

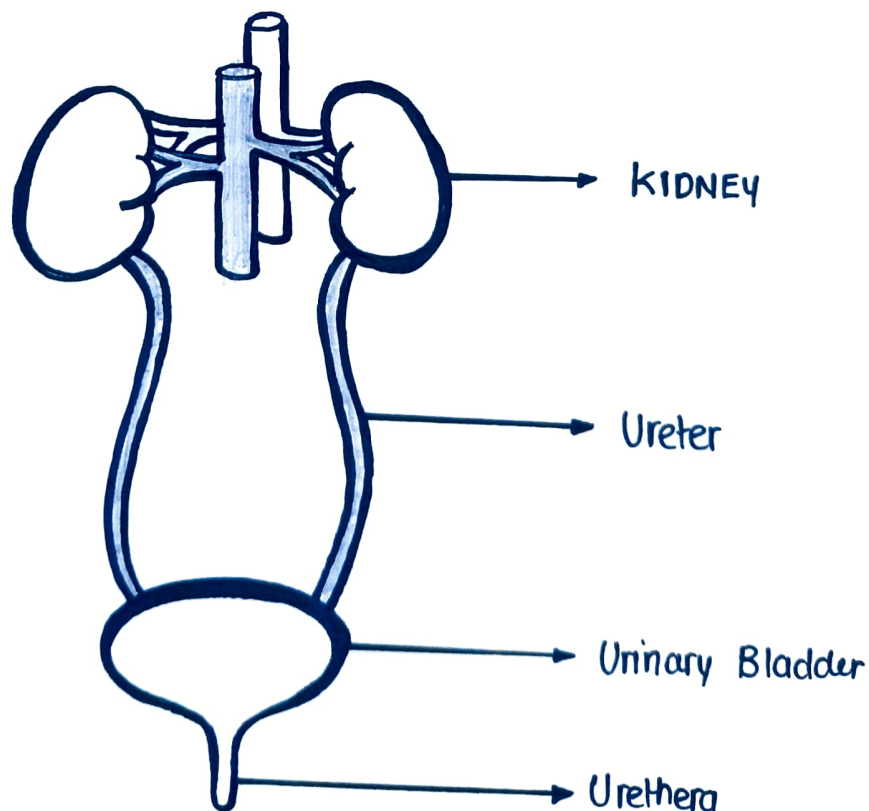
URINARY SYSTEM

- Excretion is the process by which unwanted substances & metabolic wastes are eliminated from the body.
- Although there are various systems in our body that are involved in the excretion process, but Urinary System has major excretory capacity, hence it is known as major excretory system of human body.
- It is also known as Renal System.

Parts Of Urinary System

Urinary System mainly consist of :

- A pair of kidneys
- Ureters
- Urinary Bladder
- Urethra



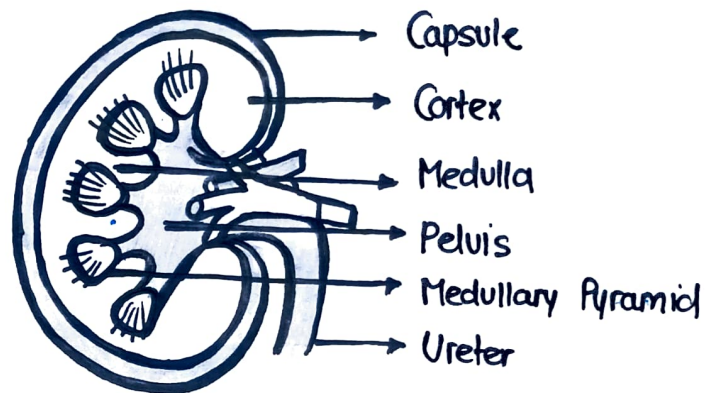
KIDNEY

- They are present in a pair in our body.
- Kidneys are two bean shaped organ located on each side of vertebral column. (T-12 - L3).
- It is reddish-brown in colour.
- It is about 10-12 cm long & 5-7 cm wide.
- Its weight is about 120-170 gram.

