

Mechanism of Urine formation (Renal Physiology)

① Urine : \Rightarrow Urine is a waste product that is

Produced by the kidneys in their process of cleaning the blood and is made up of water and dissolved waste products.

- \rightarrow Transparent in appearance.
- \rightarrow Acidic in nature.
- \rightarrow Pale yellow colour for the presence of urochrome.
- \rightarrow Aromatic due to urinoïd
- \rightarrow pH 4.8 - 7.5
- \rightarrow Excretion of Urine in hypertonic condition.
- \rightarrow Amount of urine release = 1 to 1.5 lt/day.

② Mechanism : \Rightarrow

There are 3 main steps in urine formation-

- ① Ultrafiltration
- ② Selective reabsorption
- ③ Tubular secretion

① Ultrafiltration : \Rightarrow

- Filtration under pressure
- It is passive process
- Takes place in malphigian corpuscles.

\Rightarrow Blood enters the glomerulus through the afferent arterioles, it passes under pressure that results in filtration of blood. Water and small molecules are forced out of glomerular capillary walls and Bowman's capsule.

②

The large molecules remains in the blood of the glomerulus.

Process: →

As the diameter of Afferent arteriole is much higher than Efferent arteriole, so when the blood enters to the nephron through this afferent arteriole it creates a very high pressure.



With this pressure the entire blood hits the glomerulus and this pressure is known as G.H.P [Glomerular hydrostatic pressure]

→ The pressure exerted by the blood on the glomerulus capillaries of nephron.

It is 55 mm Hg.]



Blood has some plasma proteins that can't pass the network of glomerulus but this plasma protein prevents other filtrate molecules to pass. This prevents

This process creates a pressure, known as

B.C.O.P (30 mm Hg) [Blood colloidal

osmotic pressure → The pressure exerted

by the plasma protein on the glomerulus to resist filtration.]

Now the liquid that passes and reaches to the capsular space, is called filtrate.

This filtrate creates a pressure back to the glomerulus so that no more filtrate can pass and it is called C.H.P. (15 mmHg) capsular

Hydrostatic Pressure. → The pressure exerted by the filtrate on the glomerulus to resist filtration.]

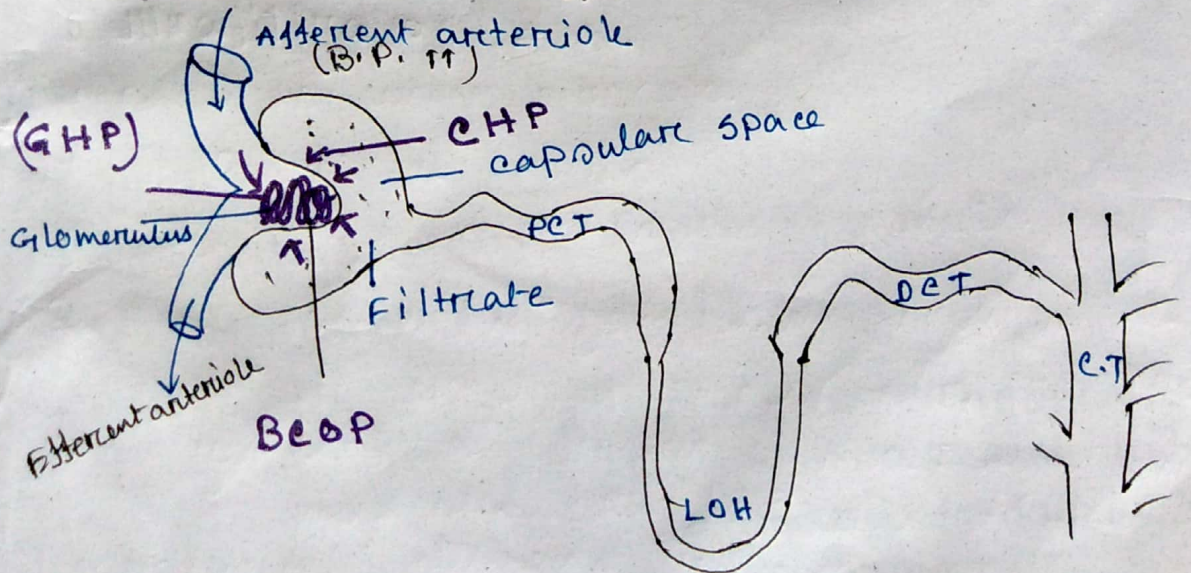
By the all combination of pressure, the filtrate is produced that may can be calculated by Effective filtrate pressure.

$$\begin{aligned}
 \text{E.F.P.} &= \text{GHP} - (\text{BOP} + \text{CHP}) \\
 &= 55 - (30 + 15) \text{ mmHg} \\
 &= 10 \text{ mmHg}
 \end{aligned}$$

G.F (Glomerular filtrate) = Blood - (R.B.c + W.B.c + Platelet + Plasma Protein)

G.F.R = 120 ml / min.

