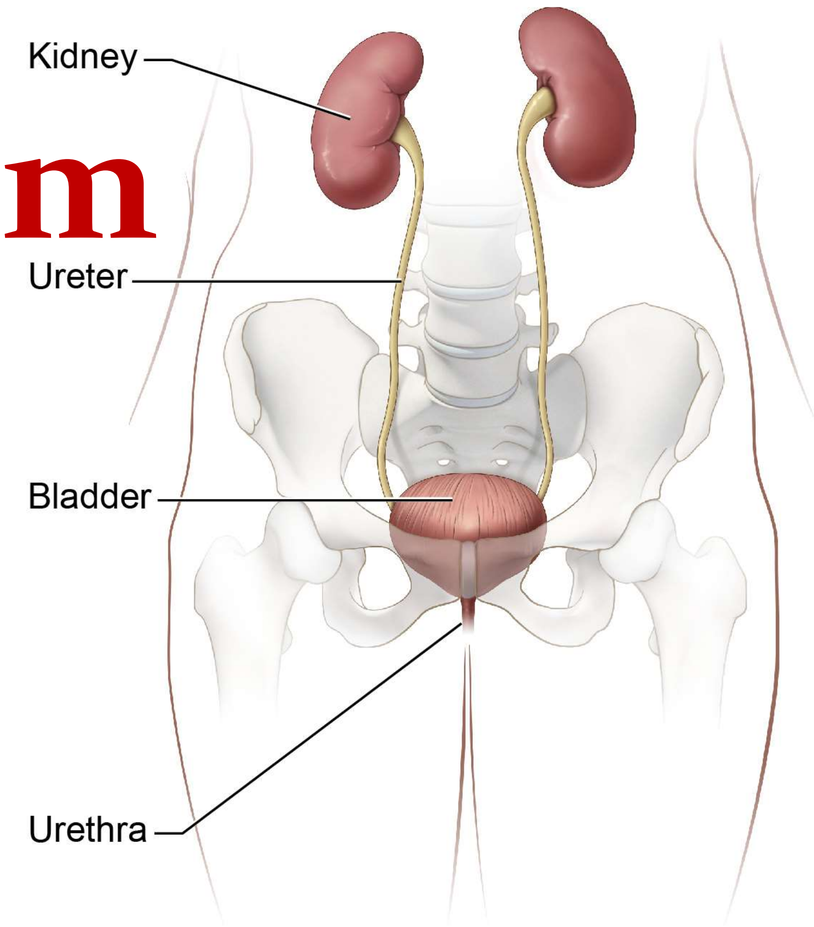
Urinary System



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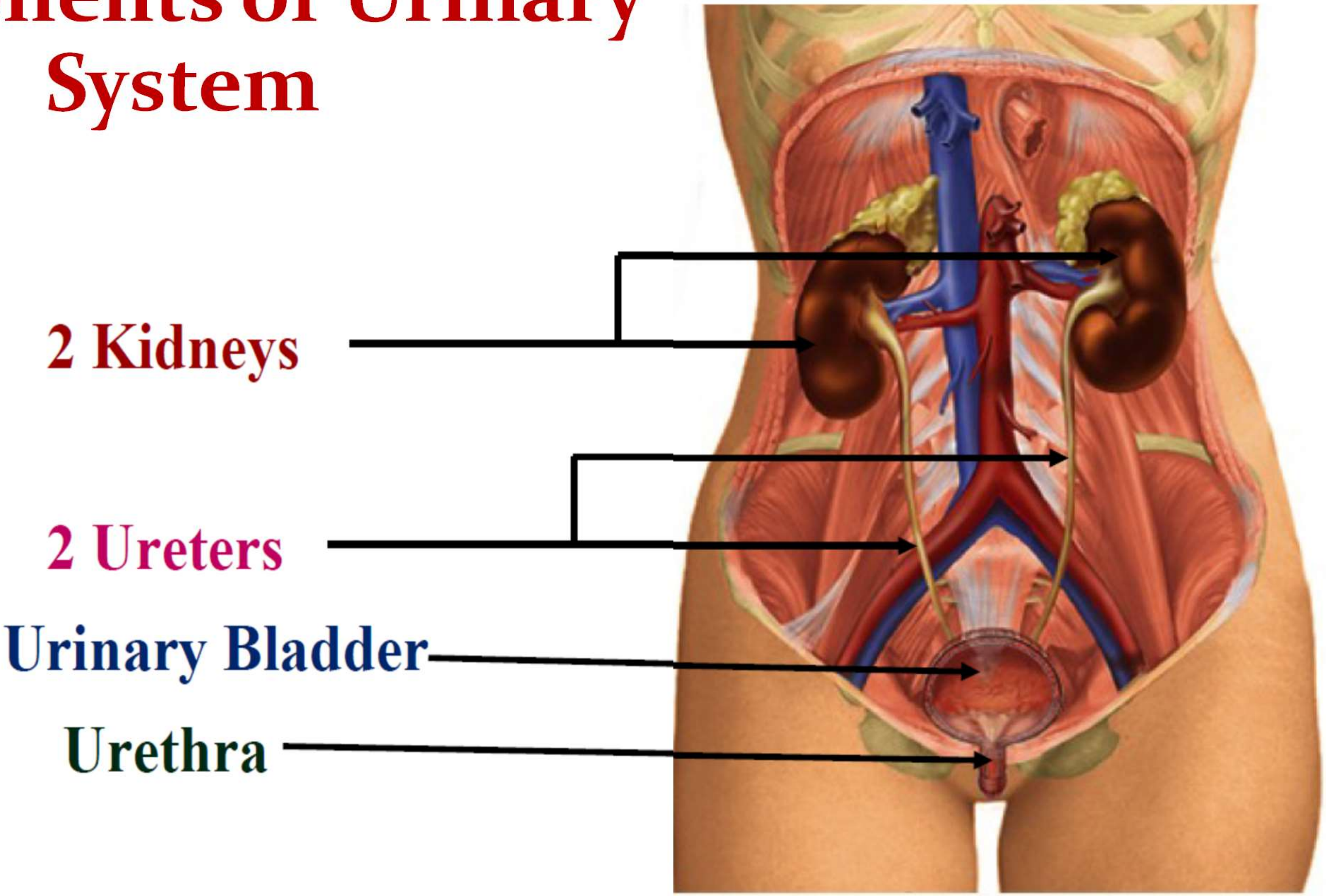
The Urinary System

- Urinary System is one of the four excretory systems in our body. The other three are
- **Bowel** (Digestive), **Lungs** (Respiratory) & **Skin** (Integumentary).
- Urinary system is responsible for the creation, storage and elimination of urine.
- Allows the body to eliminate nitrogenous wastes, such as urea and uric acid.
- Allows the body to adjust its concentrations of salt by producing dilute or concentrated urine.

Components of Urinary System



Function

- **The kidneys** remove waste products of metabolism, excess water and salts from blood and maintain the pH.
- **Ureters** convey urine from the kidneys to the urinary bladder.
- The **urinary bladder** is the muscular reservoir of urine.
- **Urethra** is the channel to the exterior.

Other Parts of Renal System

- **Nephrons –** functional unit of kidney. Each kidney is formed of about one million nephrons.

- **Glomerulus –** filters the blood

- **Bowman's Capsule –** is a large double walled cup. It lies in the renal cortex

- **Tubular Component –** necessary substances are being reabsorbed

- **Loop of Henle –** create a concentration gradient in the medulla of the kidney.

  - reabsorb water and important nutrients in the filtrate.

- **Renal Vein –** a blood vessel that carries deoxygenated blood out of the kidneys

- **Renal Artery –** supply clean, oxygen-rich blood to the kidneys

- **Adrenal Gland (Suprarenal Gland) –** located on top of the kidneys and is essential for balancing salt and water in the body

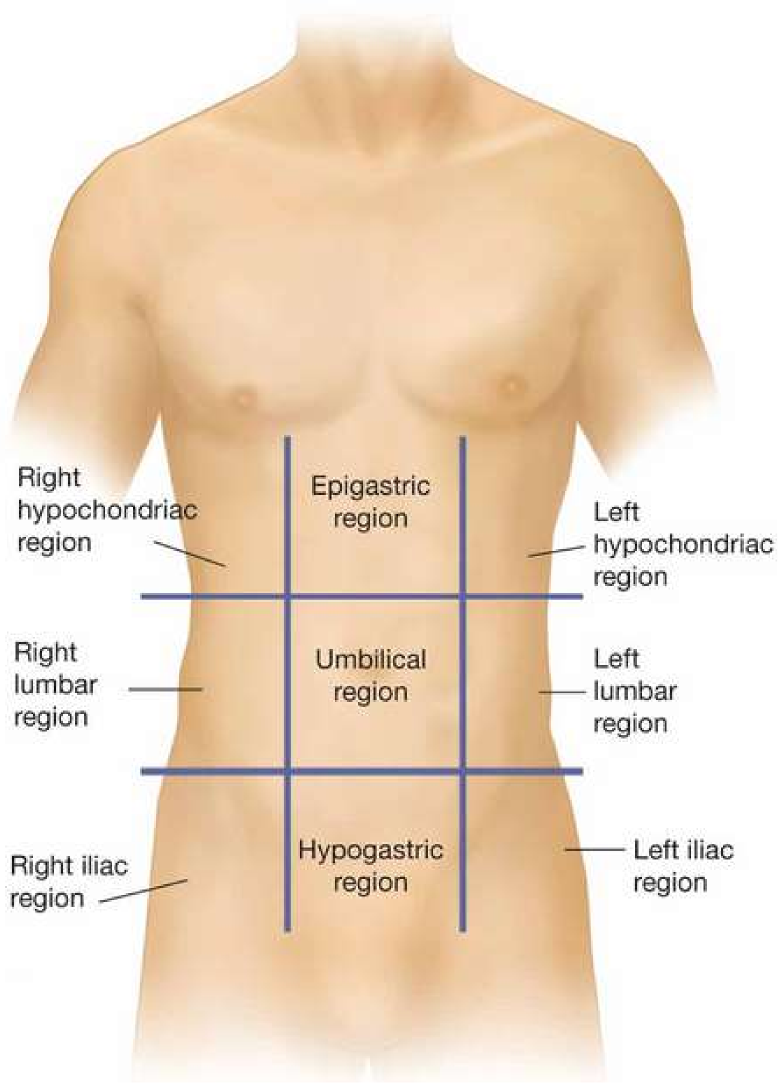
The Kidneys

Definition

- *The kidneys are a pair of excretory organs situated on the posterior abdominal wall, one on each side of the vertebral column, behind the peritoneum.*

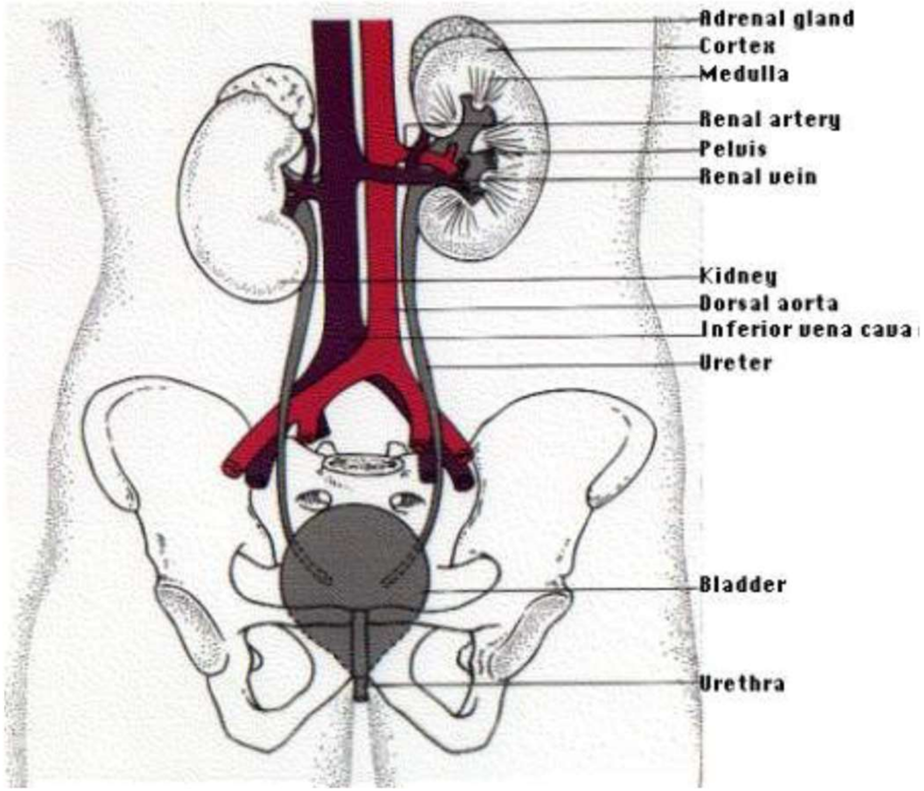
Location

- The kidneys occupies the epigastric , hypochondriac, lumbar & umbilical regions.
- Vertically they extends from upper border of twelfth thoracic vertebra to the center of the body of third lumbar vertebra.
- The right kidney is slightly lower than the left, & the left kidney is little nearer to the median plane than the right.



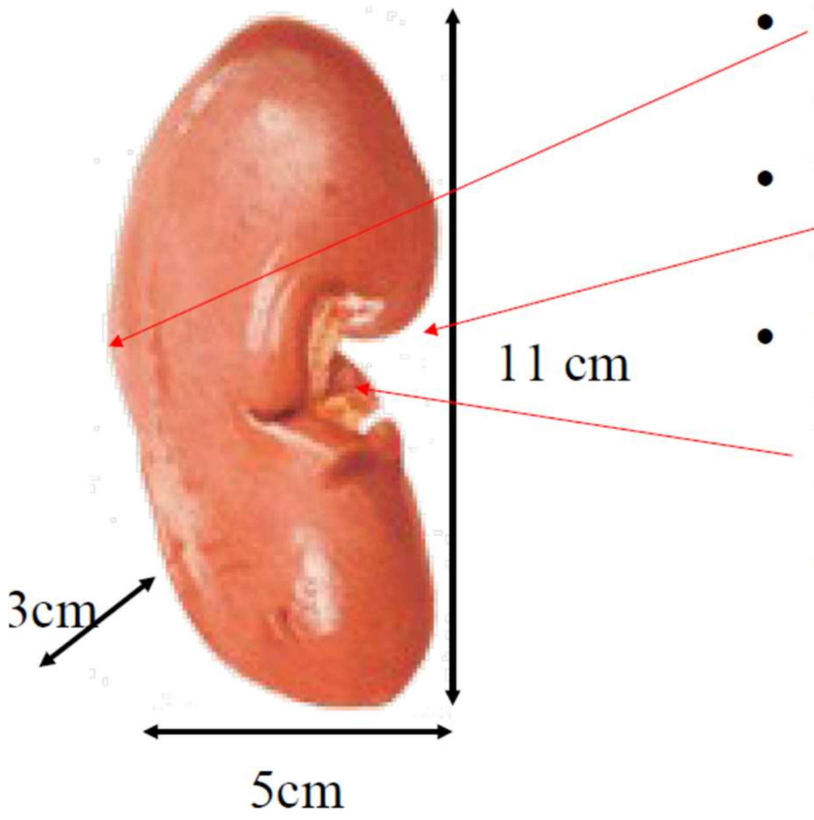
The Kidneys- Surface Anatomy

- **External Features**
  - Each kidney is bean shaped.
  - It has upper & lower poles, medial and lateral borders, and anterior and posterior surfaces.



- The upper pole is broad & is in close contact with the corresponding suprarenal glands.

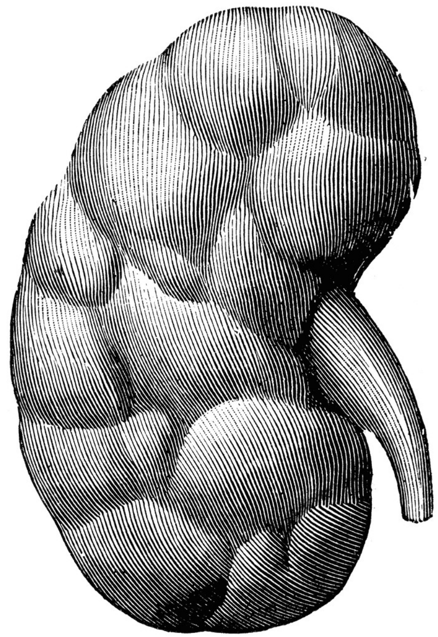
- The lower pole is pointed.