Layers of kidney

Kidney mainly contains 3 layers:

- ① Outer Cortex
- ② Inner Medulla
- ③ Renal Pelvis



NEPHRONS

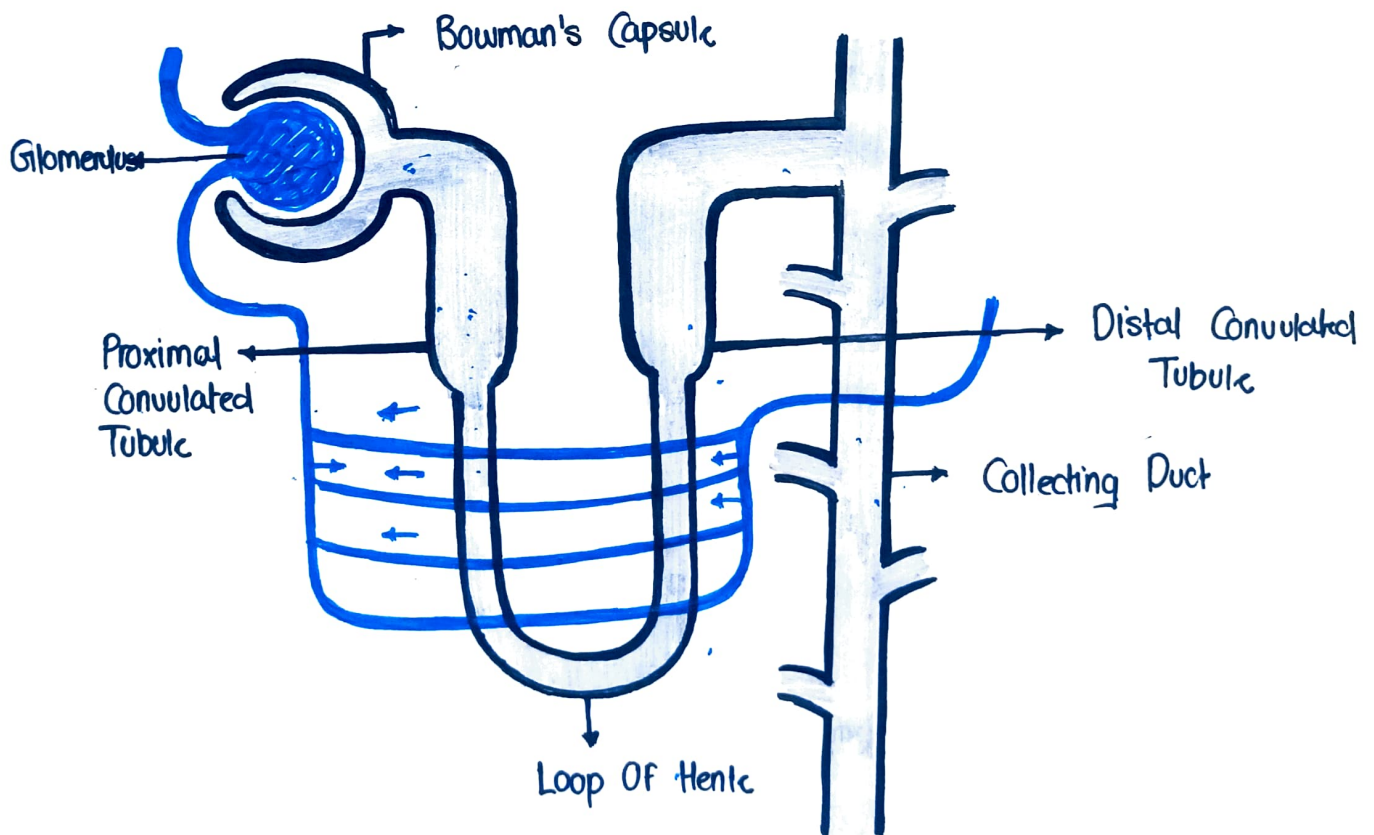
- Nephrons are the major functional unit of kidney.
 - Nephron is mainly consist of two parts:
- ① Renal Corpuscle
 - ② Renal Tubule

RENAL CAPSULE CORPUSCLE

- It is present in the cortex of kidney.
 - The major function of renal corpuscle is filtration of blood.
 - It can be further subdivided into two portions
- ① Glomerulus : Bunch of capillaries.
 - ② Bowman's Capsule : Upper end of renal tubule.

