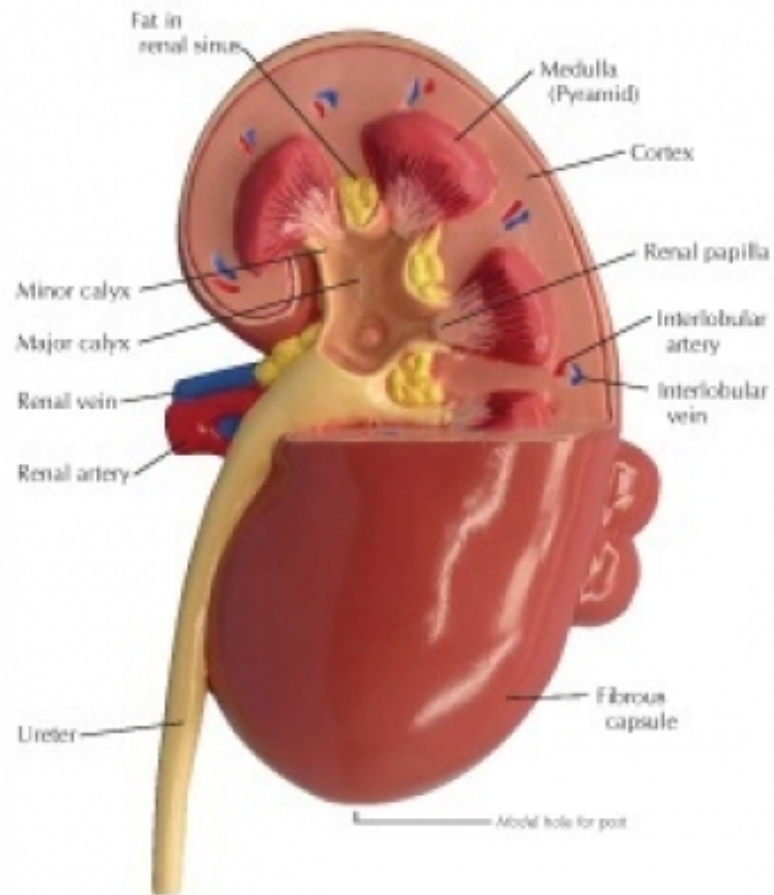
Healthy kidney



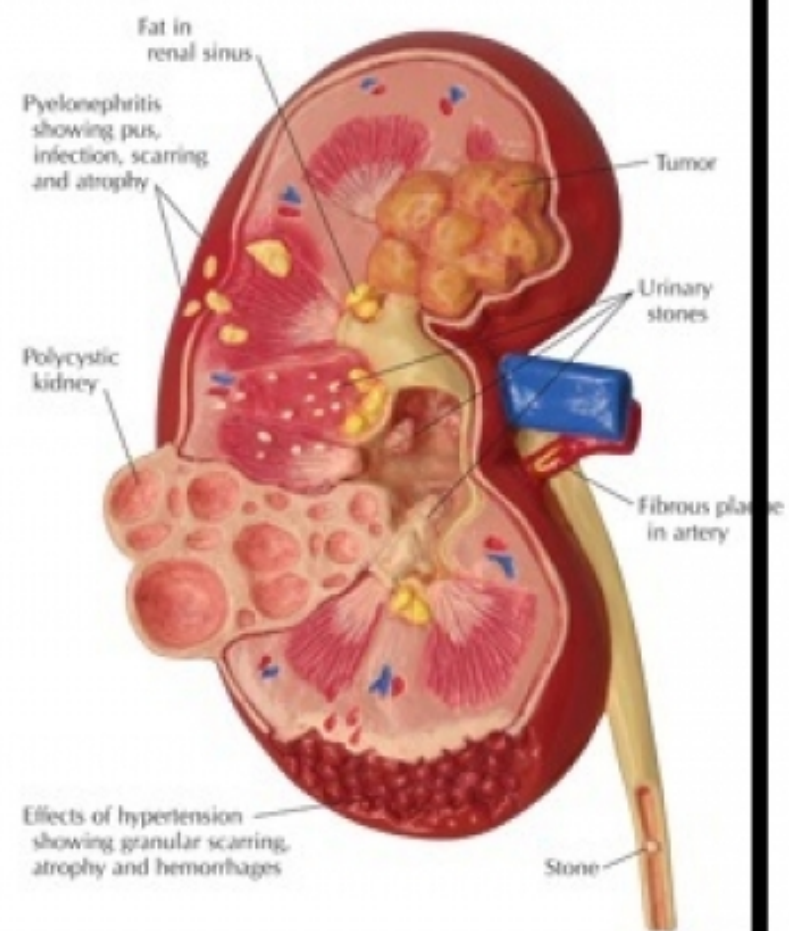
Unhealthy kidney



NORMAL KIDNEY



DISEASED KIDNEY



Chronic kidney disease

- The cause of chronic kidney disease isn't always known.
- But any condition or disease that damages blood vessels or other structures in the kidneys can lead to kidney disease. The most common causes of chronic kidney disease are:
 - Diabetes
 - Arterial Hypertension

Chronic kidney disease

- Diabetes :
- High blood sugar levels caused by diabetes damage blood vessels in the kidneys.
- If the blood sugar level remains high over many years, this damage gradually reduces the function of the kidneys.

Kidney disease

- Hypertension
- Uncontrolled high blood pressure damages blood vessels, which can lead to damage in the kidneys.
- And blood pressure often rises with chronic kidney disease, so high blood pressure may further damage kidney function even when another medical condition initially caused the disease

Kidney disease

- Other conditions that can damage the kidneys and cause chronic kidney disease include:
- Kidney diseases and infections, such as polycystic kidney disease, pyelonephritis, glomerulonephritis, or a kidney problem patients were born with.
- Having a narrowed or blocked renal artery.
- Long-term use of medicines that can damage the kidneys. Examples include nonsteroidal anti-inflammatory drugs (NSAIDs), such as celecoxib and ibuprofen, and certain antibiotics.

Complications

- Chronic kidney disease can affect almost every part of the body. Potential complications may include:
- Fluid retention, which could lead to swelling in arms and legs, high blood pressure, or pulmonary edema
- A sudden rise in potassium levels (hyperkalemia),
- Heart and blood vessel (cardiovascular) disease
- Weak bones and an increased risk of bone fractures
- Anemia

Complications

- **Decreased sex drive, erectile dysfunction or reduced fertility**