- The lateral border is convex.
- The medial border is concave.
- The middle part of the medial border is depressed and is known as hilum (hilus)

Measurements

- **Colour : Reddish Brown**
- **Length :** About 11 cm long(the left kidney is little longer & narrower than right)
- **Width :** 6cm broad
- **Thickness :** 3cm thick

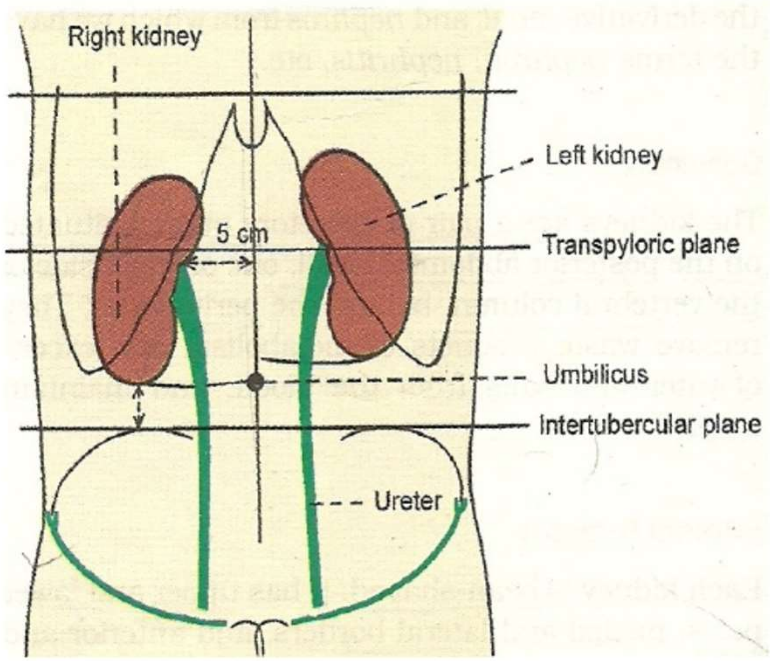


Weight

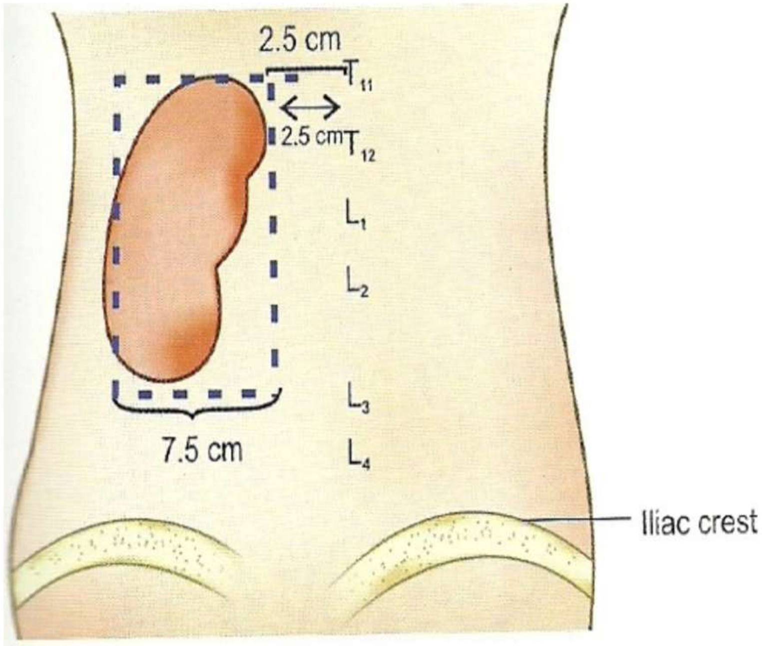
- –Males : 150gm
- – Females : 135gm

(In fetus the kidney is lobulated & is made up of about 12 lobules. After birth the lobules fuse , so that in adults the kidney is uniformly smooth)

Surface Marking- Morris Parallelogram



Anterior aspect



Posterior aspect

Coverings

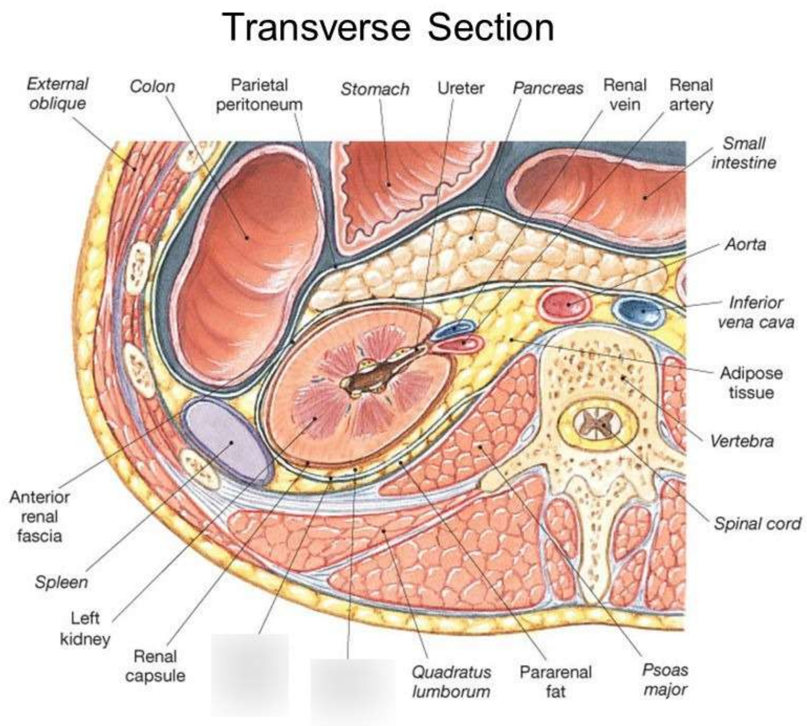
- It has 3 coverings

1. Innermost fibrous capsule or true capsule

2. Middle fatty capsule / perinephric fat-it is a collection of fatty tissue. (It acts as a shock absorber & helps to maintain the kidney in its position)

3. The false capsule – made of renal fascia .It has two layers-***Anterior*** & ***Posterior.***

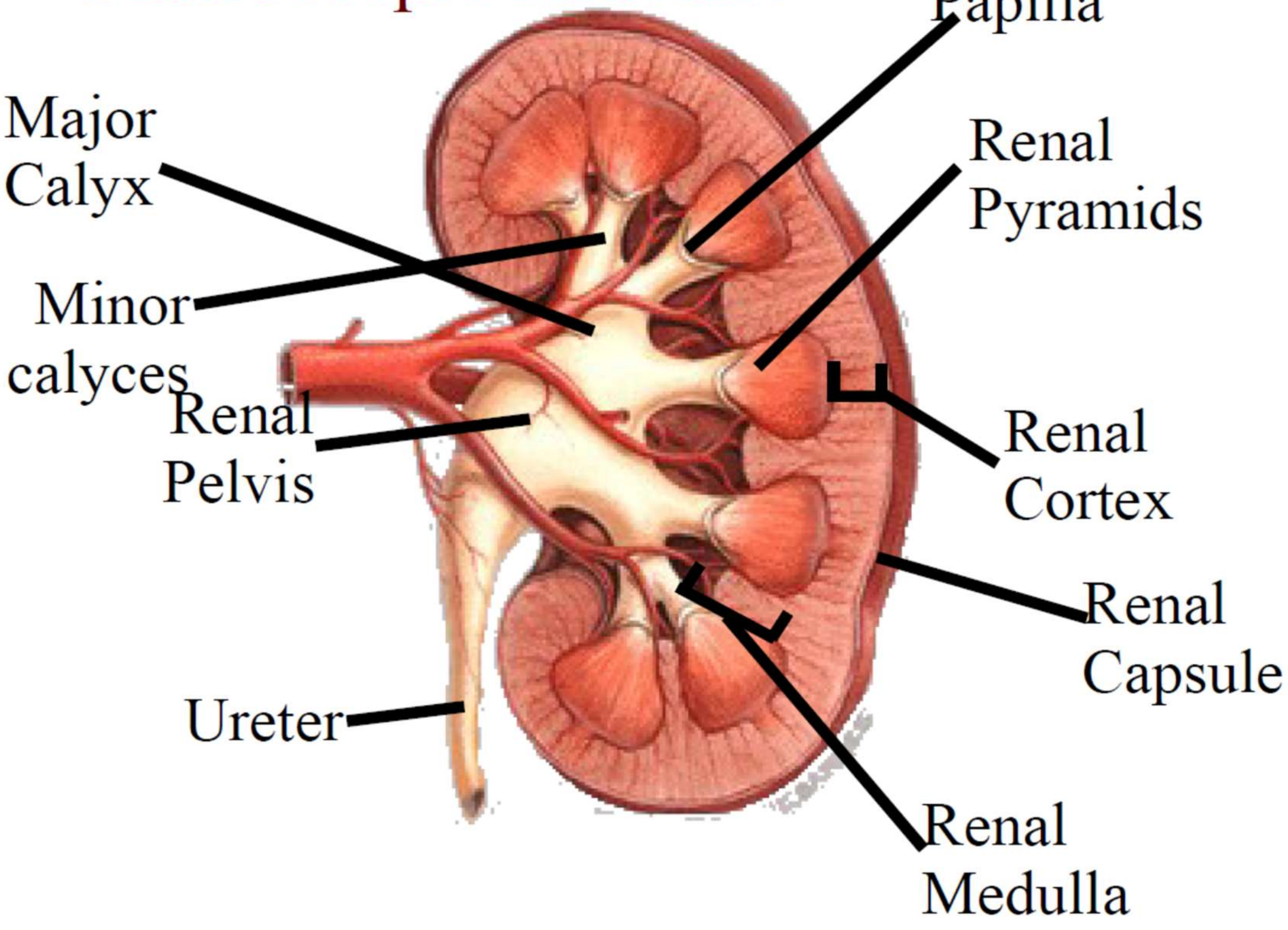
(Superiorly the two layers enclose the supra renal gland & then merge with diaphragmatic fascia, that is why the kidneys move with respiration)



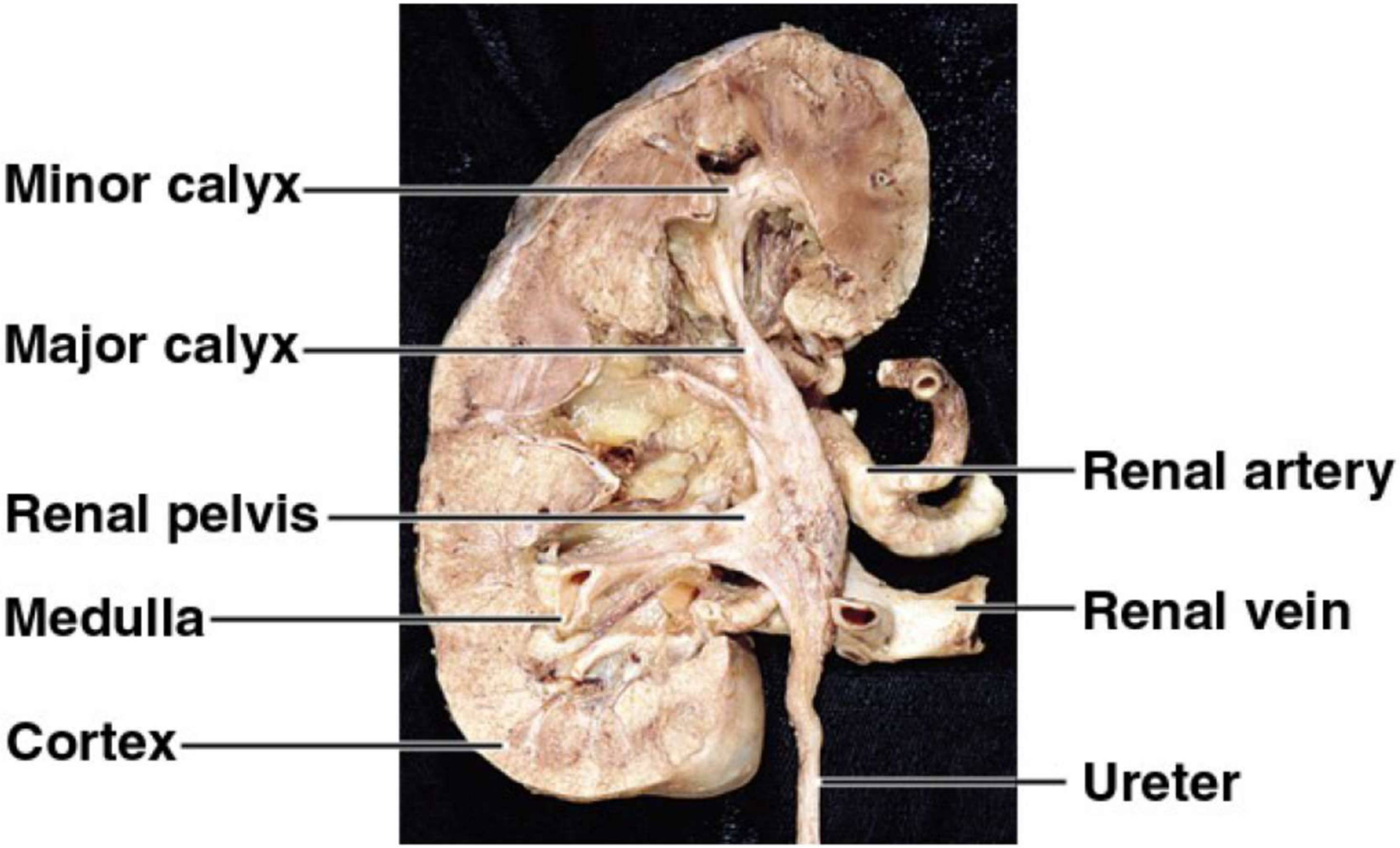
Anatomy of Kidney

Macroscopic Structure

Macroscopic Structure

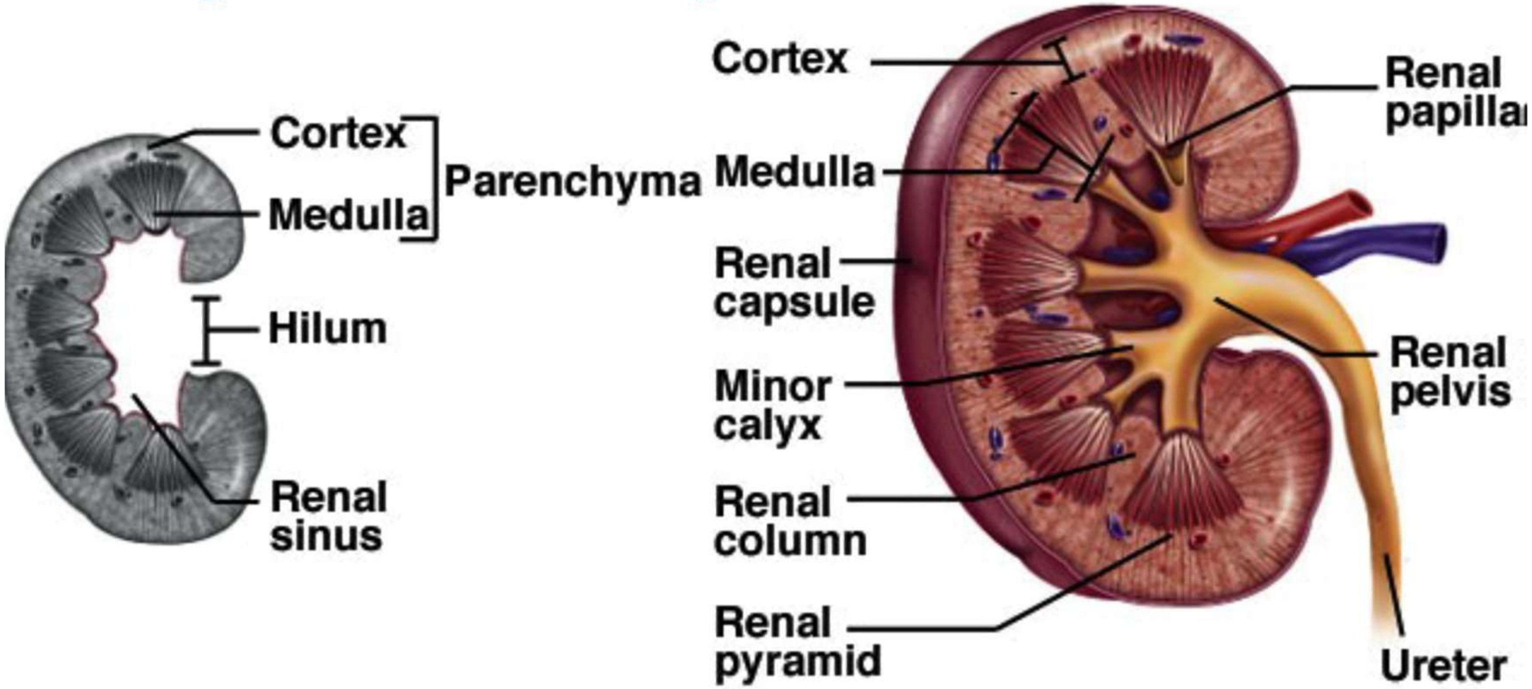


Kidney: Frontal Section



Minor calyx: cup over papilla collects urine

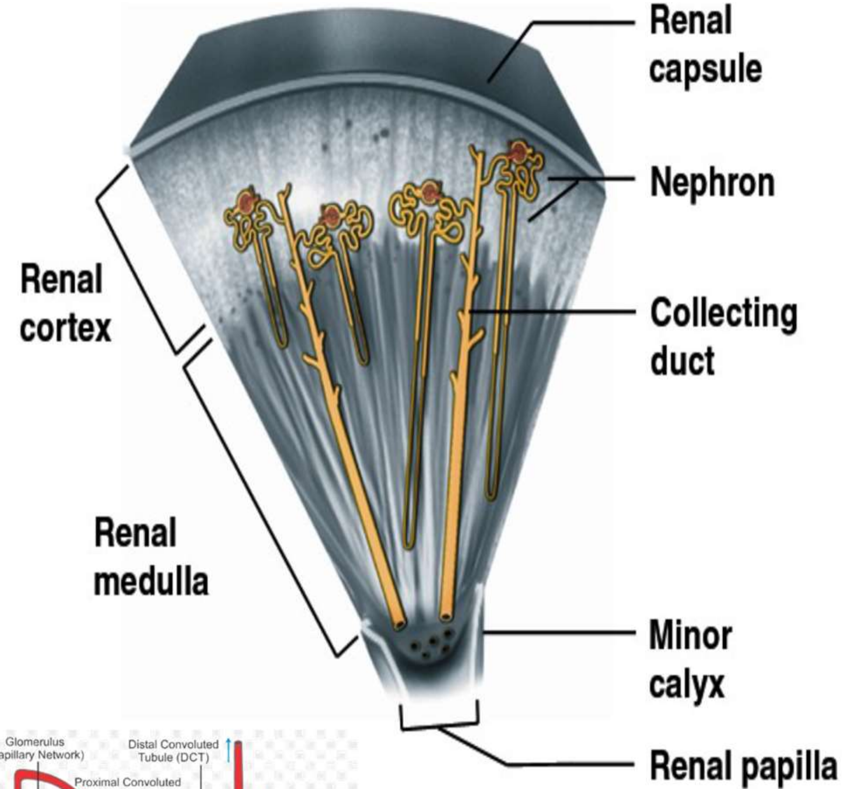
Anatomy of Kidney

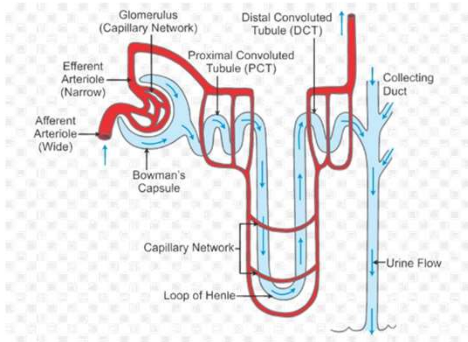


- **Renal cortex:** outer 1 cm
- **Renal medulla:** Composed of renal columns, pyramids - papilla
- **Lobe of kidney:** Composed of pyramid and it's overlying cortex