RENAL TUBULE

- It is a tube like structure and the continuation of Bowman's capsule.
- Proximal \in Renal tubule mainly consist of 3 parts :
 - ① Proximal Convulated Tubule : Present in Cortex
 - ② Loop of Henle : Present in Medulla
 - ③ Distal Convulated Tubule : Present in Cortex
- Loop of Henle can be further subdivided into 2 parts :
 - (i) Descending Limb
 - (ii) Ascending Limb



NEPHRON

Types Of Nephrons

Nephrons are of basically two types :

- ① Cortical Nephrons : 85% , short Loop of Henle
- ② Juxta - Medullary Nephrons : 15% , Long Loop of Henle.

PHYSIOLOGY OF URINE FORMATION

- Urine formation is a Blood Cleansing function.
- Normally about 1300 ml of blood enters into the kidney.
- Kidney excreted the unwanted substances from the blood as Urine .
- Normal Urine output is 1-1.5 Litre/ day.

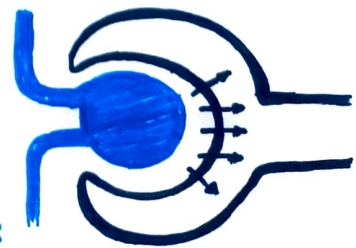
Formation Of Urine

It mainly involves 3 steps :

- ① Glomerular Filtration
- ② Tubular Reabsorption
- ③ Tubular Secretion

① GLOMERULAR FILTRATION

- It is a process by which blood is filtered while passing through glomerular capillaries by filtration membrane.
- It is first step of Urine formation.
- When blood passes through glomerular capillaries the plasma is filtered in Bowman's capsule.
- All the substance of plasma filtered in glomerular filtration except plasma protein & filtered fluid is known as Glomerular filtrate.



Glomerular Filtration Rate

- Glomerular filtration rate (GFR) is defined as total quantity of filtrate formed in all the nephrons of both the kidney in the given unit of time.
- Normal GFR is 125 ml / minute or 180 L / day

Factors Affecting GFR

- Renal blood flow
- Glomerular capillary Pressure
- Colloidal Osmotic Pressure
- Hydrostatic pressure in Bowman's capsule.

② TUBULAR REABSORPTION

- As we clearly saw that about 180 L filtrate formed per day but only 1.5 litre urine is excreted out from our body that means about 99% part of filtrate again reabsorbed in blood.
- It is the process by which water & other necessary substances are reabsorbed from Renal Tubule to Blood.
- The reabsorbed substances moves into the interstitial fluid of renal medulla & after that they moved into ~~cap~~ tubular capillaries.
- Tubular reabsorption is a selective reabsorption as the tubular cells reabsorbs only those substances that are necessary for our body.
- Essential substances get reabsorbed while unwanted substances excreted out from body.

Site of Reabsorption

PROXIMAL CONVULATED TUBULE	LOOP OF HENLE	DISTAL CO. TUBULE
Glucose , Amino Acids Sodium , Potassium Calcium , Bicarbonates Chlorides , Phosphates Urea , Uric Acid Water	Sodium Chloride	Sodium Calcium Bicarbonates Water

③ TUBULAR SECRETION

- It is process in which substance are transported from blood to renal tubules.
- The unwanted substances that are not get filtered from blood to Bowman's capsule in first step are directly transported to renal tubules later in this process.

Substance secreted in different segment of renal ~~capsu~~ tubule

- Proximal Convulated Tubule : Potassium, Ammonia, H^+ ions.
- Loop of Henle : Urea
- Distal Convulated Tubule : Potassium, H^+ ions.
- Collecting Ducts : Potassium.