OR
180 lt / day



② Selective Reabsorption : ⇒

④

- ↳ It takes place in PCT, LOH, DCT.
- ↳ It is both active and passive process because some molecule absorbed by active process and other are through passive process, so called selective reabsorption.
- ↳ Here some molecules are selectively reabsorbed into the blood. The glomerular filtrate flows through the proximal convoluted tubule, loop of henle and distal convoluted tubule. The useful substances present such as glucose, amino acids and salts are reabsorbed by a process, which requires energy.

List of molecules that absorbed in PCT, LOH, DCT through active and passive process: ⇒

i) PCT : ⇒

- ✓ Active through active process → Glucose, amino acids, 70% Na^+ , 75% K^+ , Ca^{2+} , etc.
- ✓ Through passive process → 80% Water, Urea, Cl^-

ii) L.O.H : ⇒

- ✓ Through active process → Na^+
- ✓ Through passive process → K^+ , Cl^-

- Descending loop → Permeable to H_2O i.e. only water can reabsorb but it is impermeable to salt i.e. salt can not pass.

- Ascending limb: \rightarrow it is permeable to salt i.e. salt can pass but it is impermeable to H_2O i.e. H_2O cannot pass.

iii) D.C.T \rightarrow

Through active process $\rightarrow Na^+$

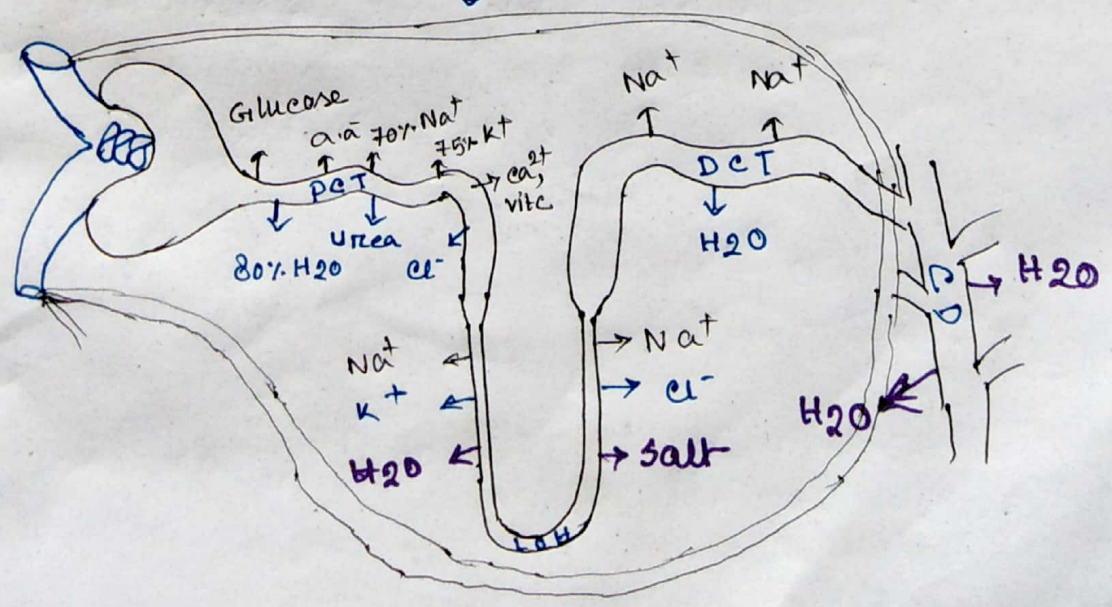
Through passive process $\rightarrow H_2O$

- \hookrightarrow Aldosterone responsible for Na^+ absorption
- \hookrightarrow ADH responsible for H_2O absorption.

iv) C.D \rightarrow only water absorb

Process \rightarrow All the molecules that selectively absorbed in different parts of nephron i.e. P.E.T, L.O.H, D.C.T, C.D, they travel reach to a peritubular capillary.

And all the peritubular capillary finally reach to Efferent arteriole to normal blood circulation.



② Secret Tubular Secretion : ⇒

⑥

As urea is a nitrogenous waste that is through ultra filtered ultrafiltration and finally it secreted to DCT by the process of tubular secretion.