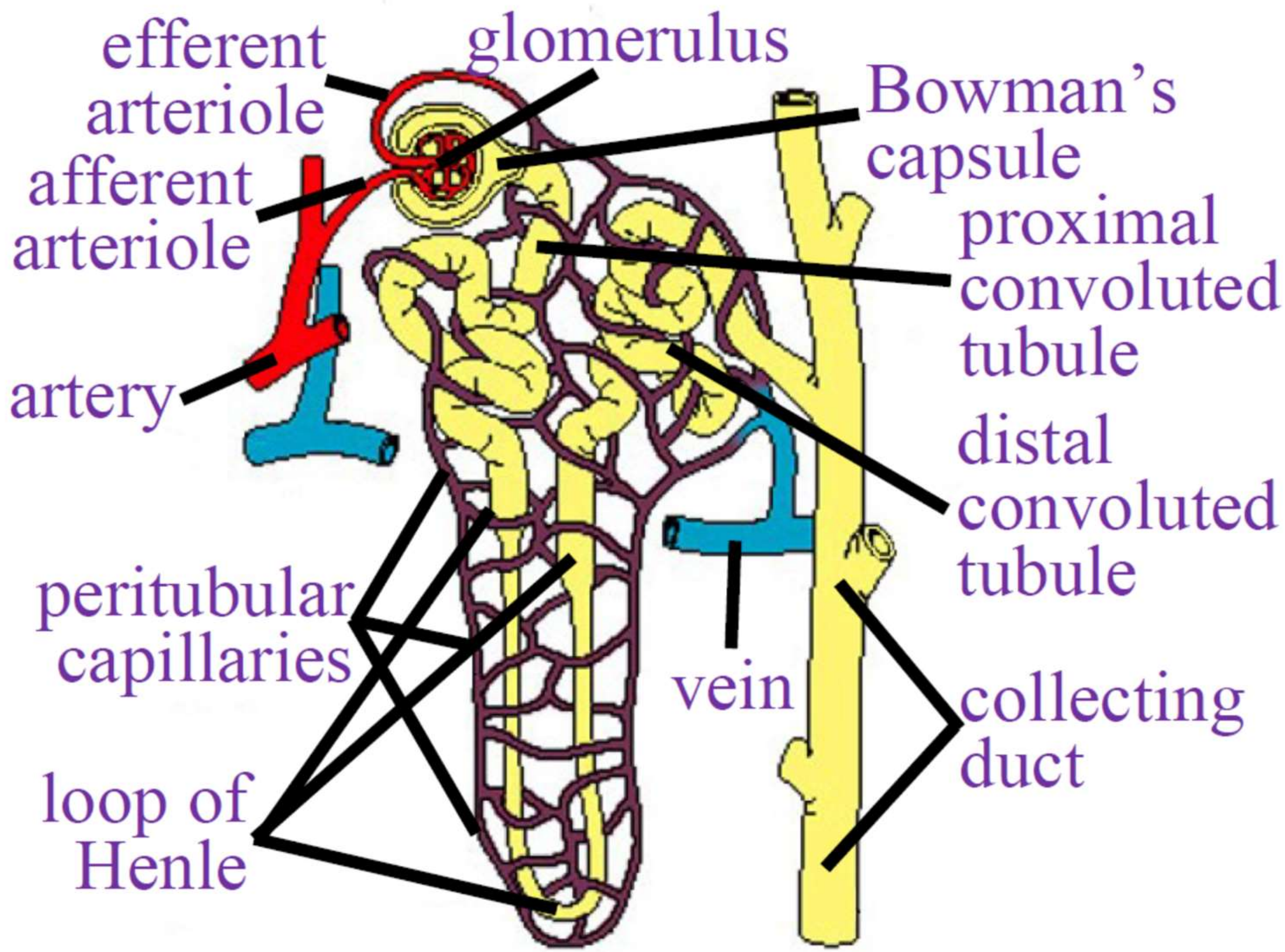
Microscopic Structure(Histology)

- The kidney may be regarded as a collection of millions of uriniferous tubules.
- Each uriniferous tubule consists of an excretory part called ***nephron*** and of a collecting tubule.
- Each kidney contains over 1(1-2 millions) million nephrons and thousands of collecting ducts





Structure of Nephron



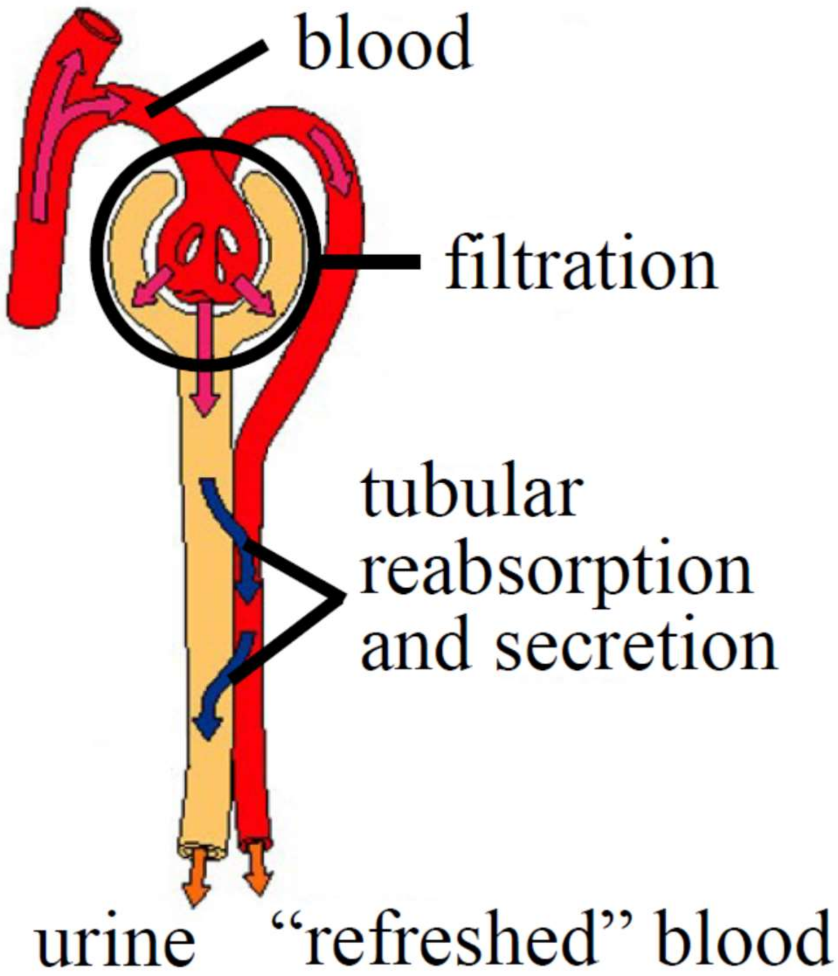
Nephron Functioning

Reabsorption

- Water
- Glucose
- Amino acids
- NaCl

Secretion

- Potassium Ion
- Hydrogen Ion
- Xenobiotics

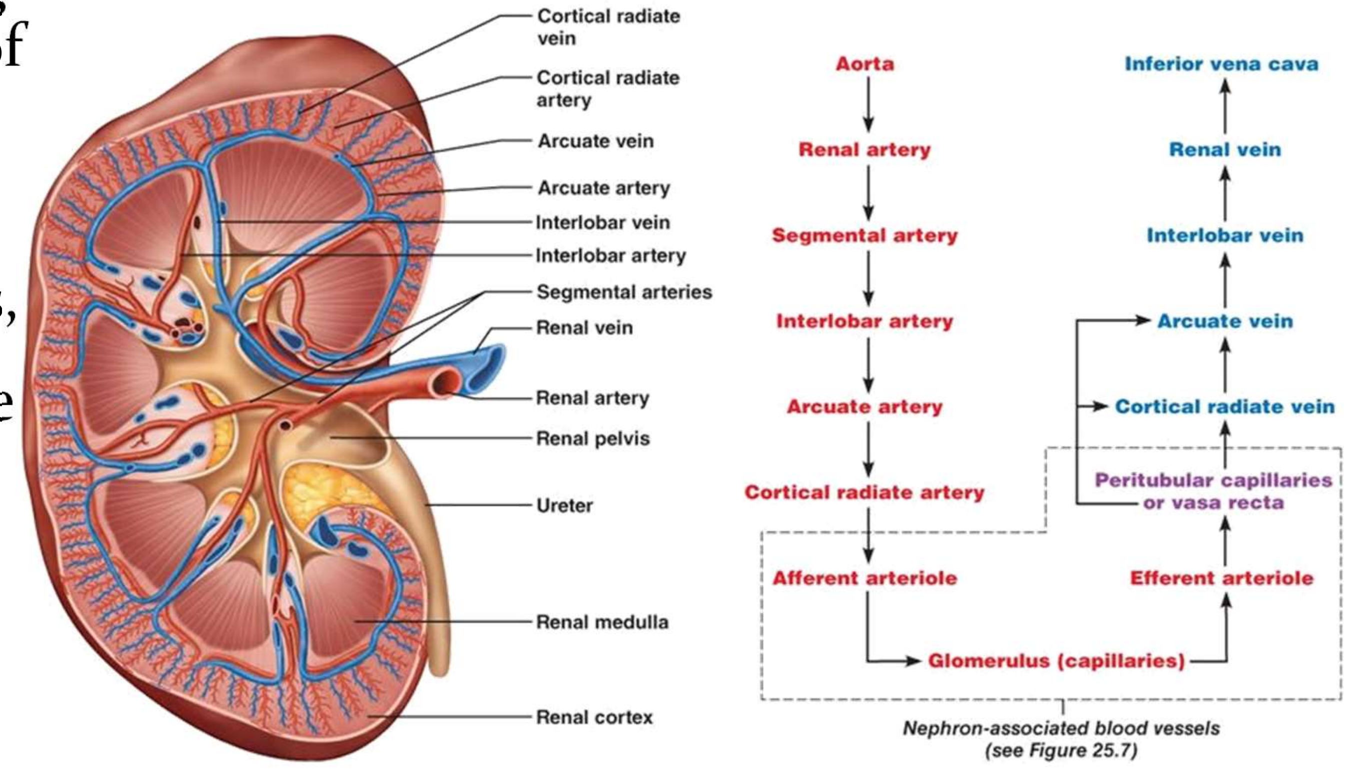


Kidney Functions

1. Filters blood plasma, eliminates waste, returns useful chemicals to blood
2. Regulates blood volume and pressure
3. Regulates osmolarity of body fluids
4. Secretes renin, activates angiotensin, aldosterone – controls BP, electrolyte balance
5. Secretes erythropoietin, controls RBC count
6. Regulates PCO_2 and acid base balance
7. Detoxifies free radicals and drugs
8. Gluconeogenesis

Blood Supply to Kidney

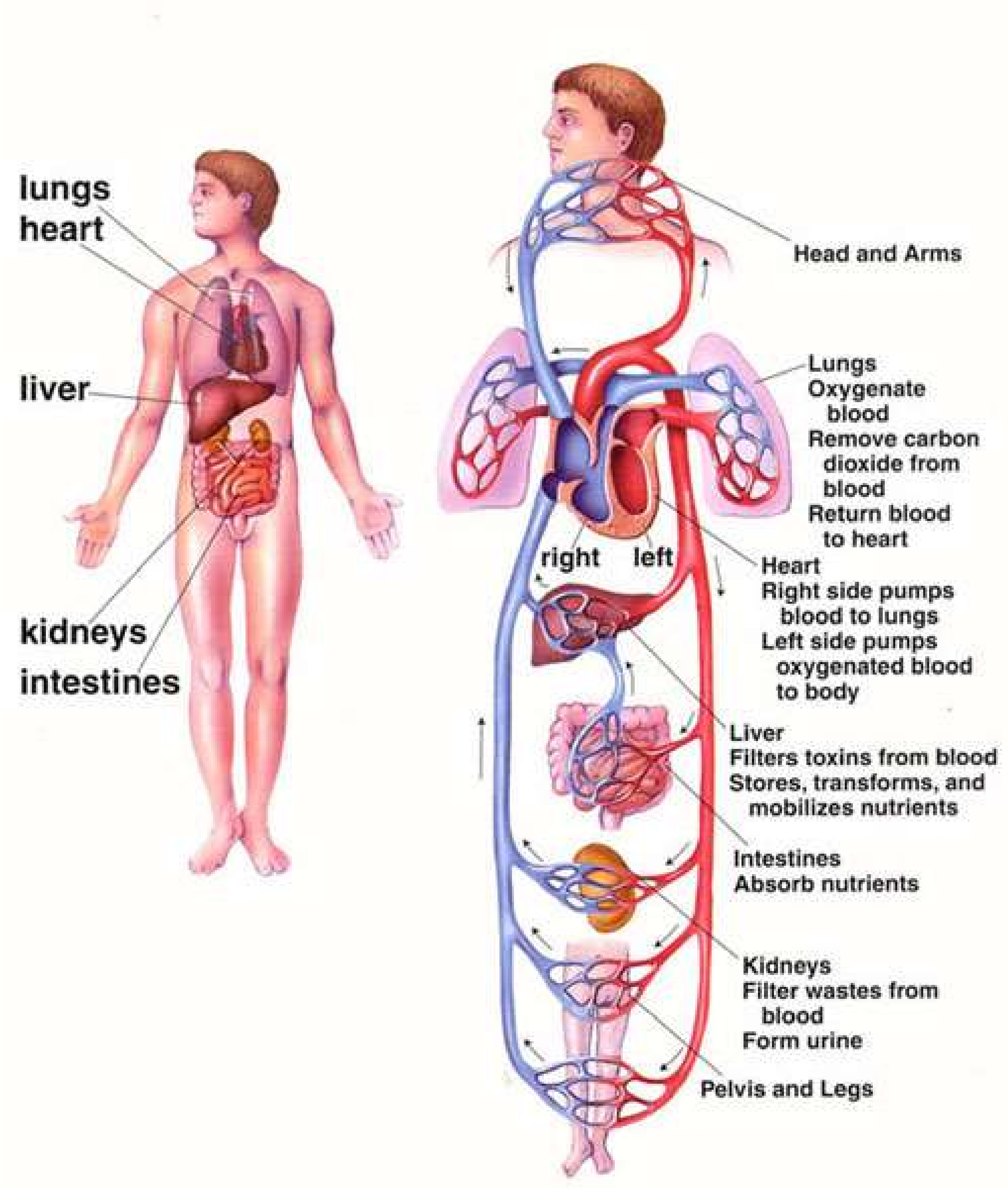
- ***Arterial Supply***: Renal arteries which are the direct branches of abdominal aorta & are large in size.
- ***Venous Drainage:*** Renal veins, ends in inferior vena cava. The left renal vein is longer than the right.
- ***Nerve Supply:*** Sympathetic fibers derived from T10,L1 segments and parasympathetic fibers from vagus nerve.
- ***Lymphatic drainage:*** into lateral aortic nodes.



(a) Frontal section illustrating major blood vessels

(b) Path of blood flow through renal blood vessels

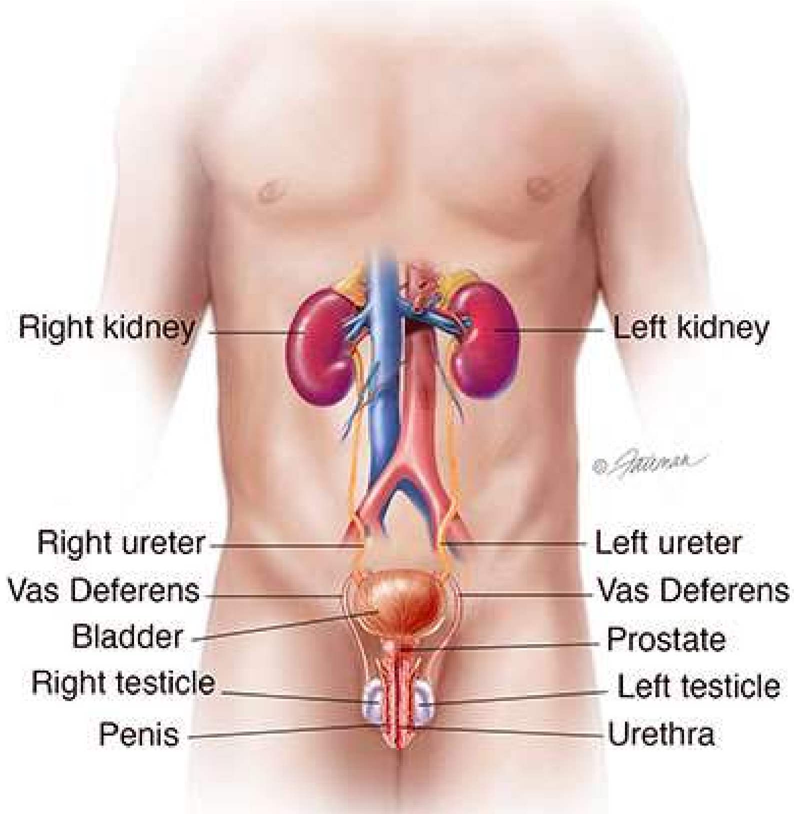
Blood Supply to Kidney



THE URETERS

Definition

- The Ureters are a pair of narrow , thick walled muscular tubes which convey urine from the kidneys to urinary bladder.



Dimensions

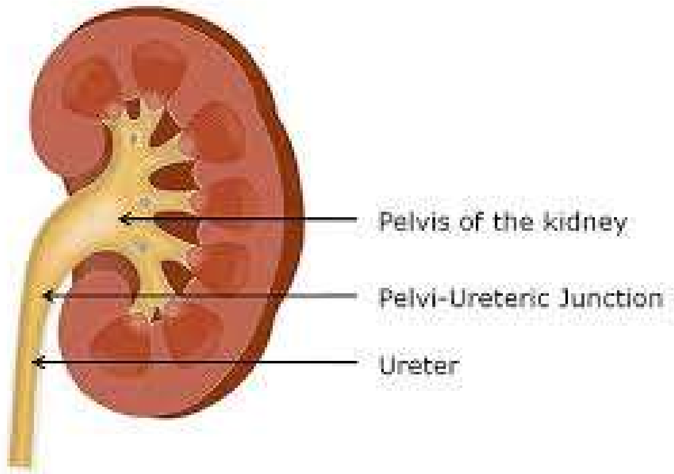
- Each Ureters is about 25cm (10 inch)long.
- The upper half lies in the abdomen and the lower half in the pelvis.

- It measures 3mm diameter, but it slightly constricted at three places.