FUNCTIONS OF KIDNEY

- It helps in the excretion of waste products
- It maintains water- electrolyte balance.
- It maintains acid- base balance.
- It also helps in the process of erythropoiesis by secreting erythropoietin & also in thrombopoiesis by secreting thrombopoietin.
- It secretes renin, prostaglandin hormones.
- It also helps in regulation of blood pressure.
- It also regulates blood- calcium level.

URETERS

- They are paired tube like structures.
 - They carry urine from kidney to urinary bladder.
 - The wall of ureter is made up of 3 layers.
- ① Inner Mucous Layer
 - ② Outer Fibrous Layer
 - ③ Middle Muscular Layer

URINARY BLADDER

- It is an inverted pear shaped structure that acts as a collector for urine.
 - It lies in the pelvic cavity.
 - The lower part of bladder is known as base while upper part is called Fundus.
 - It has three opening two for ureter & one for urethra.
 - It has 4 layers.
- ① Outer Serous Layer
 - ② Muscular Layer
 - ③ Sub-Mucous Layer
 - ④ Mucous Layer

URETHRA

- It is a canal through which urine passes from bladder to outside.
- It is different in males & females

ROLE OF KIDNEY IN ACID BASE BALANCE

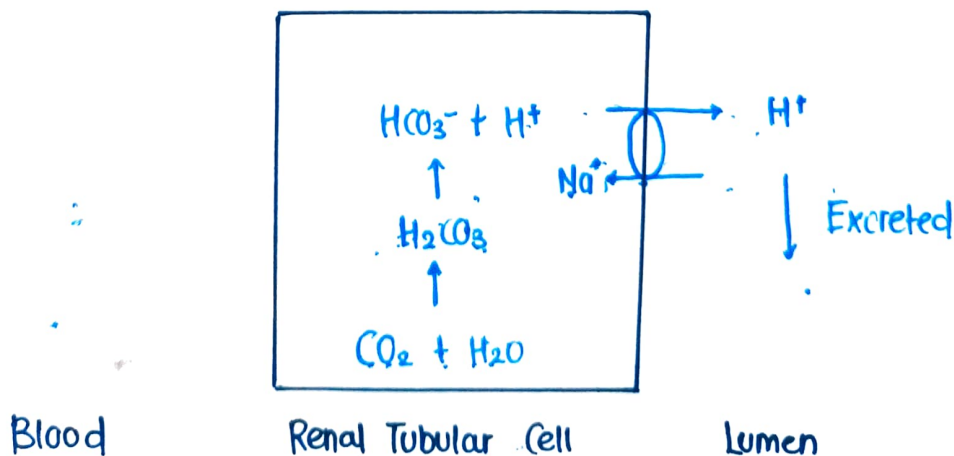
- Acid base balance is a part of homeostasis process that deals with maintenance of pH
- Most of the reactions in our body occurs at a specific pH & change in this pH can lead to major disturbances.
- The normal pH value of blood is approx 7.42 & survival range of pH in blood is between 6.8 - 8.0, now if the pH limit crosses this value then it may lead to death, so it becomes very important to maintain pH balance of our body.
- Now, there are various mechanism in our body to regulate this acid-base balance but the renal mechanism is the most effective & final process of acid-base balance in which kidneys play major role.

Renal Mechanism of Acid base balance

It mainly works by 2 mechanism :