- **Damage to central nervous system, which can cause difficulty concentrating, personality changes or seizures**
- **Decreased immune response**
- **Pericarditis, an inflammation of the pericardium**
- **Pregnancy complications that carry risks for the mother and the developing fetus**
- **Irreversible damage to kidneys (end-stage kidney disease), eventually requiring either dialysis or a kidney transplant for survival**

Two Types of Kidney Failure



“ACUTE”

Kidney failure develops within hours or days, includes chance of kidney function recovery

Possible causes, e.g.:

- traumatic (e.g. post surgical)
- acute intoxications
- part of multiorgan failure
- various other diseases (e.g. infections)

“CHRONIC”

Kidney failure develops over years, irreversible at the end

Possible causes, e.g.:

- secondary to high blood pressure and / or diabetes
- chronic bacterial inflammation of the kidneys
- cystic kidneys
- various autoimmune diseases

Table 1. Stages of Chronic Kidney Disease

Stage No.	Stage Description	GFR, mL/ min/1.73 m²
1	Kidney damage with normal or increased GFR	≥90
2	Kidney damage with decreased GFR	60-89
3	Kidney damage with moderately decreased GFR	30-59
4	Kidney damage with severely decreased GFR	15-29
5	Kidney failure	<15 or dialysis

Abbreviation: GFR, glomerular filtration rate.

DIAGNOSTIC EVALUATION

- Urine Examination -routine & -microscopic •
- Evaluation of Renal Function •
- Renal Biopsy
- Imaging

DIAGNOSTIC EVALUATION

- **URINE EXAMINATION** • It is the most important step for the diagnosis of renal disease. •
- **COLLECTION OF SAMPLE** : -the 1st morning specimen is preferred -collected in a clean container -for culture, the specimen should be collected in a sterile container & sent to the lab.
- Immediately, where it should be plated within 15minutes or stored in a refrigerator at 4 degree celsius.
- Bacteria multiply rapidly at room tempt., which may give false positive results.