– At the pelvi-ureteric junction

– At the brim of lesser pelvis

– At its passage through the bladder wall



Parts

- For the purpose of description, ureter is divided into 2 parts
  - From the site of origin to pelvic brim- **abdominal part**
  - From pelvic brim to entry into urinary bladder- **pelvic part**

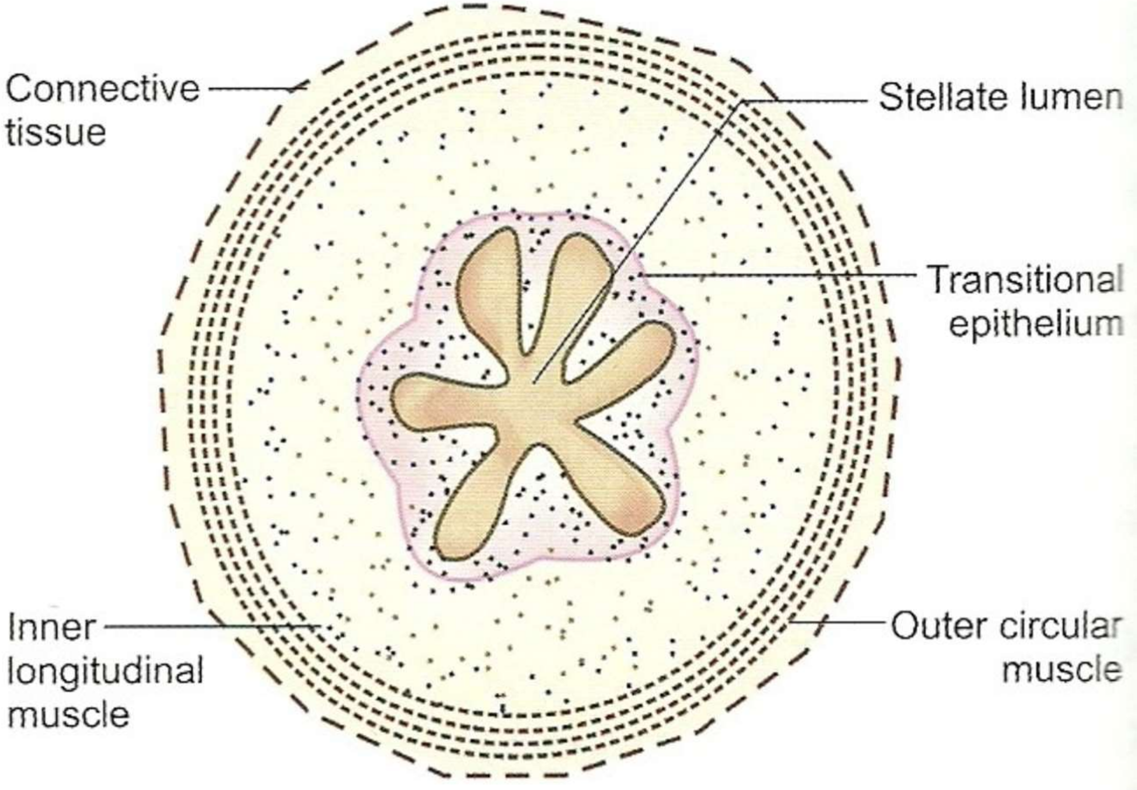
Ureter- Cross Section

- 3 layers of tissue

– Outer layer
  - Fibrous tissue

– Middle layer
  - Muscle

– Inner layer
  - Epithelium



- **Blood Supply**

– Ureter is supplied by branches of

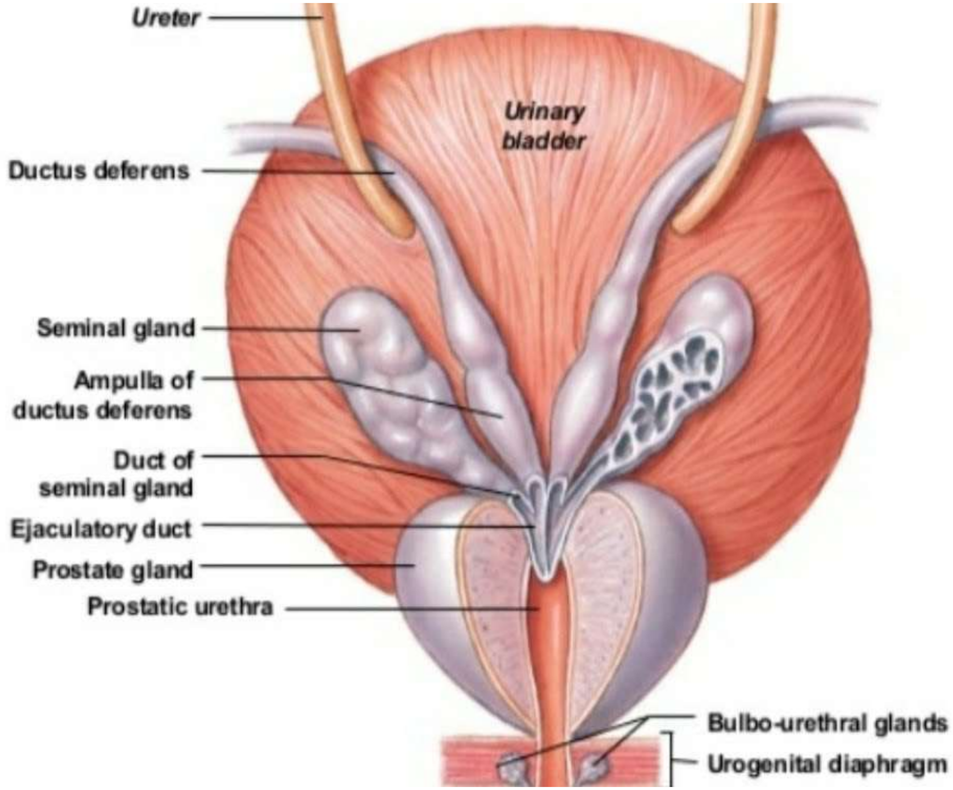
- » Renal artery
- » Abdominal aorta
- » Gonadal artery
- » Common iliac artery
- » Internal iliac artery
- » Inferior vesical artery

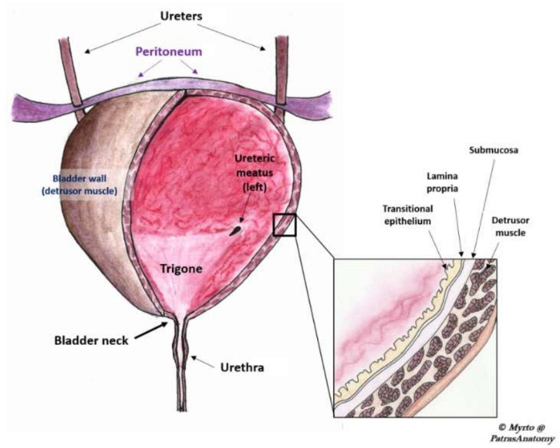
- **Nerve Supply**

– Autonomic nervous system

Urinary Bladder

- The urinary bladder is a hollow , muscular organ, which functions as the reservoir for the urine received from the kidneys and to discharge it out periodically





Position

- Empty bladder , in the adult situated within the pelvis . When distended, it rises up to the abdominal cavity and becomes an abdominopelvic organ.

Capacity

- The mean capacity of the bladder is **220 ml**, filling beyond 220ml causes a desire to micturate. Filling up to **500ml** may be tolerated, but it becomes painful.

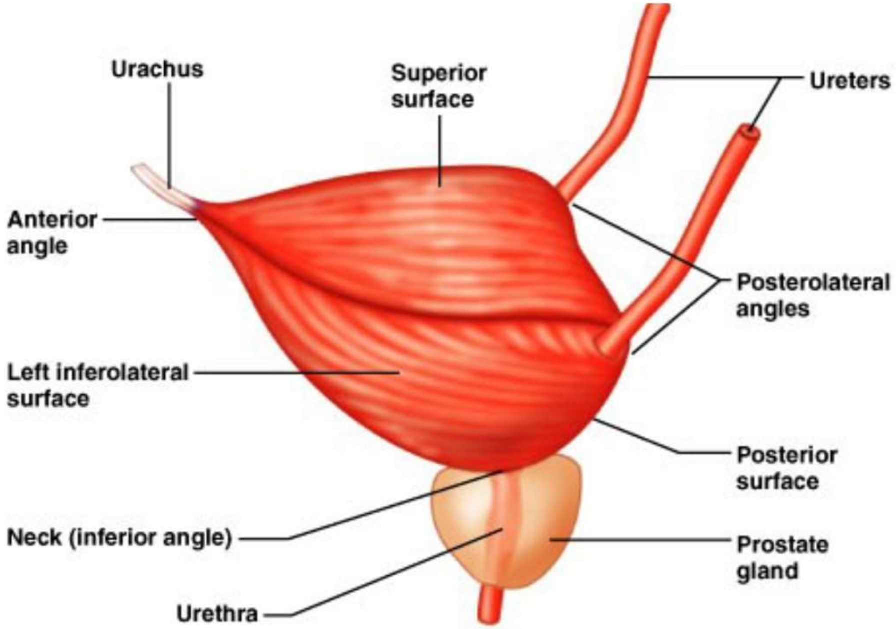
Shape

- An empty bladder is 4 sided pyramid in shape and has
- – 4 angles -an apex, neck & 2 lateral angles
- – 4 surfaces

- Base (posterior surface)

- 2 inferiolateral surfaces

- Superior surface



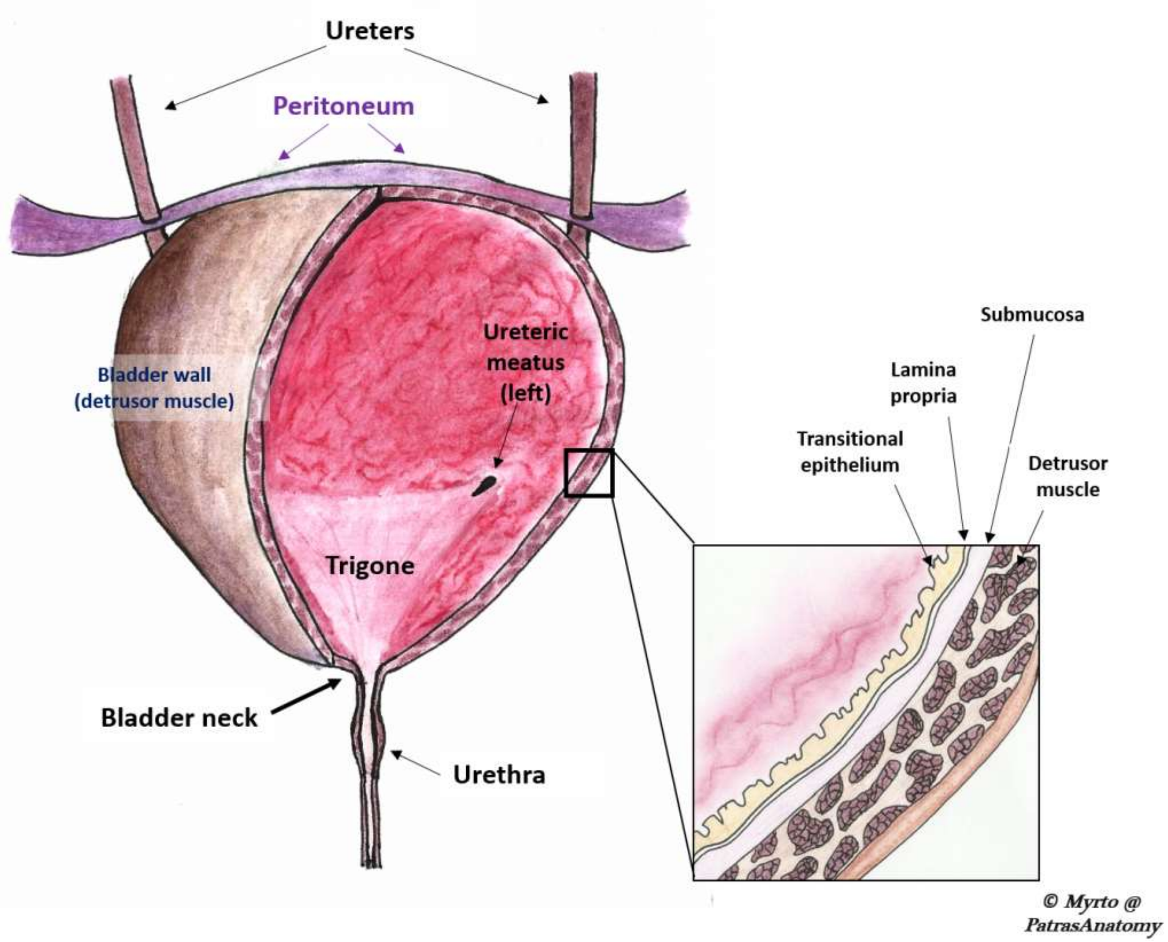
Bladder- structure

3 layers

- – **Outer layer**
- Loose connective tissue

- – **Middle layer**
- Smooth muscle and elastic fibres

- – **Inner layer**
- Lined with transitional epithelium



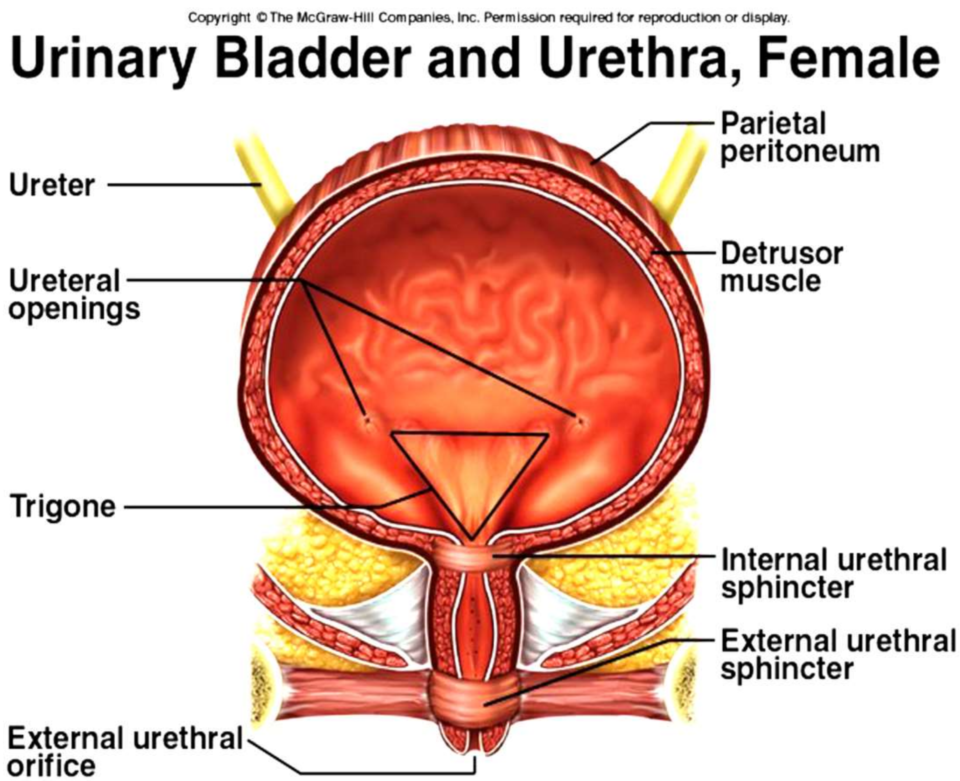
Interior of Bladder

- The mucous membrane is straw colored & is thrown into folds. When bladder is distended, these folds disappear.

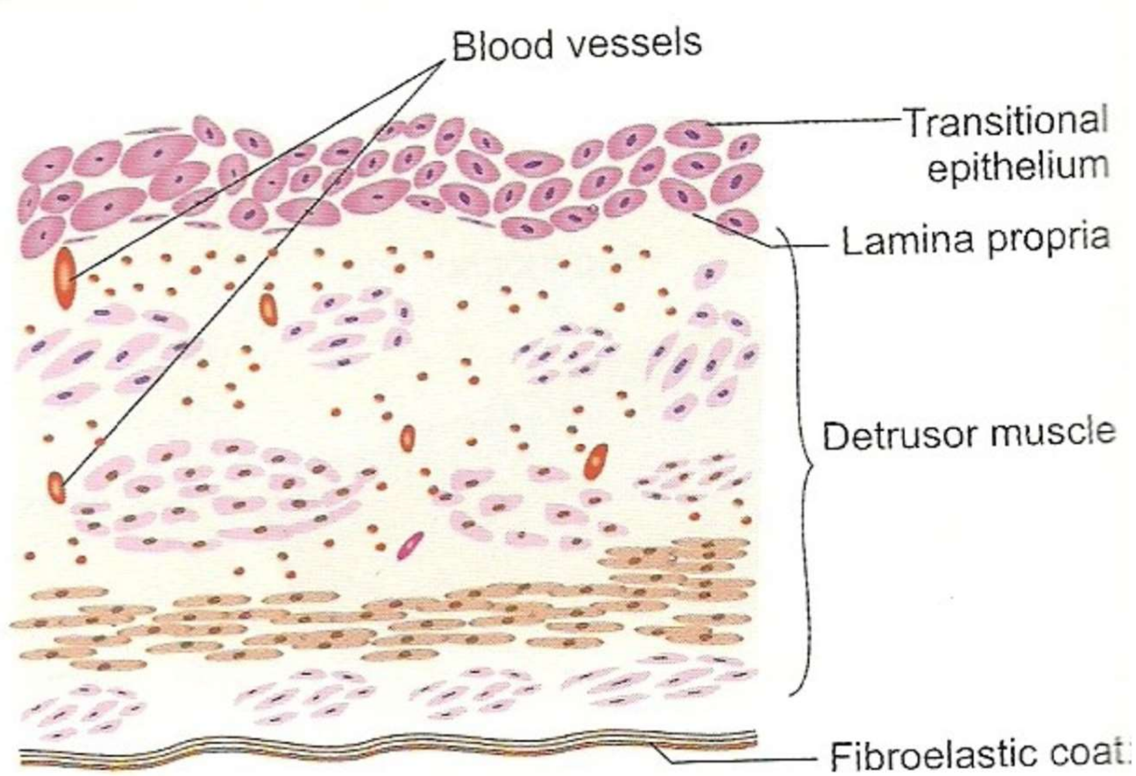
- The posterior wall shows a smooth triangular area called ***trigone***. There are no mucous folds in this region.

- At the upper lateral angles of the trigone are the ureteric openings.

- At its inferior angle is the internal urethral orifice



Histology



Blood vessels
Transitional epithelium
Lamina propria
Detrusor muscle
Fibroelastic coat

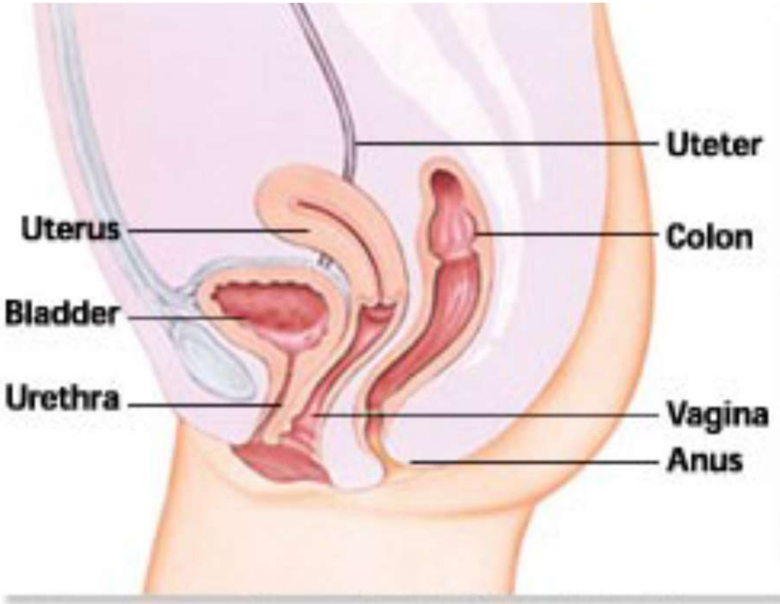
The Urethra

- The urethra is a canal extending from the neck of the bladder to the exterior, at the external urethral orifice.