- Excretion of H^+
- Reabsorption of bicarbonate ions

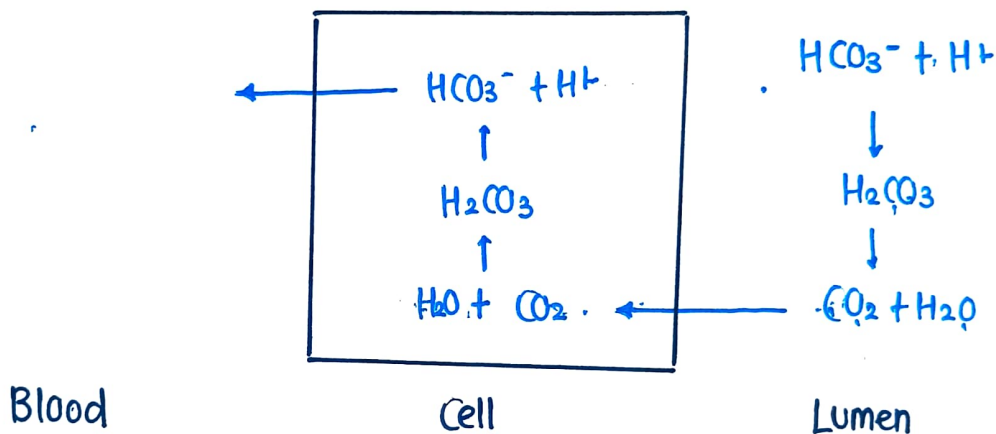
Excretion of H^+



STEPS

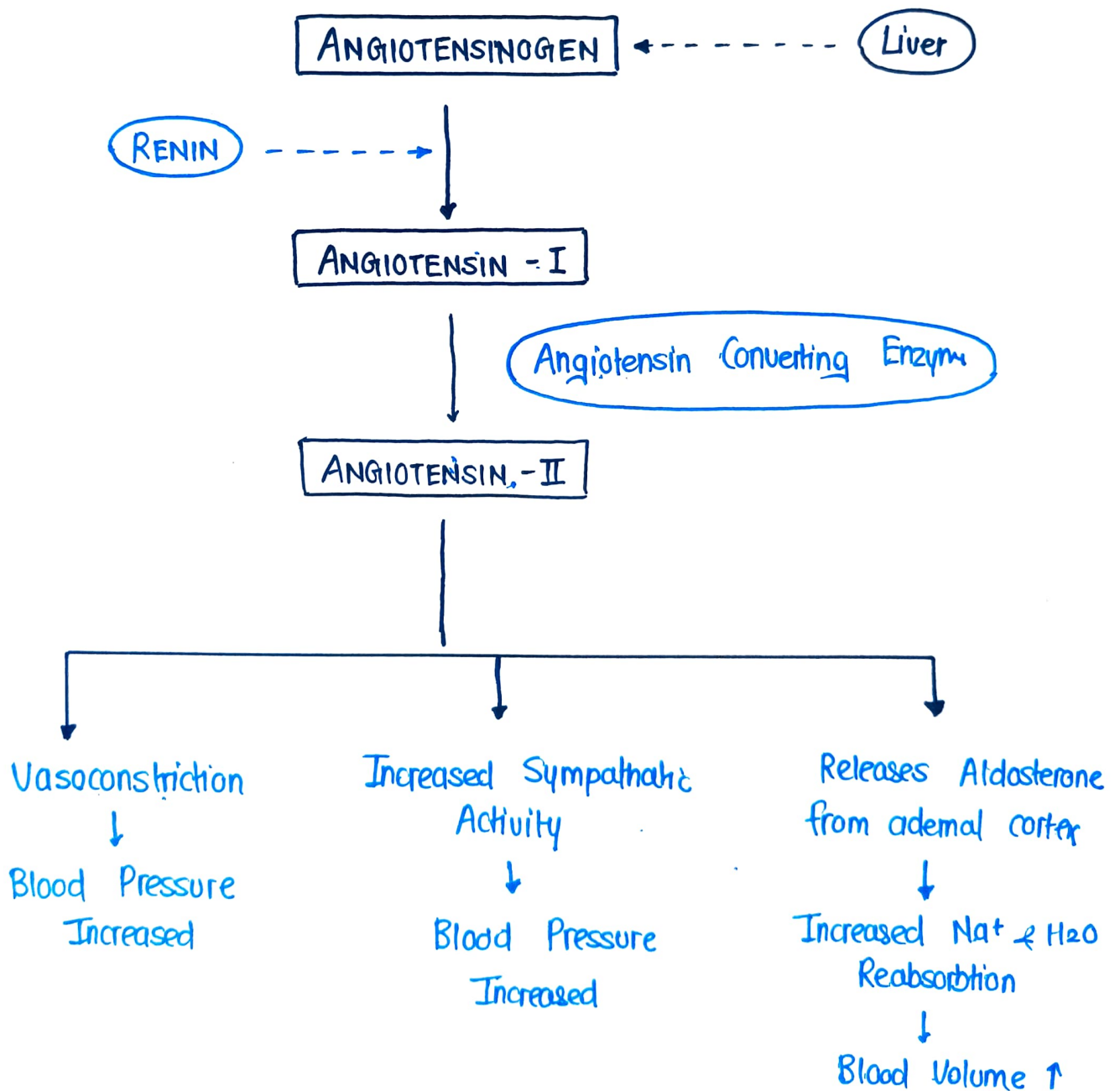
- This step mainly occurs proximal tubule.
- CO_2 combines with H_2O to form H_2CO_3
- Now H_2CO_3 dissociates into $\text{HCO}_3^- + \text{H}^+$
- H^+ is secreted in Lumen in exchange to Na^+
- Now this H^+ is excreted out from body through urine.