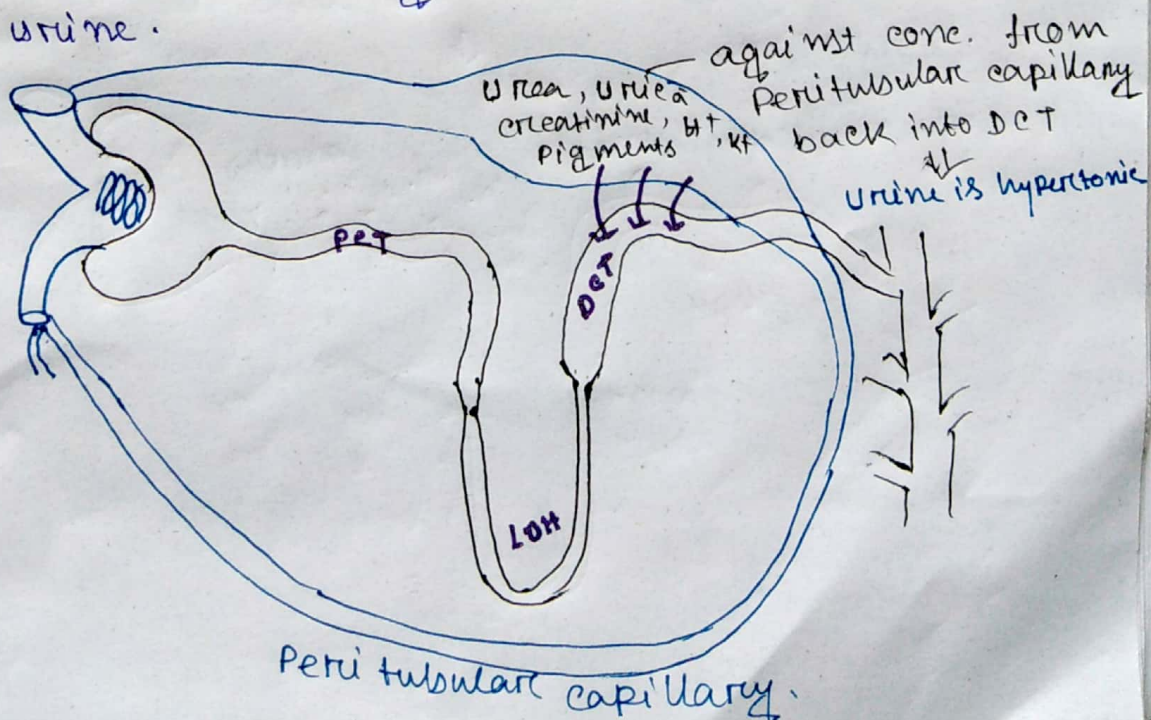
→ Tubular secretion takes place in distal convoluted tubule and collecting duct.

→ It is an active process

Process → In the peritubular capillary the compounds like urea, uric acid, creatinine, H^+ , K^+ , pigments and other harmful components present and all are must be secreted from this peritubular capillary to DCT

↓
This DCT pass this to CT

↓
That • And thus these compounds eliminated from our body through urination as urine.



Finally =>

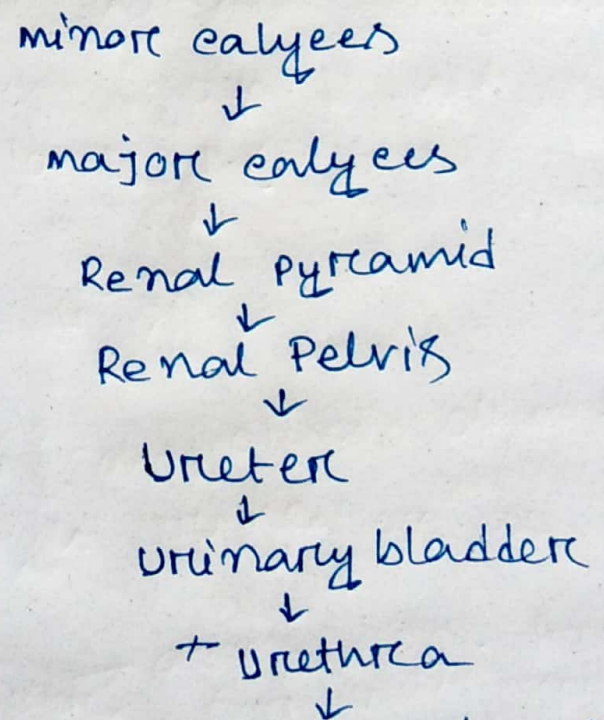
Urine is formed to filter the blood.
↓

So, urine is collection of wasteful materials.
↓

Blood enters through afferent arteriole and
release through efferent arteriole.

↓
Here blood purification occurs in glomerulus
↓

The filtrate produced in glomerulus reach
to P.E.T → L.O.H → D.C.T → collecting duct
↓



Urine is released through urination from
our body.