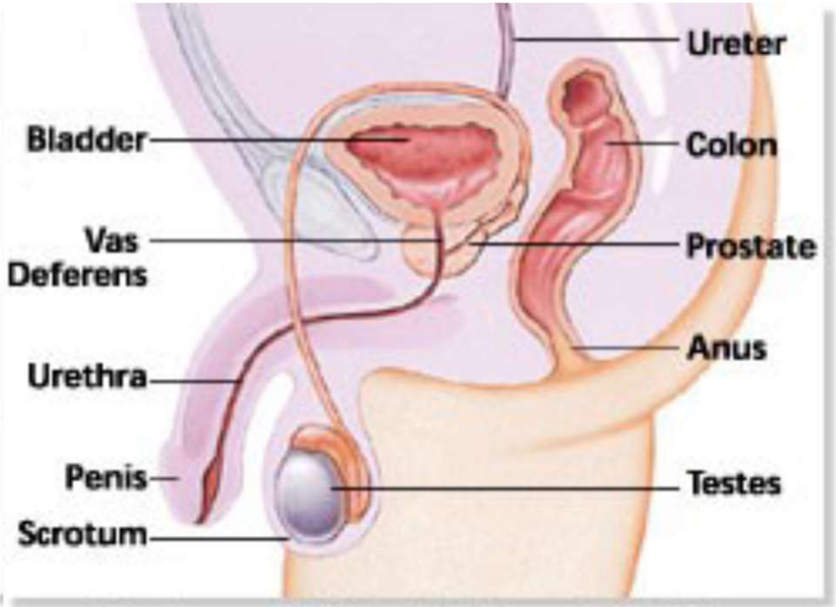
- **Male: about 20 cm (8”) long**

- **Female: 3-4 cm (1.5”) long**

- – Short length is why females have more urinary tract infections than males - ascending bacteria from stool contamination

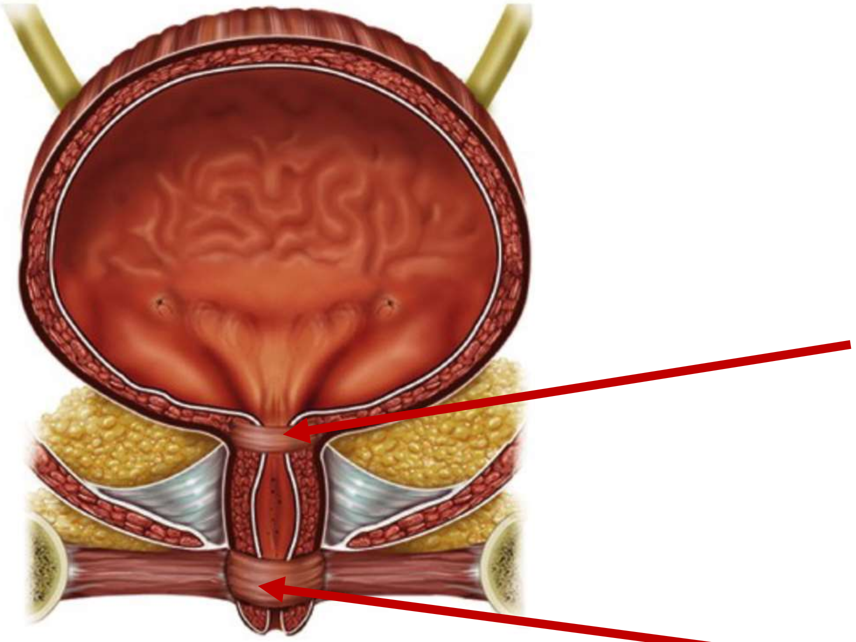


Interior of Female Pelvis - Side View



Interior of Male Pelvis - Side View

Urinary Bladder and Urethra, Female



Female Urethra

- 3 to 4 cm long

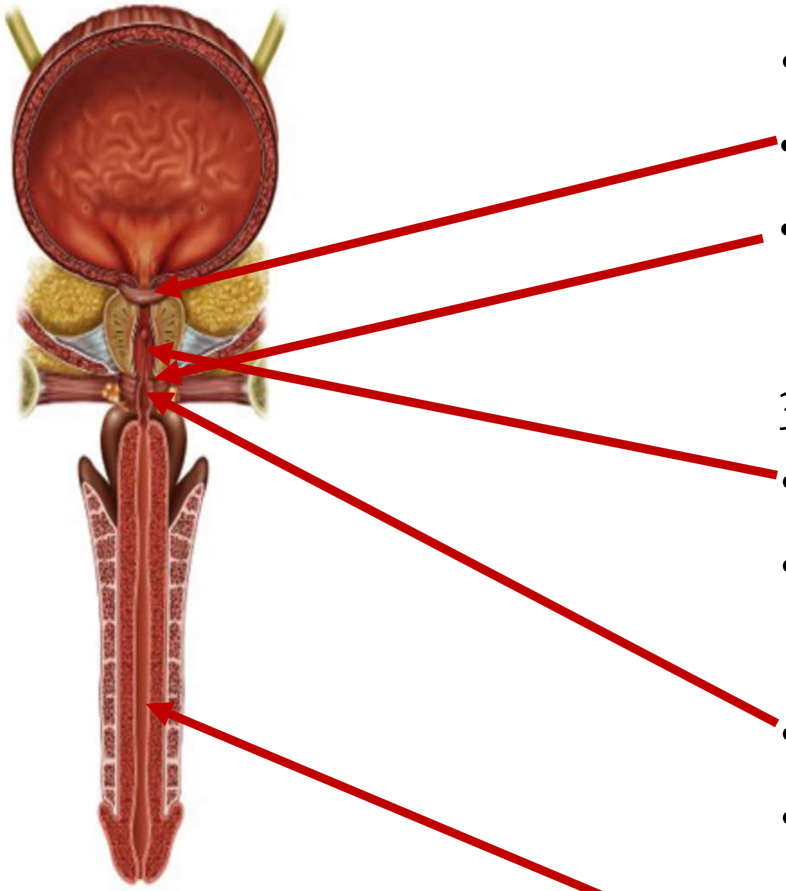
- **External urethral orifice**
- – between vaginal orifice and clitoris

- **Internal urethral sphincter**
- – detrusor muscle thickened, smooth muscle, involuntary control

- **External urethral sphincter**

– skeletal muscle, voluntary control

Urinary Bladder and Urethra, Male



- Male Bladder and Urethra
- 18 cm long
- Internal urethral sphincter
- External urethral sphincter

3 regions

- – prostatic urethra
- during orgasm receives semen
- – membranous urethra
- passes through pelvic cavity
- – penile urethra

Process in Urine Formation

Three processes are there

- Glomerular filtration
- Tubular reabsorption
- Tubular secretion

Glomerular filtration

- Beginning of the process.
- A process by which the blood courses through the glomeruli, much of its fluid, containig both useful chemicals and dissolve waste materials, soaks out the blood through membranes where it is filtered and then flows into Bowman's capsule.

Tubular Reabsorption

- A movement of substances out of the renal tubules back into the blood capillaries located around the tubules (peritubular capillaries).

Tubular Secretion

- disposing of substances not already in the filtrate (drugs)
- eliminating undesirable substances that have been reabsorbed by passive processes (urea and uric acid)
- ridding the body of excess potassium ions
- controlling pH

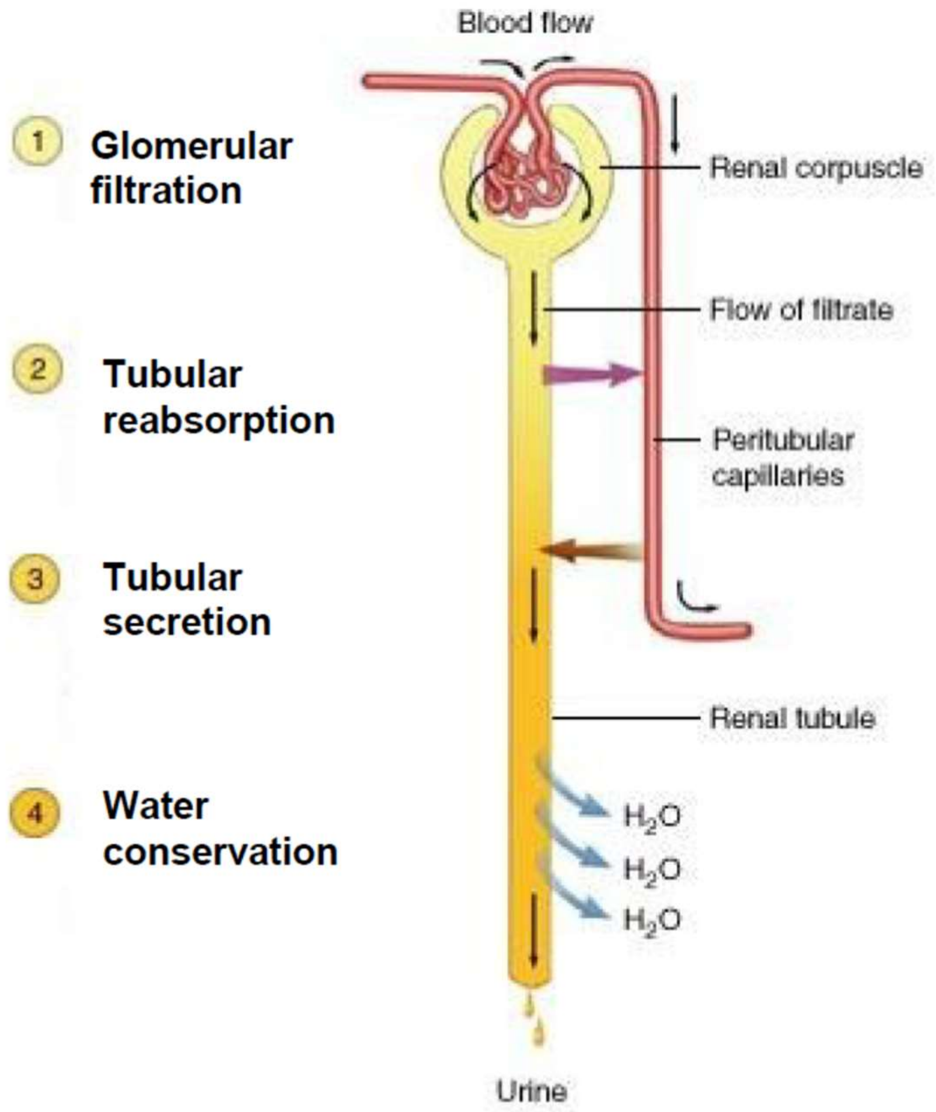
Glomerular Filtration Rate

- is the amount of fluid filtered from the blood into the capsule each minute. Factors governing the filtration rate at the capillary beds are:

1. total surface area available for filtration

2. filtration membrane permeability

3. net filtration pressure


1 Glomerular filtration
2 Tubular reabsorption
3 Tubular secretion
4 Water conservation
Blood flow
Renal corpuscle
Flow of filtrate
Peritubular capillaries
Renal tubule
H_2O
H_2O
H_2O
Urine

PHYSIOLOGY OF MICTURITION

1. FILLING

- The walls of the **ureters** contain **smooth muscle** arranged in spiral, longitudinal, and circular bundles, but distinct layers of muscle are not seen.

- **Regular peristaltic contractions** occurring **one to five times per minute** move the urine from the renal pelvis to the bladder, where it **enters in spurts** synchronous with each peristaltic wave.

- The ureters **pass obliquely** through the bladder wall and, although there are **no ureteral sphincters** as such, the oblique passage tends to keep the **ureters closed except during peristaltic waves**, **preventing reflux** of urine from the bladder.

- **Expected bladder capacity = [30+ (age in yrs x 30)] ml**

2. EMPTYING

- Contraction of the circular muscle, which is called the **detrusor muscle,** is mainly responsible for **emptying the bladder during** micturition.

- Muscle bundles pass on either side of the urethra, and these fibers are sometimes called the **internal urethral sphincter (smooth muscle)** although they **do not encircle the urethra.**

- Farther along the urethra is a sphincter of **skeletal muscle**, the sphincter of the membranous urethra, **external urethral sphincter.**

BLADDER INNERVATION

- Micturition is fundamentally a **spinal reflex** facilitated and inhibited by higher brain centers and, like defecation, subject to **voluntary facilitation and inhibition**

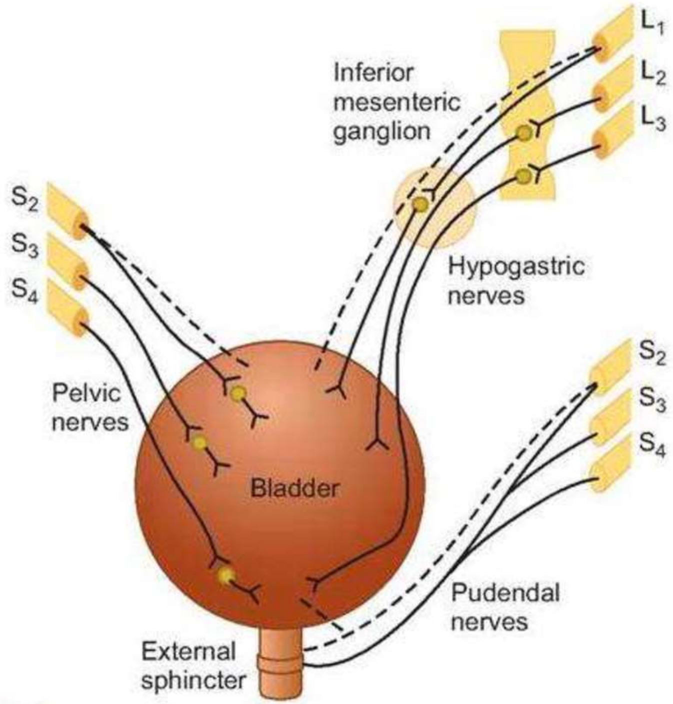
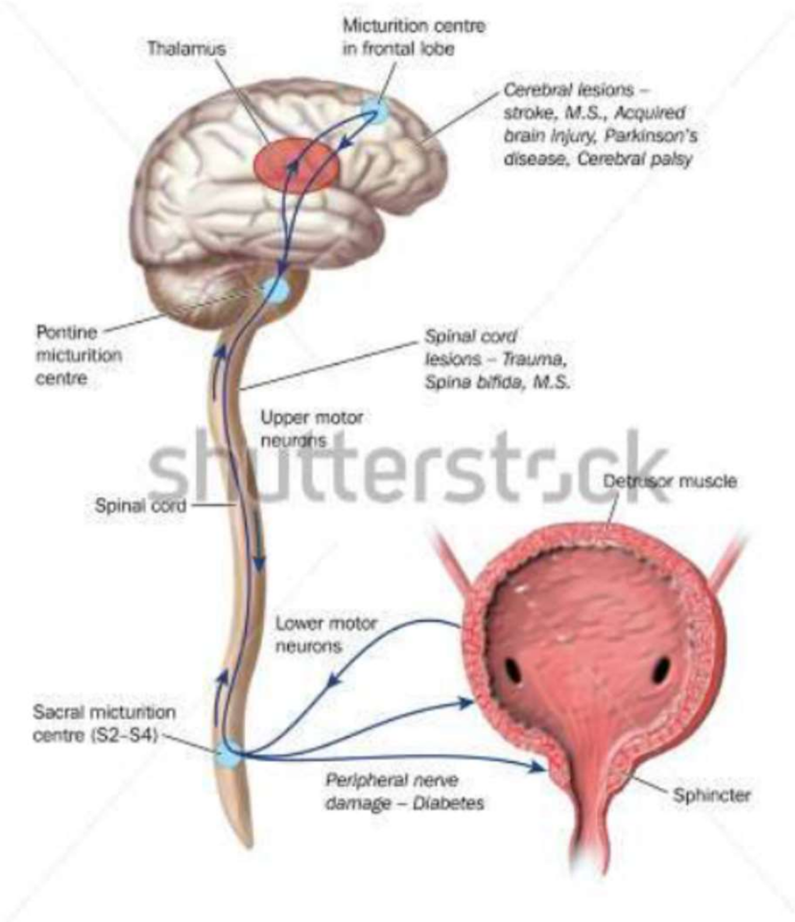


FIGURE 38–20 **Innervation of the bladder.** Dashed lines indicate sensory nerves. Parasympathetic innervation is shown at the left, sympathetic at the upper right, and somatic at the lower right.

NERVE ACTION

TYPES OF NERVES	NERVE FIBRES	ACTION	COMMENTS
SYMPATHETIC	**HYPOGASTRIC** NERVES(L1,L2,L3) INFERIOR MESNTERIC GANGLION	motor to internal urethral sphincter, **inhibitory to detrusor**	**No significant role** in micturition; along wit IUS prevent reflux of semen into the bladder during ejaculation
PARASYMPATHETIC	**PELVIC** NERVES (S2,S3,S4)	motor to **detrusor** **inhibitory to internal urethral sphincter**	Stretch receptors present on the wall of the urinary bladder → Sensory fibers in the pelvic nerve → intermediolateral column of spinal cord → parasympathetic nerves →**Muscarinic receptors** → emptying of urinary bladder
SOMATIC	**PUDENDAL** NERVES (S2,S3,S4)	Voluntary control of **External urethral sphincter**	This maintains the tonic contractions of the **skeletal muscle fibers** of the external sphincter, so that this sphincter is **contracted always.** During micturition this nerve is **inhibited,** causing relaxation of the external sphincter and voiding of urine.
SENSORY	HYPOGASTRIC, PELVIC AND PUDENDAL NERVES	Cortical sensation	

BRAIN AREAS



Cortical center

Second frontal gyrus(paracental lobule)

Inhibitory to pontine center

Brain stem center

Pons- Barrington nucleus

Facilitatory to micturition

Sacral spinal cord (Onuf nucleus)

Parasympathetic (s2,S3,s4)

Reflex evacuation

Renal Control of Acid-Base Balance

- The kidneys are the third line of defense against wide changes in body fluid pH.

– movement of bicarbonate

– Retention/Excretion of acids

– Generating additional buffers

➢ Long term regulator of ACID – BASE balance

➢ May take hours to days for correction

Renal regulation of acid base balance

- Role of kidneys is preservation of body's bicarbonate stores.