② REABSORPTION OF BICARBONATE IONS



ROLE OF RAS In kidney

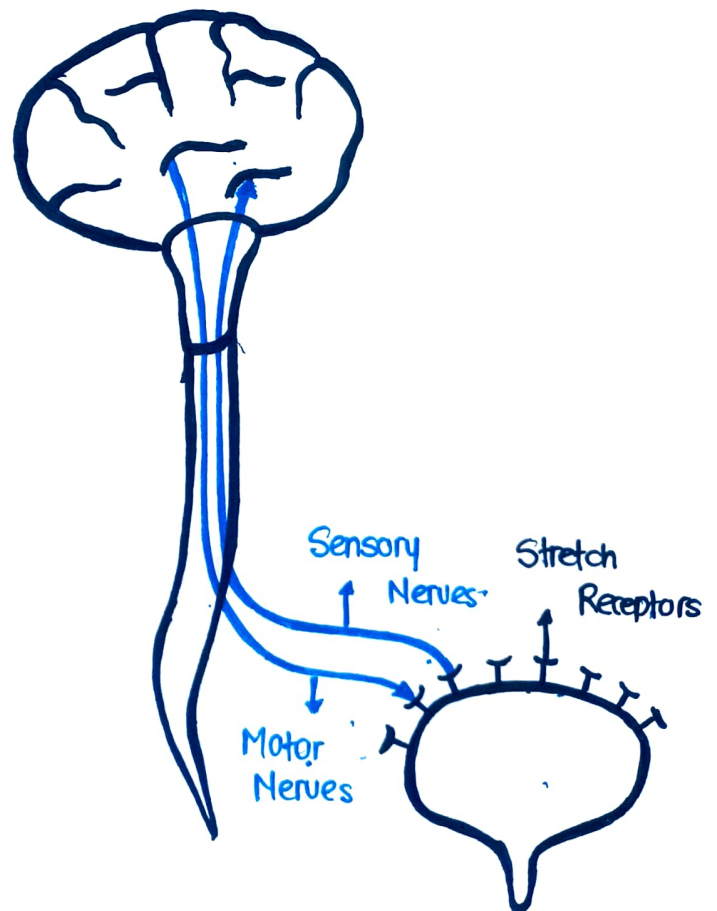
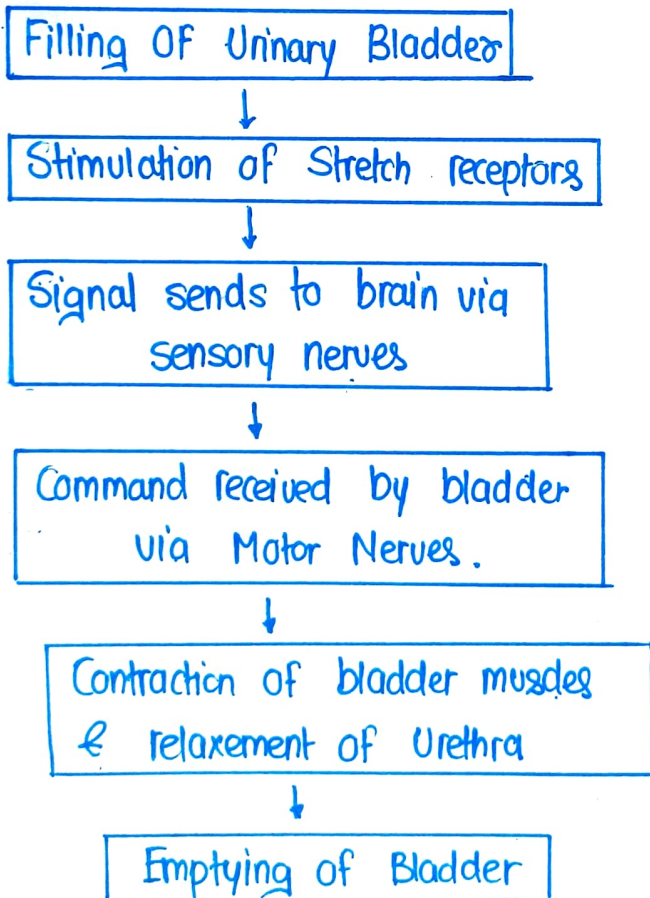
- RAS stands for Renin Angiotensin System.
- Renin Angiotensin system is a physiological hormone system involved in the regulation of arterial blood pressure & plasma sodium concentration
- Renin is a hormone secreted by Juxtaglomerular Apparatus.
- Angiotensinogen is a plasma protein released by liver