DIAGNOSTIC EVALUATION

- Method of urine collection •
- Midstream urine : a clean-catch midstream specimen is widely used.
- The initial part of urine is discarded. •
- Bag collection : in neonates & infants, urine can be collected in sterile bags. Not used for microscopic exam.

DIAGNOSTIC EVALUATION

- URINE ROUTINE EXAMINATION:
- SPECIFIC GRAVITY : full term infants have a limited concentrating ability with a maximum sp.gravity of 1.021 – 1.025.It is measured with clinical Hydrometer.
- Increase in sp.gravity may be ass. with dehydration, diarrhea, emesis, excessive sweating etc.
- decrease in sp.gravity may be ass. with renal failure, interstitial nephritis & excessive fluid intake.
- pH : tested with pH meter. Routine lab reports of pH are of no importance.
- Normal pH ranges from 4.6 -8.0.
- In fasting, the concentrated urine sample is highly Acidic .
- UTI with urea splitting organisms make urine highly Alkaline

DIAGNOSTIC EVALUATION

- **PROTEIN : Boiling test : satisfactory but cumbersome.**
- **10-15 ml of urine is taken in a test tube & upper portion is boiled.**
- **If turbidity appears 3 drops of concentrated acetic acid are added & specimen is boiled again.**
- **A zero to +4 grading is used.**

URINE ROUTINE EXAMINATION

- +1 Presence of slight 30-100mg of turbidity,through protein/dl which print can be read
- +2 Turbidity with slight 100-300mg of precipitates protein/dl
- +3 White cloudiness 300-1000mg with fine protein/dl precipitate,through which black lines are not visible
- +4 Large clumps of >1mg of protein/dl white precipitates

URINE ROUTINE EXAMINATION

- Dipstick methods(e.g uristix) : widely used test for Proteinuria,
- more convenient & equally reliable.
- Colour changes from yellow to green.-light chain proteins & LMW tubular proteins are not detected by this method.
- Trace react. € 5 to 20 mg/dl urinary prtn +1 € 30 mg/dl +2 € 100 mg/dl +3 € 300 mg/dl +4 € > 1000 mg/dl

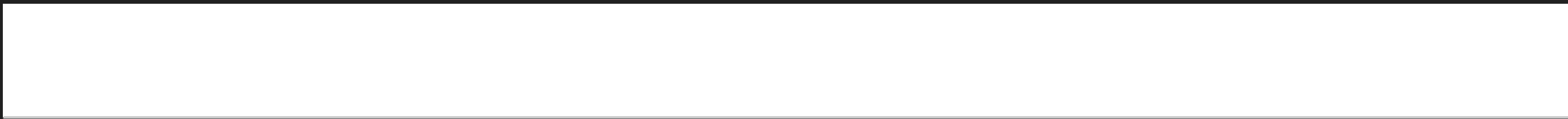
Urinary tract infections

- Urinary tract infections don't always cause signs and symptoms, but when they do they may include:
- A strong, persistent urge to urinate.
- A burning sensation when urinating.
- Passing frequent, small amounts of urine.

Urinary tract infections

- Urine that appears cloudy
- Urine that appears red, bright pink or cola-colored — a sign of blood in the urine
- Strong-smelling urine
- Pelvic pain, in women — especially in the center of the pelvis and around the area of the pubic bone

Each type of UTI may result in more-specific signs and symptoms, depending on which part of the urinary tract is infected.



Kidneys (acute pyelonephritis)

- Upper back and side (flank) pain
- High fever
- Shaking and chills
- Nausea
- Vomiting

Each type of UTI may result in more-specific signs and symptoms, depending on which part of the urinary tract is infected

Bladder (cystitis)

- Pelvic pressure
- Lower abdomen discomfort
- Frequent, painful urination
- Blood in urine

Urethra (urethritis)

- Burning with urination
- Discharge

Tests and procedures

- Tests and procedures used to diagnose urinary tract infections include:
- Analyzing a urine sample - urine sample for lab analysis to look for white blood cells, red blood cells or bacteria.
- Growing urinary tract bacteria in a lab - urine culture.

Tests and procedures

- **Creating images of the urinary tract - ultrasound, a computerized tomography (CT) scan or magnetic resonance imaging (MRI).**
- **Cystoscopy The cystoscope is inserted in the urethra and passed through to the bladder.**