Accomplished by:

– Reabsorption of 99.9% of filtered bicarbonate

– Regeneration of titrated bicarbonate by excretion of:

- Titratable acidity (mainly phosphate)
- Ammonium salts

- The kidneys control acid-base balance by excreting either acidic or basic urine

- Excreting acidic urine reduces the amount of acid in extracellular fluid

- Excreting basic urine removes base from the extracellular fluid

- The kidneys regulate extracellular fluid H^+ concentration through three fundamental mechanisms:

(1) Secretion of H^+

(2) Reabsorption of filtered HCO3 (Bicarbonate)

(3) Production of new HCO3

- In acidosis, the kidneys do not excrete HCO_3 into the urine but reabsorb all the filtered HCO_3 and produce new HCO_3 which is added back to the extracellular fluid

- This reduces the extracellular fluid H^+ concentration back toward normal

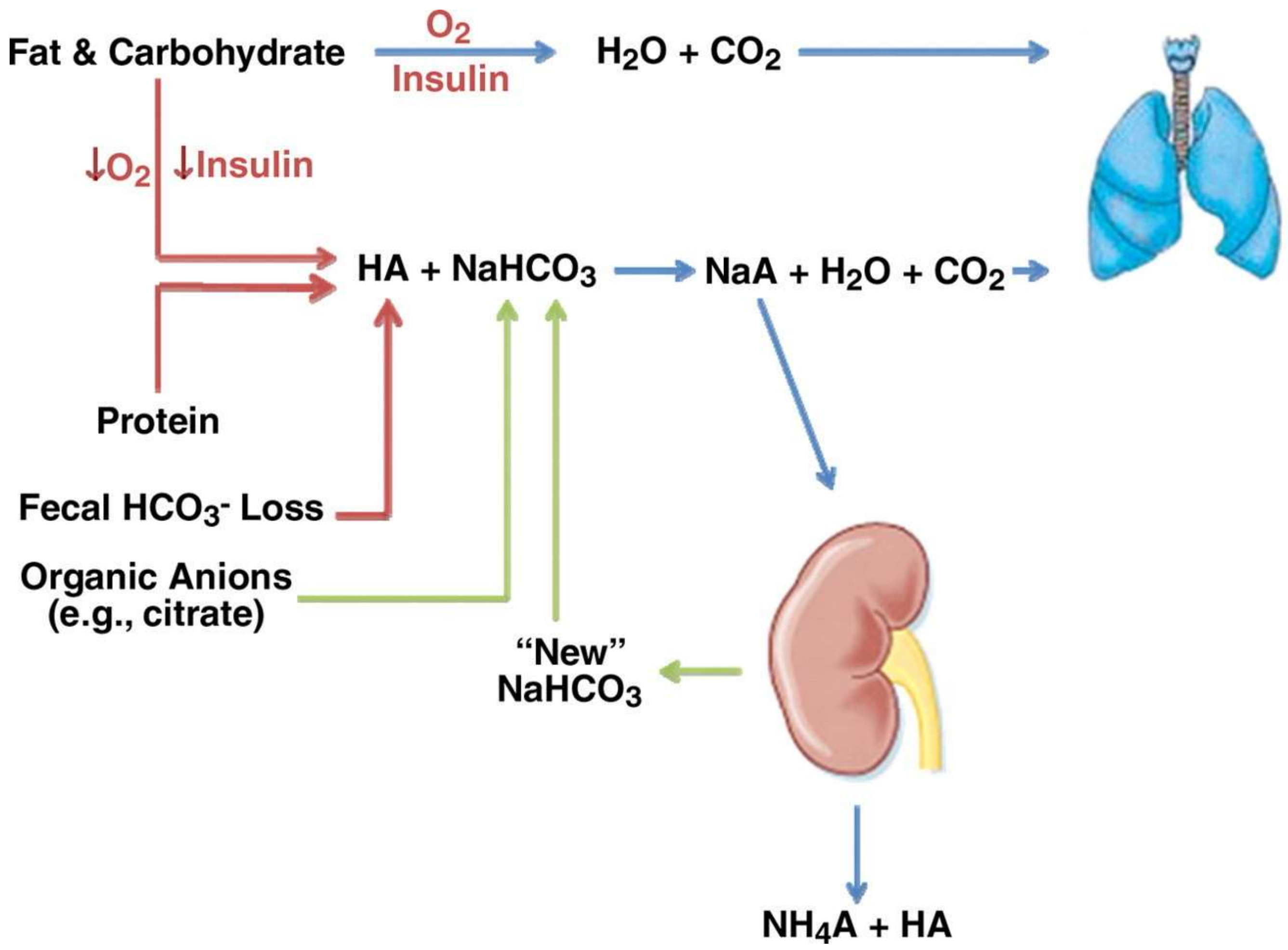
- In alkalosis the kidneys fail to reabsorb all the filtered HCO_3 thus increasing the excretion of HCO_3

- Because HCO_3 normally buffers H^+ in the extracellular fluid, this loss of HCO_3 is the same as adding H^+ to the extracellular fluid.

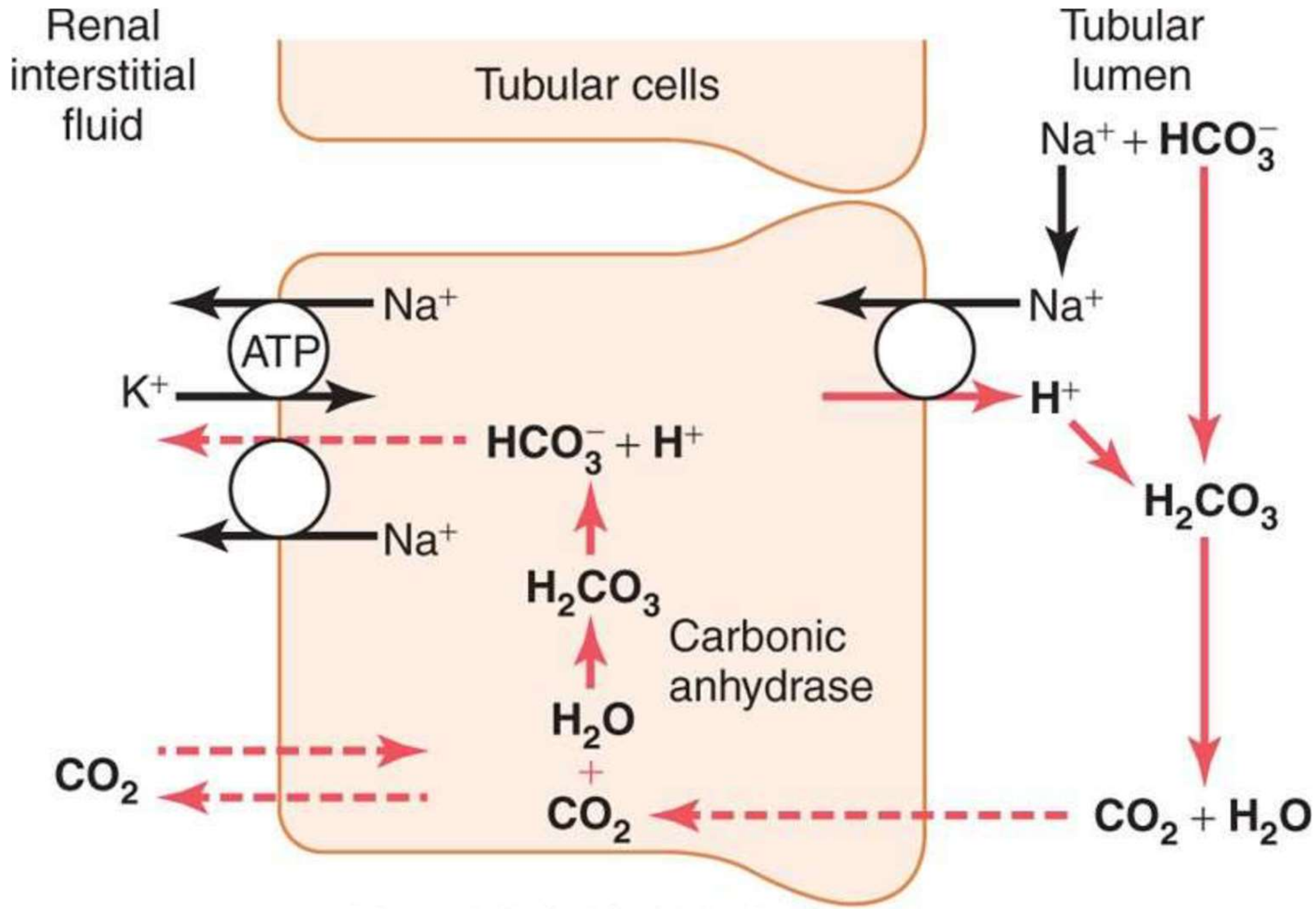
- In alkalosis the removal of HCO_3 raises the extracellular fluid H^+ concentration back towards normal

- Secretion of H^+ and Reabsorption of Bicarbonate by the Renal Tubules

- About 80 to 90 percent of the bicarbonate reabsorption and H^+ secretion occurs in the proximal tubule

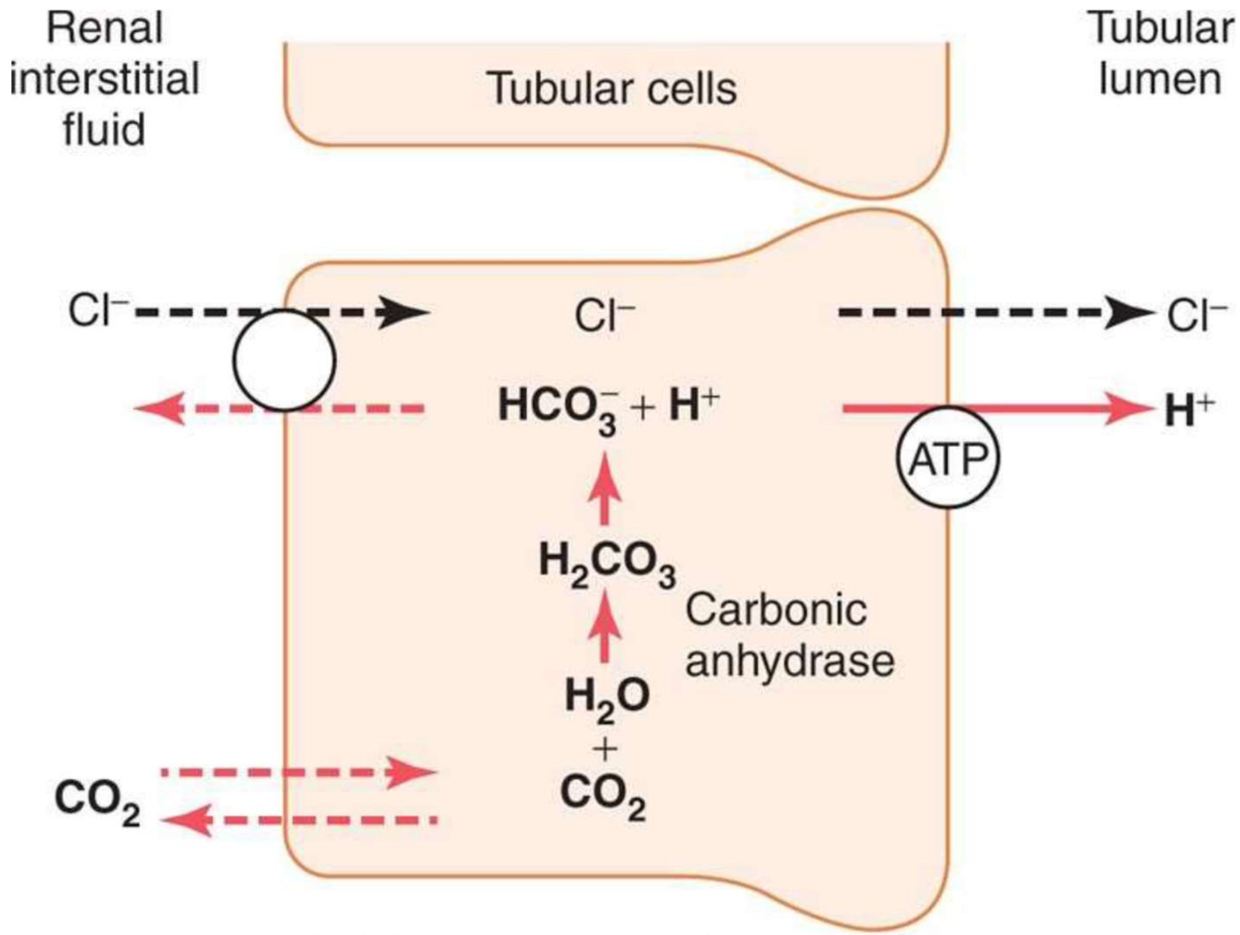

Fat & Carbohydrate
O_2
Insulin
$H_2O + CO_2$
↓O_2 ↓Insulin
$HA + NaHCO_3$
$NaA + H_2O + CO_2$
Protein
Fecal HCO_3^- Loss
Organic Anions
(e.g., citrate)
"New"
$NaHCO_3$
$NH_4A + HA$

Mechanism of Hydrogen ion secretion and Bicarbonate Reabsorption

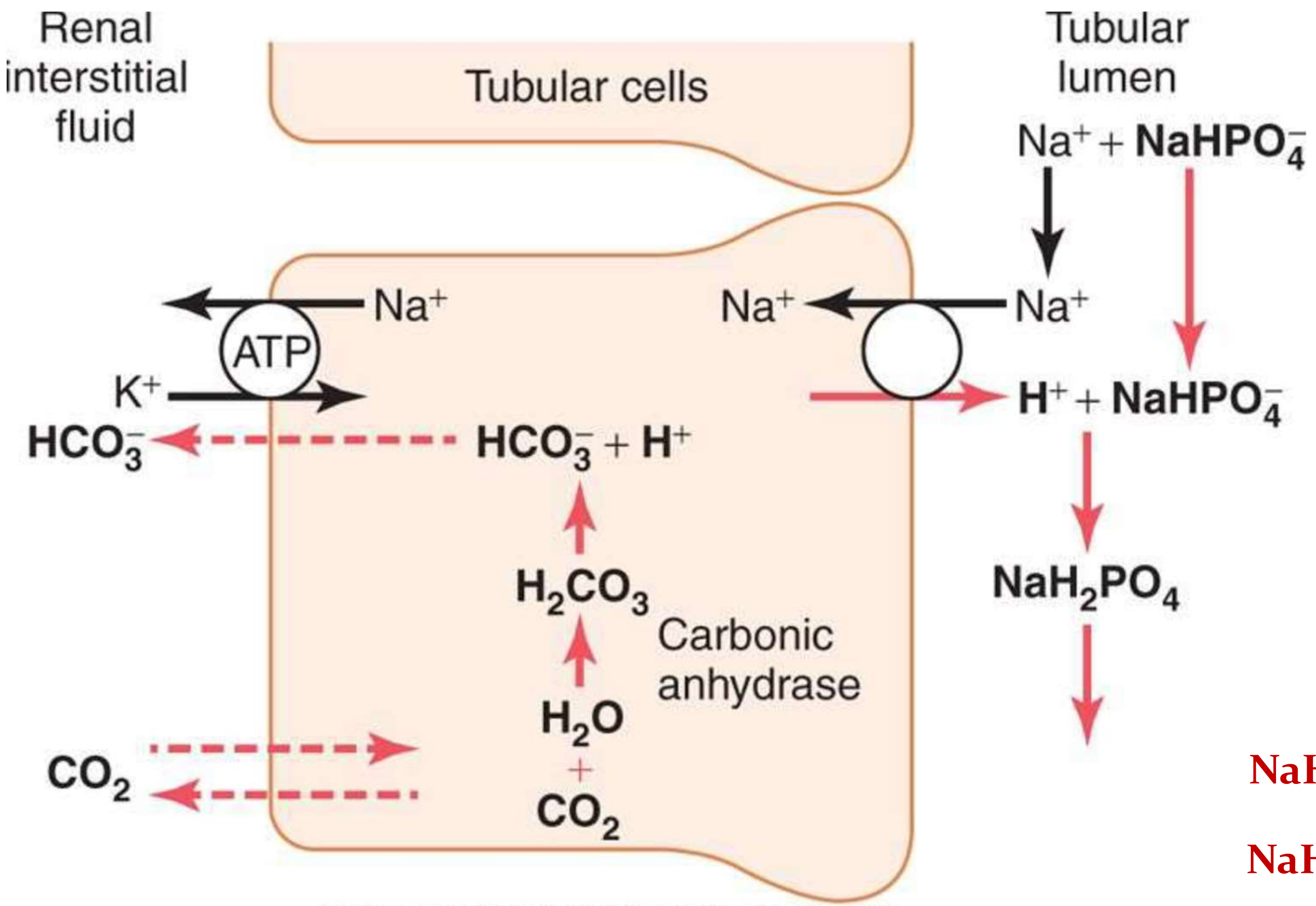


Hall: Guyton and Hall Textbook of Medical Physiology, 12th Edition

Primary Active Secretion of H^+ in the Intercalated Cells of Late Distal and Collecting Tubules



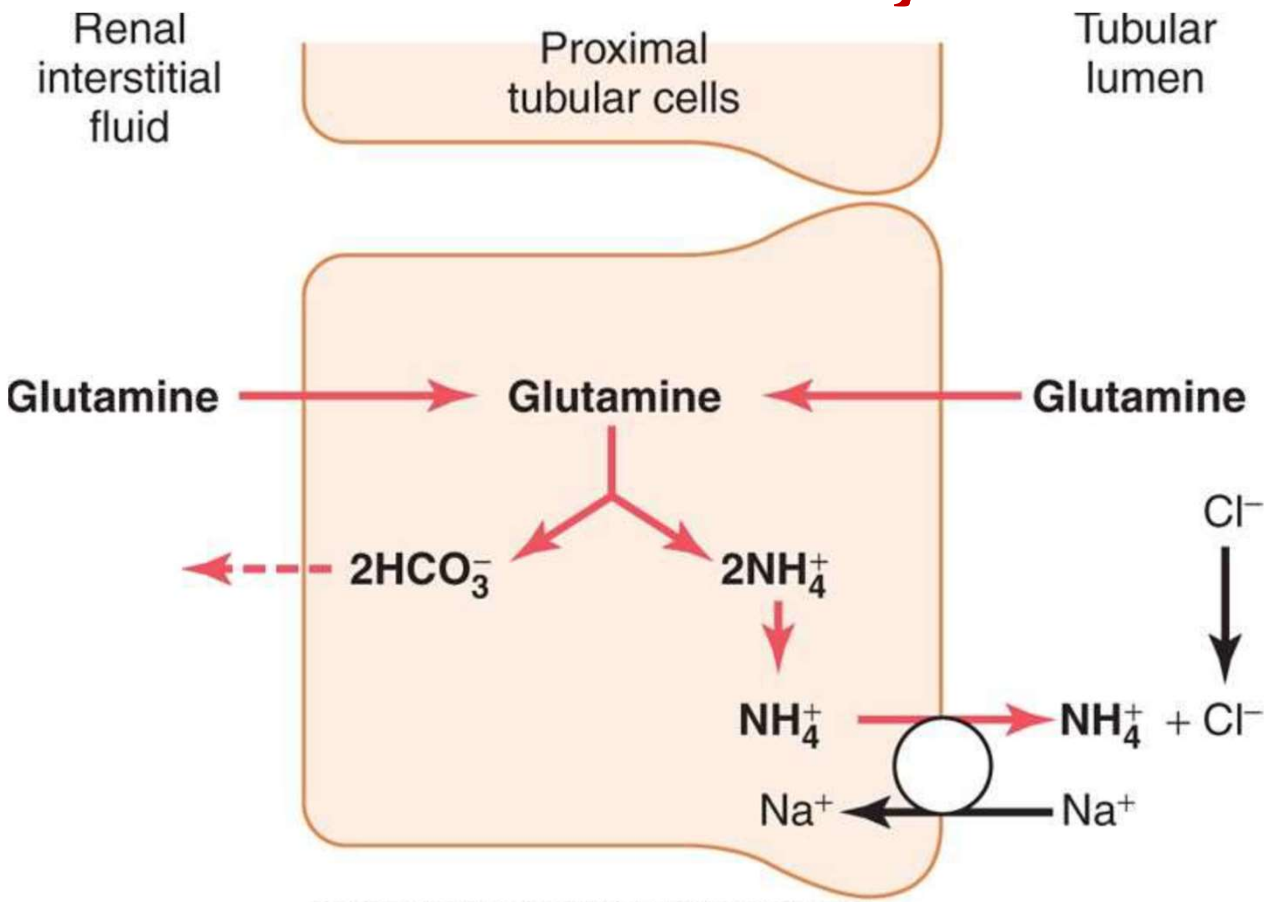
Buffering of Secreted Hydrogen Ions by Filtered Phosphate