MICTURITION

- Micturition is a process by which the urinary bladder empties when it becomes filled.
- This involves two main steps:
 - ① First the bladder fills progressively until the tension in its walls rises above a threshold level.
 - ② Now in the second step as bladder is filling continuously, A nervous reflex generates known as Micturitional Reflex that empties the bladder or atleast cause a desire of urination

Micturitional Reflex



DISORDERS OF URINARY SYSTEM

There can be various disorders related to Urinary System :

- Polycystic kidney Disease
- Urinary Tract Infection
- Nephrotic Syndrome
- Urinary Incontinence
- Kidney Stones

Polycystic kidney Disease

- Enlargement of kidneys because of presence of many cyst within them .
- Polycystic kidney disease is an inherited disorder in which clusters of cyst develops over the kidney that cause enlargement of kidney & lose function over time

Urinary Tract Infection

- Urinary Tract infections (UTI) are generally caused by harmful microorganism in Urinary Tract .
 - UTI are generally more common in females .
 - They usually occur in bladder or Urethra , but more serious infections involve the kidney
 - Bladder Infection leads to pain with urination , blood in the urine & increased urge to urinate .
 - A kidney infection may cause back pain , nausea , vomiting and fever :
 - Bacteria that lives in vaginal or anal area may enter the urethra & travel to bladder & can cause an infection .
 - It can be of two types :
- ① Upper UTI
 - ② Lower UTI

Nephrotic Syndrome

- It is a type of renal failure occur due to increased glomerular permeability.
- Nephrotic syndrome is a kidney disorder that causes your body to pass too much protein in your urine.
- It generally occurs due to damage in blood vessels of kidney.

Urinary Incontinence

- It is a common & embarrassing problem in which bladder control get lost.
- If this the urge of urination gets so strong that you can't control without discharge.

Kidney Stones

- Kidney stones are hard deposits of mineral & salt that forms inside your kidney.
- They can be painful when passing through the urinary tract but usually don't cause permanent damage.
- It can be occur due to :
 - ① Drinking too little water
 - ② Obesity
 - ③ Weight loss surgery
 - ④ Eating food with too much salt or sugar