NaHpo4- Disodium Hydrogen Phosphate

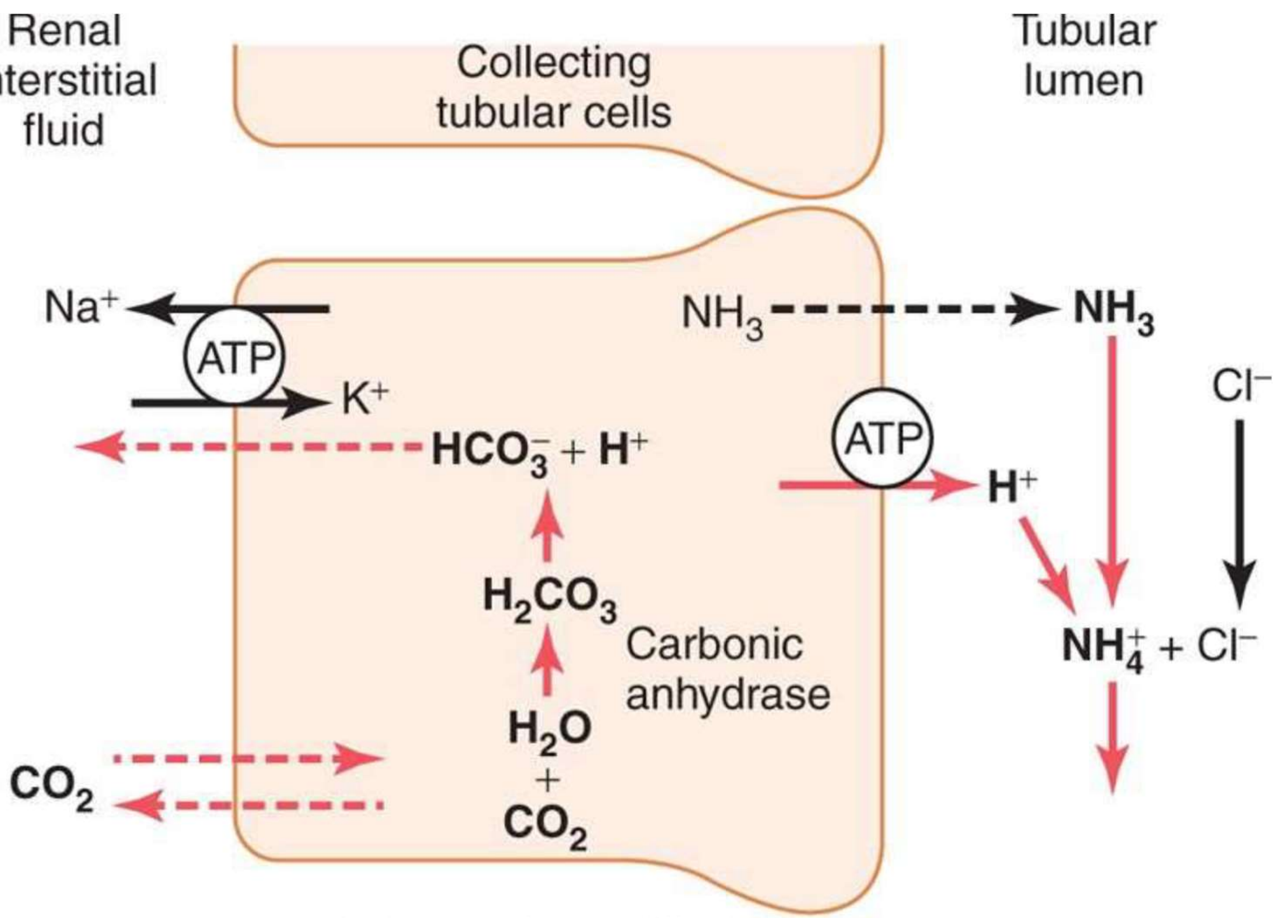
NaH2po4-Sodium Dihydrogen Phosphate

Excretion of Excess H^+ and Generation of New Bicarbonate by the Ammonia Buffer System



NH4- Ammonium

Buffering of hydrogen ion secretion by ammonia (NH3) in the collecting tubules



Renal Correction of Acidosis-Increased Excretion of H^+ and Addition of Bicarbonate to the ECF (Extracellular fluid)

- Acidosis decreases the ratio of Bicarbonate/Hydrogen ion in Renal Tubular Fluid

- As a result, there is excess H^+ in the renal tubules, causing complete reabsorption of bicarbonate and still leaving additional H^+ available to combine with the urinary buffers (phosphate and ammonia)

- Thus, in acidosis, the kidneys reabsorb all the filtered bicarbonate and contribute new bicarbonate through the formation of ammonium ions and titratable acid

Renal Correction of Alkalosis-Decreased Tubular Secretion of H+ and Increased Excretion of Bicarbonate

- Alkalosis increases the ratio of bicarbonate/hydrogen ion in renal tubular fluid

- The compensatory response to a primary reduction in PCO_2 in respiratory alkalosis is a reduction in plasma concentration, caused by increased renal excretion of bicarbonate

- In metabolic alkalosis, there is also an increase in plasma pH and decrease in H^+ concentration
- The cause of metabolic alkalosis is a rise in the extracellular fluid bicarbonate concentration
- This is partly compensated for by a reduction in the respiration rate, which increases PCO_2 and helps return the extracellular fluid pH toward normal
- In addition, the increase in bicarbonate concentration in the extracellular fluid leads to an increase in the filtered load of bicarbonate which in turn causes an excess of bicarbonate over H^+ secreted in the renal tubular fluid
- The excess bicarbonate in the tubular fluid fails to be reabsorbed because there is no H^+ to react with, and it is excreted in the urine
- In metabolic alkalosis, the primary compensations are decreased ventilation, which raises PCO_2, and increased renal excretion of bicarbonate which helps to compensate for the initial rise in extracellular fluid bicarbonate concentration

	pH	H^+	P_{CO_2}	Bicarbonate
Normal	7.4	40 mEq/L	40 mm Hg	24 mEq/L
Respiratory acidosis	↓	↑	↑↑	↑
Respiratory alkalosis	↑	↓	↓↓	↓
Metabolic acidosis	↓	↑	↓	↓↓
Metabolic alkalosis	↑	↓	↑	↑↑

RENIN ANGIOTENSIN ALDOSTERONE (RAAS) SYSTEM

INTRODUCTION

- Coordinated hormonal cascade in the control of cardiovascular, renal, and adrenal function that governs fluid and electrolyte balance and arterial pressure.

- RAAS is a system that is activated in the body by decrease in arterial pressure.

- Upon activation, it produces some responses that tries to increase arterial pressure to normal.

RENIN

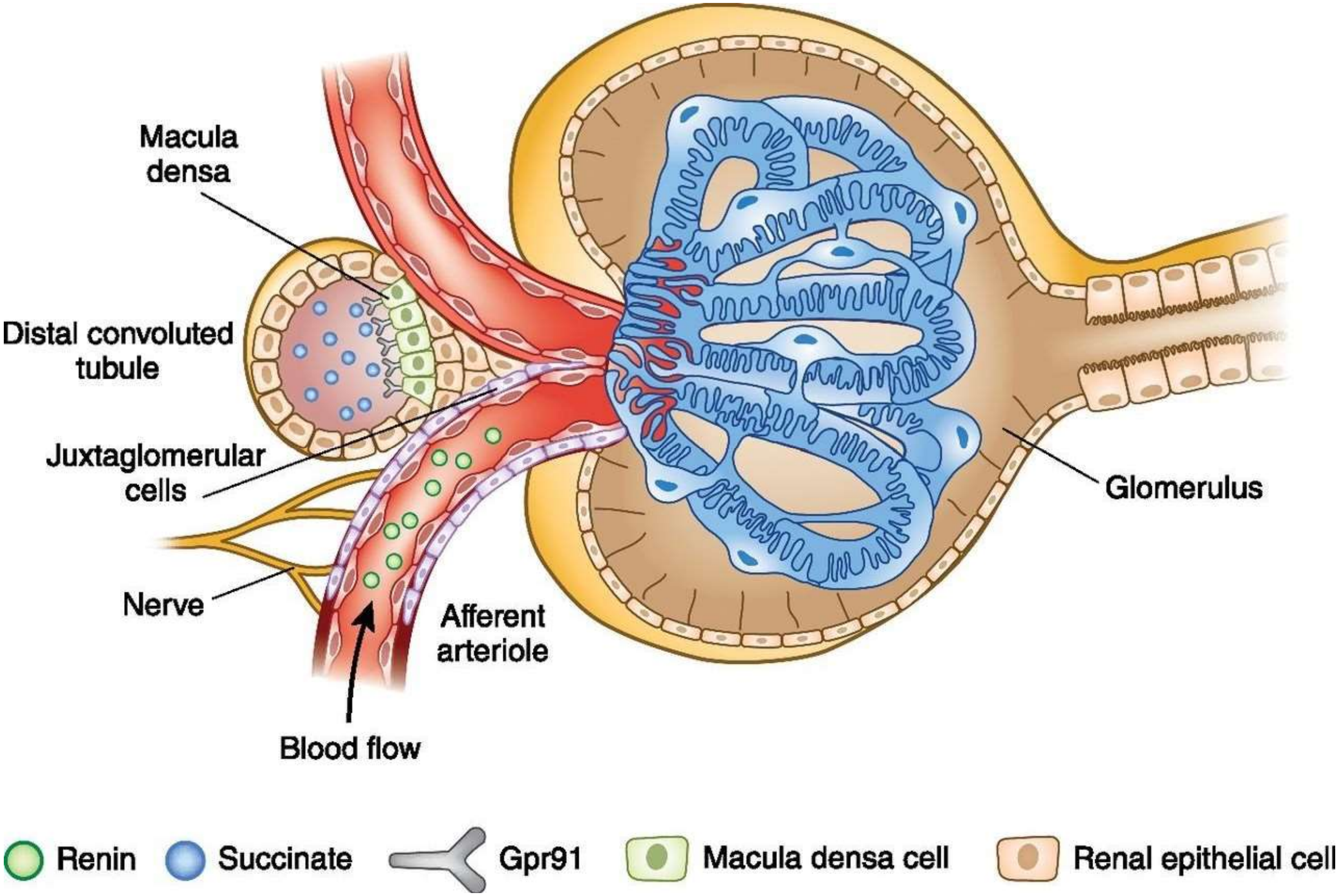
- It is an enzyme secreted by juxtaglomerular cells of the kidneys into blood stream.

- It is synthesized as pre-pro hormone known as human pre pro -renin which has little or no biologic activity.

- Pro-renin is converted to renin in kidneys. It can also be secreted by other organs such as ovaries

- The function of renin is to convert angiotensinogen to angiotensin I.

JUXTAGLOMERULAR CELL



ANGIOTENSINOGEN

- It is synthesized in the liver and removed in endoplasmic reticulum.

- Circulating angiotensinogen can be found in plasma

Angiotensin converting enzyme(ACE)

- It is an enzyme that converts Angiotensin I into Angiotensin II.

- Most of the enzyme is located in endothelial cells and much of conversion occurs as blood passes through the lungs.

- Conversion can also occur in other many parts of the body.

FUNCTIONS OF ANGIOTENSIN II

- **a.** Acts on adrenal cortex (zona glomerulosa cells) to stimulate synthesis and secretion of aldosterone.

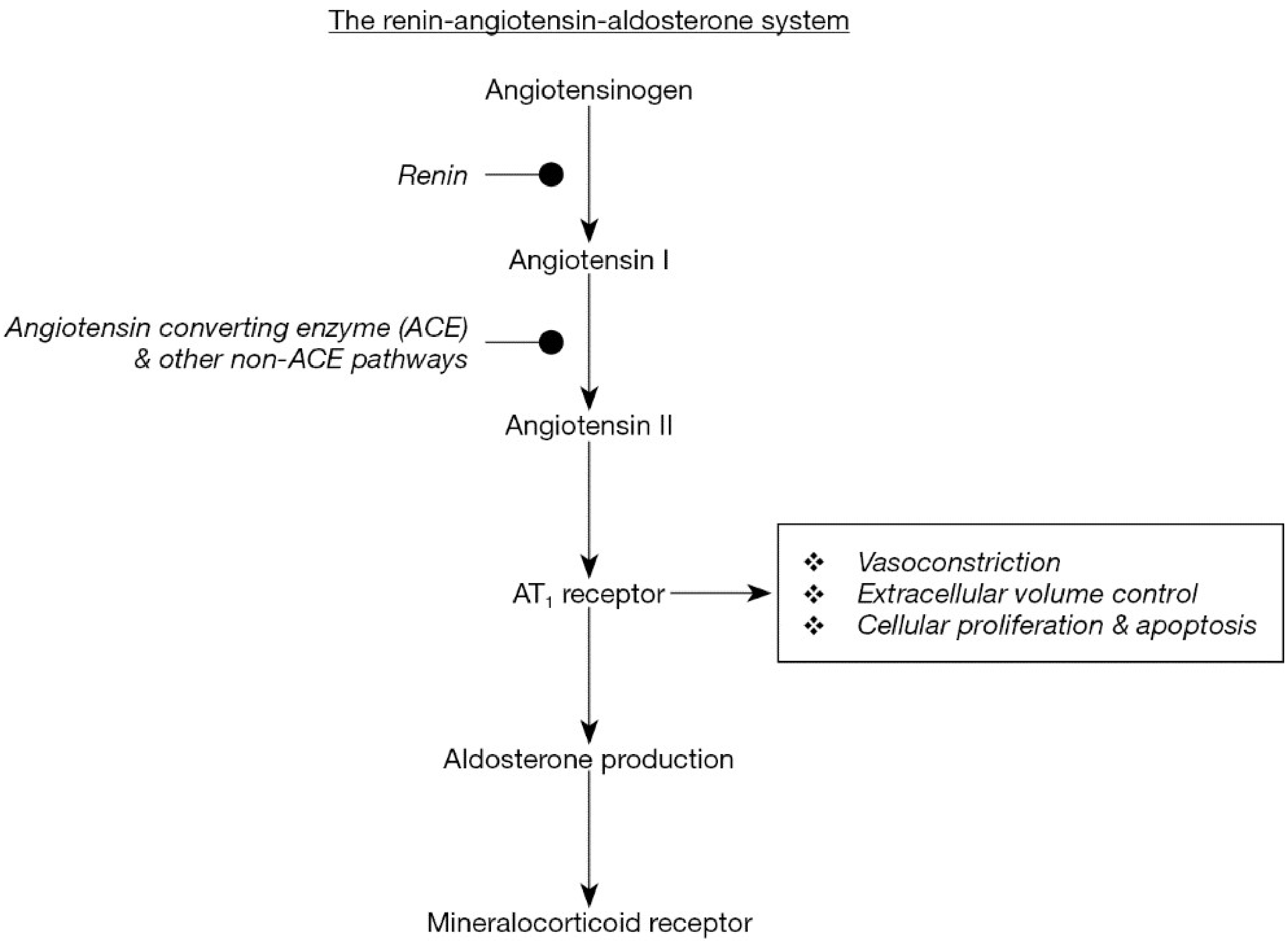
- Aldosterone increases sodium ion reabsorption as it acts on principal cells of renal distal tubule and collecting ducts.

- Water follows sodium reabsorption through osmosis hence increase blood volume.

- **b.** Angiotensin II is a potent vasoconstrictor and acts directly on arterioles to cause vasoconstriction producing increase in total peripheral resistance hence increase in arterial pressure.

- **c.** It also acts on hypothalamus to increase thirst and water intake.

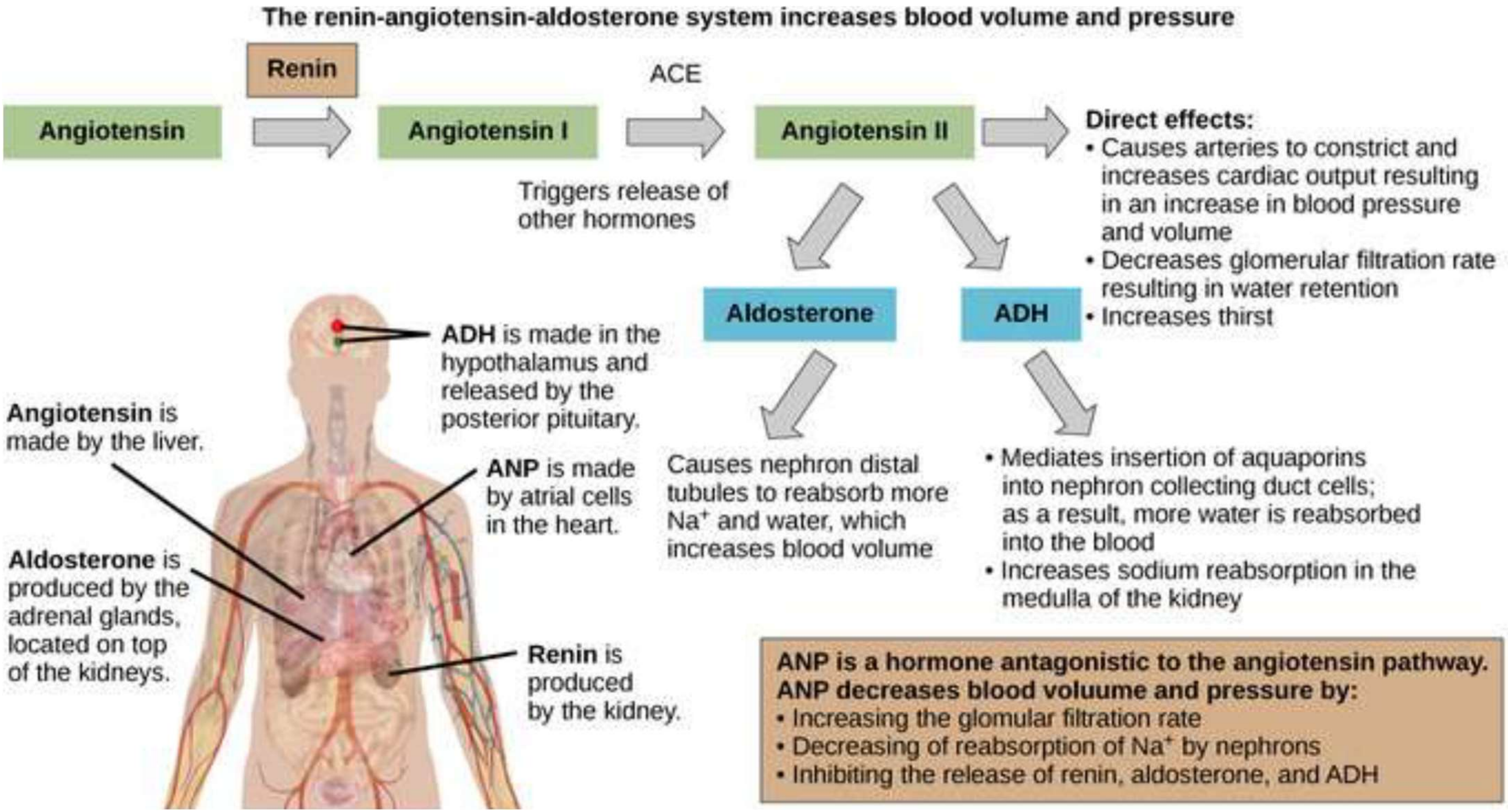
- **d.** Also stimulates secretion of anti-diuretic hormone which increases water reabsorption in collecting ducts.


The renin-angiotensin-aldosterone system
Angiotensinogen
Renin
Angiotensin I
Angiotensin converting enzyme (ACE)
& other non-ACE pathways
Angiotensin II
AT1 receptor
Vasoconstriction
Extracellular volume control
Cellular proliferation & apoptosis
Aldosterone production
Mineralocorticoid receptor

MECHANISM OF RAAS

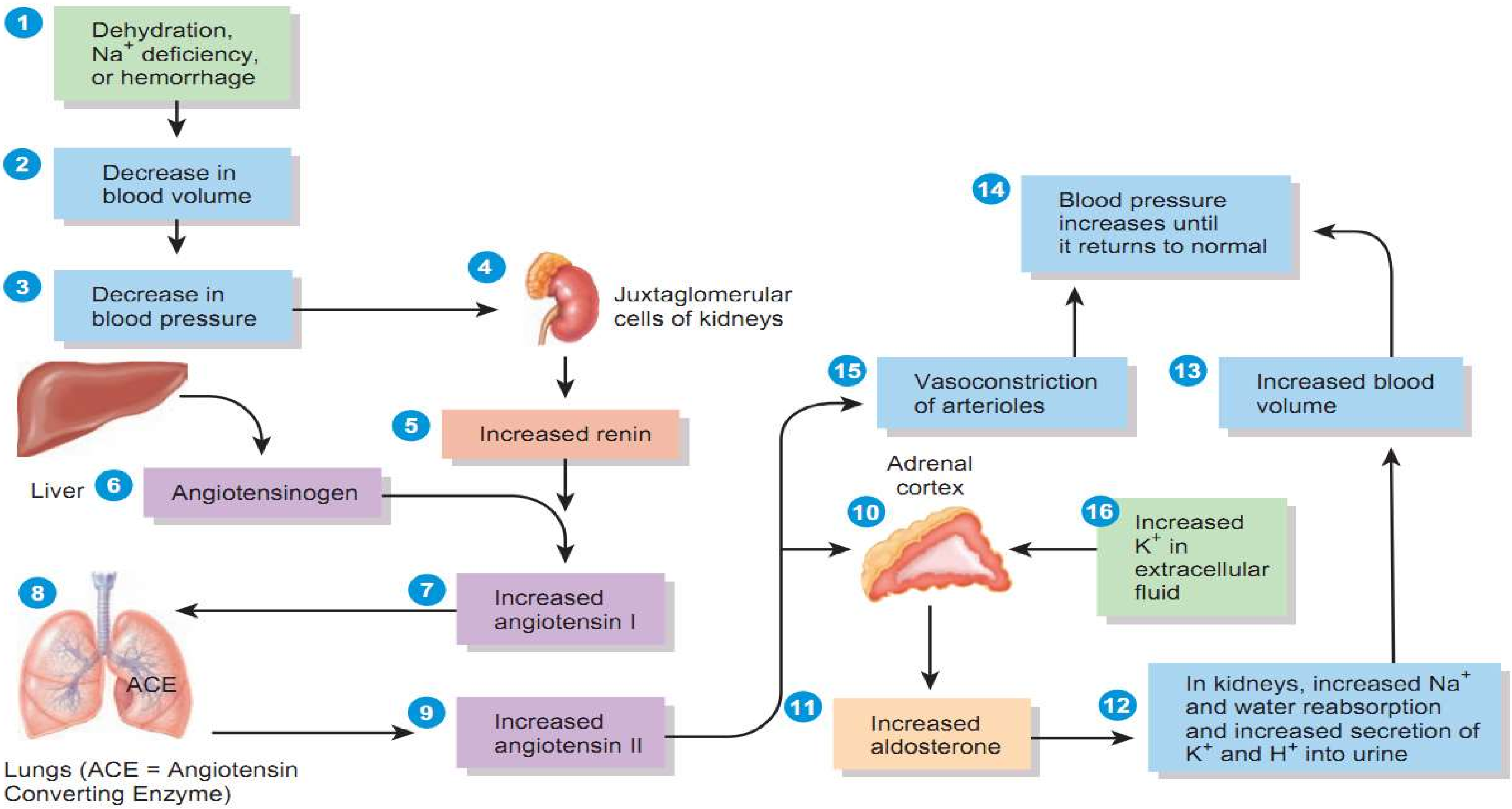
- It is a system that regulates arterial pressure by regulating blood volume.
- The system is hormonally mediated
- Reduction in arterial pressure leads to decrease in renal perfusion pressure.
- The decrease in arterial pressure cause pro-renin to be converted to renin
- In plasma renin catalyzes conversion of angiotensinogen to angiotensin I as mentioned in earlier.
- Angiotensin I is converted to angiotensin II in lungs and kidneys- a reaction catalyzed by ACE.

RAAS SYSTEM FUNCTION

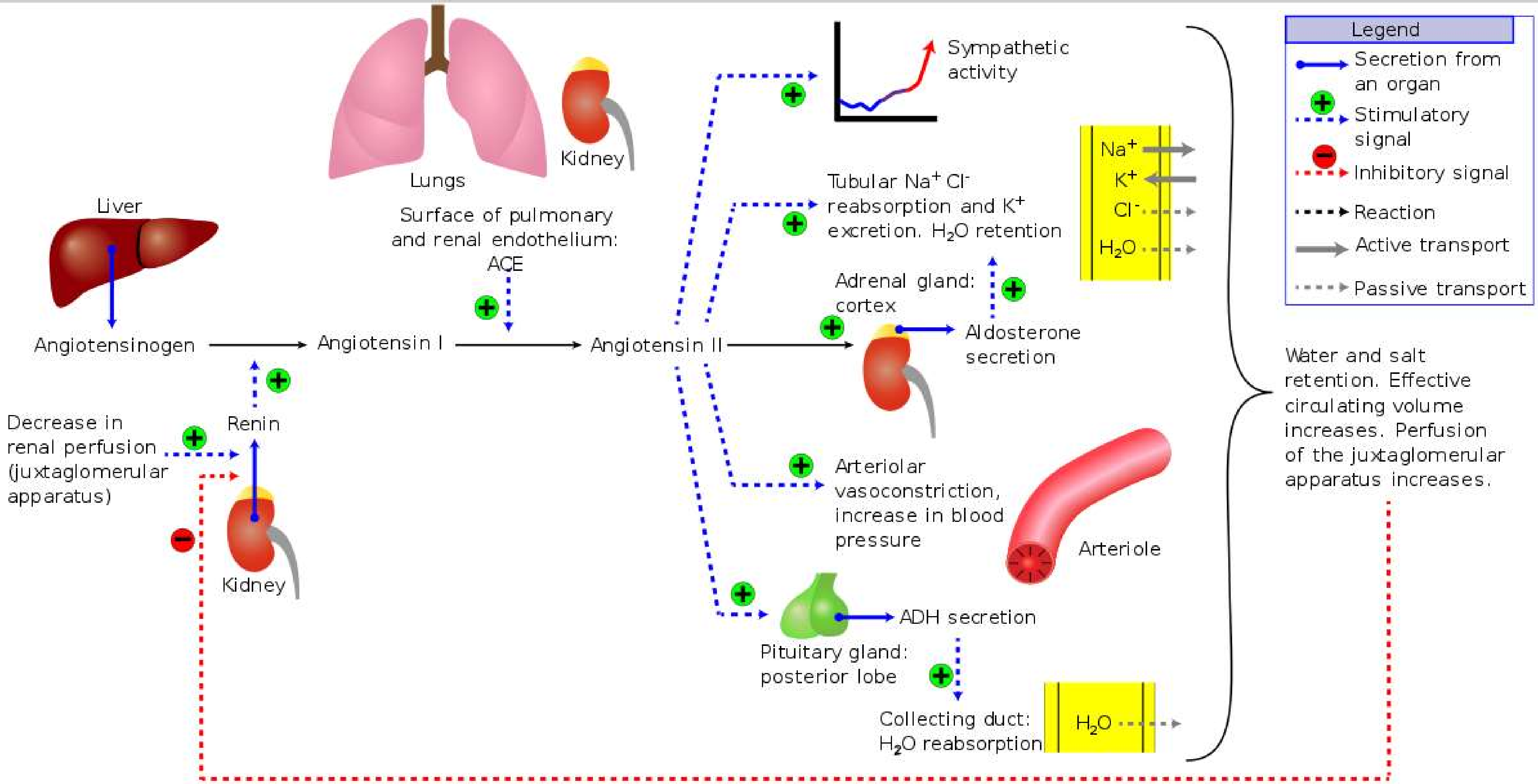


Regulation of aldosterone secretion by the renin–angiotensin–aldosterone (RAA) pathway.

Aldosterone helps regulate blood volume, blood pressure, and levels of Na^+, K^+, and H^+ in the blood.



Renin-angiotensin-aldosterone system



DISORDERS OF KIDNEY

- **Acute renal failure:** a sudden loss of renal function
- **Chronic kidney disease:** declining renal function, usually with an inexorable rise in creatinine.
- **Hematuria:** blood loss in the urine
- **Proteinuria:** the loss of protein especially albumin in the urine
- **Microalbuminuria:** slight increase in urinary albumin excretion

- **Electrolyte disorders:** acid/base imbalance
- **Kidney stones:** usually only recurrent stone formers.
- **Nephrosis:** degeneration of renal tubular epithelium.
- **Nephritis:** inflammation of the kidneys
- Chronic or recurrent urinary tract infections
- Hypertension that has failed to respond to multiple forms of anti-hypertensive medication or could have a secondary cause

Acute Renal Failure

- Acute renal failure (ARF) is the rapid breakdown of renal (kidney) function that occurs when high levels of uremic toxins (waste products of the body's metabolism) accumulate in the blood.

- ARF occurs when the kidneys are unable to excrete (discharge) the daily load of toxins in the urine.

- Based on the amount of urine that is excreted over a 24-hour period, patients with ARF are separated into two groups: **Oliguric:** patients who excrete less than 500 mL/day. **Nonoliguric:** more than 500 mL/day

CAUSES

Pre-renal (causes in the blood supply):

- hypovolemia (decreased blood volume), usually from shock or dehydration and fluid loss or excessive diuretics use.
- Hepato-renal syndrome in which renal perfusion is compromised in liver failure
- Vascular problems, such as atheroembolic disease and renal vein thrombosis (which can occur as a complication of the nephrotic syndrome)
- Infection usually sepsis, systemic inflammation due to infection

Chronic Renal Failure

- Chronic renal failure (CRF) is the progressive loss of kidney function.

- The kidneys attempt to compensate for renal damage by hyper filtration (excessive straining of the blood) within the remaining functional nephrons (filtering units that consist of a glomerulus and corresponding tubule).

- Over time, hyperfiltration causes further loss of function.

- Chronic loss of function causes generalized wasting (shrinking in size) and progressive scarring within all parts of the kidneys.

- In time, overall scarring obscures the site of the initial damage.

- Yet, it is not until over 70% of the normal combined function of both kidneys is lost that most patients begin to experience symptoms of kidney failure.

CAUSES

- The cause for CRF sometimes can be determined by a detailed medical history, a comprehensive physical examination, and laboratory studies.

- Even a kidney biopsy may be inconclusive, because all forms of kidney failure eventually progress to diffuse scarring and look the same on kidney biopsy.

- The most common causes for CRF are diabetes and hypertension.

Hematuria

- Hematuria is the presence of blood, specifically red blood cells, in the urine.

- Whether the blood is visible only under a microscope or visible to the naked eye, hematuria is a sign that something is causing bleeding in the genitourinary tract: the kidneys, the tubes that carry urine from the kidneys to the bladder (ureters), the prostate gland (in men), the bladder, or the tube that carries urine from the bladder out of the body (urethra).

- Bleeding may happen once or it may be recurrent.
- It can indicate different problems in men and women.
- Causes of this condition range from non-life threatening (e.g., urinary tract infection) to serious (e.g., cancer, kidney disease).

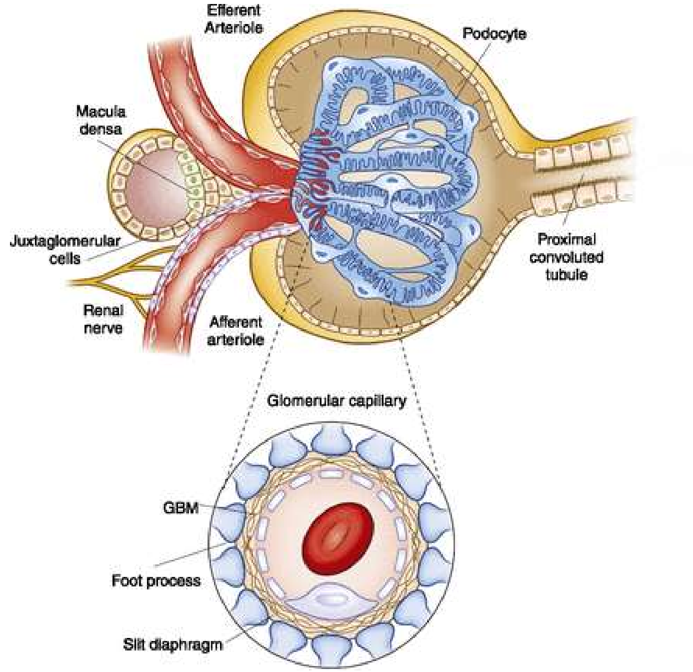
Causes

- Benign prostatic hyperplasia (BPH) in men over 40 years of age
- Kidney stones and bladder stones
- Kidney disease
- Medications (e.g., quinine, rifampin, phenytoin)
- Trauma (e.g., a blow to the kidneys)
- Tumors and/or cancer in the urinary system
- Urinary tract blockages
- Viral infections of the urinary tract and sexually Transmitted Disease

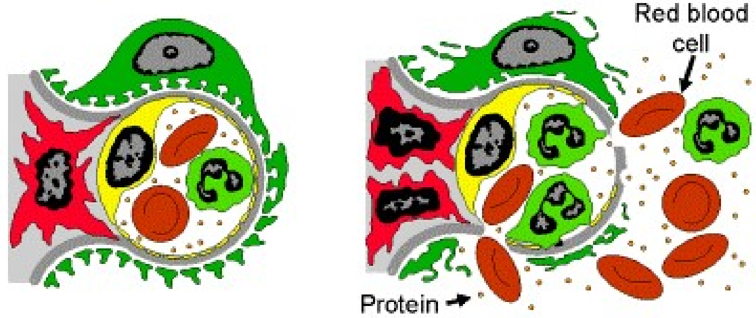
Proteinuria & Microalbuminuria

- Proteinuria is an abnormally high amount of protein in the urine.
- Proteins in the blood, like albumin and immunoglobulin, help coagulation (clotting), balance bodily fluids, and fight infection.
- The kidneys remove wastes from protein-rich blood through millions of tiny filtering screens called glomeruli.
- Most proteins are too large to pass through the glomeruli into the urine.

- The glomeruli are negatively charged, so they repel the negatively charged proteins.
- Thus, a size and charge barrier keeps protein molecules from entering the urine.
- But when the glomeruli are damaged, proteins of various sizes pass through them and are excreted in the urine.



Proteinuria and Hematuria



A normal capillary in a glomerulus keeps red blood cells, white blood cells and most proteins in the blood and only lets watery fluid into the urine.

A capillary in a diseased glomerulus lets protein into the urine (proteinuria) and red blood cells into the urine (hematuria).

Causes and Risk Factors

- Hypertension and diabetes.
- Age and weight gain also increase the risk.
- Acute glomerulonephritis
- Amyloidosis (protein deposits associated with chronic disease)
- Focal glomerulonephritis
- Hypertension
- IgA nephropathy
- Mesangial proliferation
- Minimal change disease

Electrolyte Imbalance

- Electrolytes are salts that conduct electricity and are found in the body fluid, tissue, and blood.
- Examples are chloride, calcium, magnesium, sodium, and potassium. Sodium (Na^+) is concentrated in the extracellular fluid (ECF) and potassium (K^+) is concentrated in the intracellular fluid (ICF).
- Proper balance is essential for muscle coordination, heart function, fluid absorption and excretion, nerve function, and concentration.

- The kidneys regulate fluid absorption and excretion and maintain a narrow range of electrolyte fluctuation.
- Normally, sodium and potassium are filtered and excreted in the urine and feces according to the body's needs.
- Too much or too little sodium or potassium, caused by poor diet, dehydration, medication, and disease, results in an imbalance.
- Too much sodium is called hypernatremia; too little is called hyponatremia.
- Too much potassium is called hyperkalemia; too little is called hypokalemia.

Kidney Stones

- Kidney stones (calculi) are hardened mineral deposits that form in the kidney.
- They originate as microscopic particles and develop into stones over time.
- The medical term for this condition is nephrolithiasis, or renal stone disease.
- The kidneys filter waste products from the blood and add them to the urine that the kidneys produce.

- When waste materials in the urine do not dissolve completely, crystals and kidney stones are likely to form.

- Small stones can cause some discomfort as they pass out of the body.

- Regardless of size, stones may pass out of the kidney, become lodged in the tube that carries urine from the kidney to the bladder (ureter), and cause severe pain that begins in the lower back and radiates to the side or groin.

Types

- Calcium Stones
- Uric Acid Stones
- Struvite Stones
- Cystine Stones

Causes and Risk Factors

- Several factors increase the risk for developing kidney stones, including inadequate fluid intake and dehydration, reduced urinary flow and volume, certain chemical levels in the urine that are too high (e.g., calcium, oxalate, uric acid) or too low (e.g., citrate), and several medical conditions.

- Anything that blocks or reduces the flow of urine (e.g., urinary obstruction, genetic abnormality) also increases the risk.

Signs and symptoms

- Blood in the urine (hematuria)
- Increased frequency of urination
- Nausea and vomiting
- Pain during urination (stinging, burning)
- Tenderness in the abdomen and kidney region
- Urinary tract infection (fever, chills, loss of appetite)

THANK YOU

Happy to answer if you have any quarry……….?