



Clearance and Renal Excretion

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Concept clearance

- The clearance concept was first introduced to describe renal excretion of endogenous compounds in order to measure the kidney function.
- The term is now applied to all organs involved in drug elimination such as liver, lungs, the biliary system, etc. and referred to as hepatic clearance, pulmonary clearance, biliary clearance and so on.
- *The sum of individual clearances by all eliminating organs is called as **total body clearance** or **total systemic clearance**.*
- It is sometimes expressed as a sum of renal clearance and nonrenal clearance.



Definition of clearance

- Clearance is defined as the hypothetical volume of body fluids containing drug from which the drug is removed or cleared completely in a specific period of time.
- It is expressed in ml/min and is a constant for any given plasma drug concentration.

Elimination

$$\text{Clearance (Cl)} = \frac{\text{Elimination}}{\text{Plasma drug concentration}}$$



Mechanism of renal clearance

- **Renal Clearance (Cl_R):** It can be defined as the volume of blood or plasma which is completely cleared of the unchanged drug by the kidney per unit.
- It is expressed mathematically as:

$$Cl_R = \frac{\text{Rate of urinary excretion}}{\text{Plasma drug concentration}}$$



Mechanism of renal clearance

- Physiologically speaking, renal clearance is the ratio of “sum of rate of glomerular filtration and active secretion minus rate of reabsorption” to “plasma drug concentration C”.

Rate of filtration + Rate of secretion – Rate of reabsorption

$$Cl_R = \frac{\text{Rate of filtration + Rate of secretion – Rate of reabsorption}}{C}$$

Cl_R of drug

$$\text{Renal Clearance Ratio} = \frac{\text{Rate of filtration + Rate of secretion – Rate of reabsorption}}{Cl_R \text{ of certainine}}$$



Mechanism of renal clearance

<i>Renal Clearance (ml/min)</i>	<i>Renal Clearance Ratio</i>	<i>Mechanism of Renal Clearance</i>	<i>Example(s)</i>
0 (least value)	0	Drug filtered and Reabsorbed completely	Glucose
< 130	Above 0, Below 1	Drug filtered and Reabsorbed partially	Lipophilic drugs
130 (GFR)	1	Drug is filtered only	Creatinine, Inulin
> 130	> 1	Drug filtered as well as secreted actively	Polar, ionic drugs
650 (Highest value)	5	Clearance equal to renal plasma flow rate	Iodopyracet



Determination of clearance

- One method of quantitatively describing the renal excretion of drugs is by means of the renal clearance value for the drug.
- Renal clearance can be used to investigate the mechanism of drug excretion:
 - A- If the drug is filtered but not secreted or reabsorbed the renal clearance will be about 120 ml/min in normal subjects.
 - B- If the renal clearance is less than 120 ml/min then we can assume that at least two processes are in operation, glomerular filtration and tubular re-absorption.
 - C- If the renal clearance is greater than 120 ml/min then tubular secretion must be contributing to the elimination process.



Renal excretion

- *Excretion is defined as the process whereby drugs and/or their metabolites are irreversibly transferred from internal to external environment.*
- Excretion of drug by kidneys is called as **renal excretion**.
- Excretion of unchanged or intact drug is important in the termination of its pharmacological action.
- The principal organs of excretion are kidneys.
- Excretion by organs other than kidneys such as lungs, biliary system, intestine, salivary glands and sweat glands is known as **nonrenal excretion**.

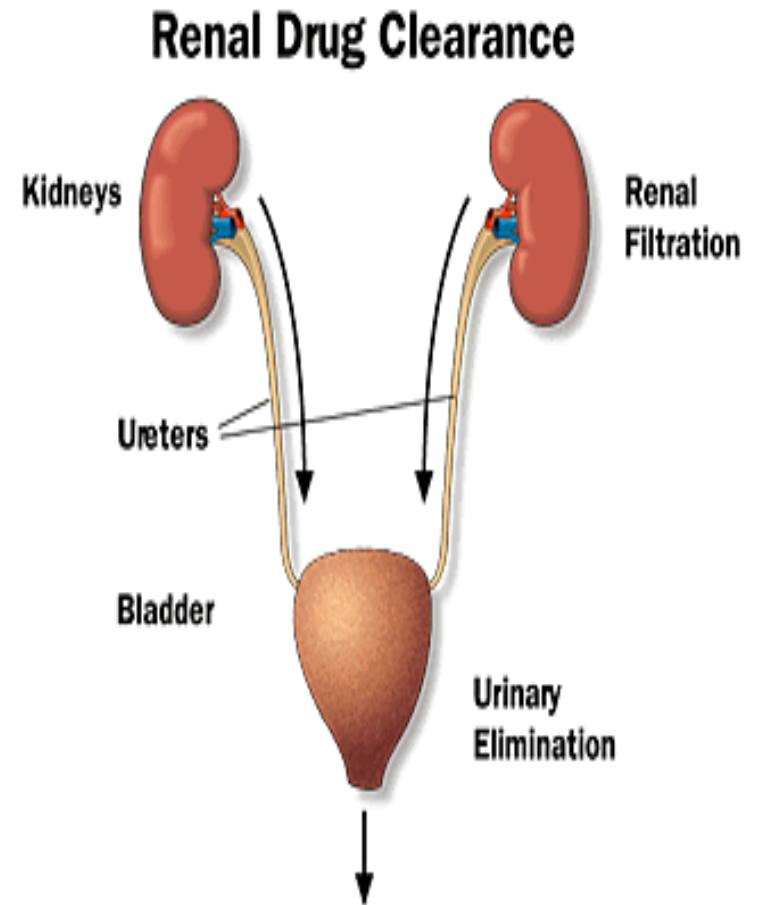
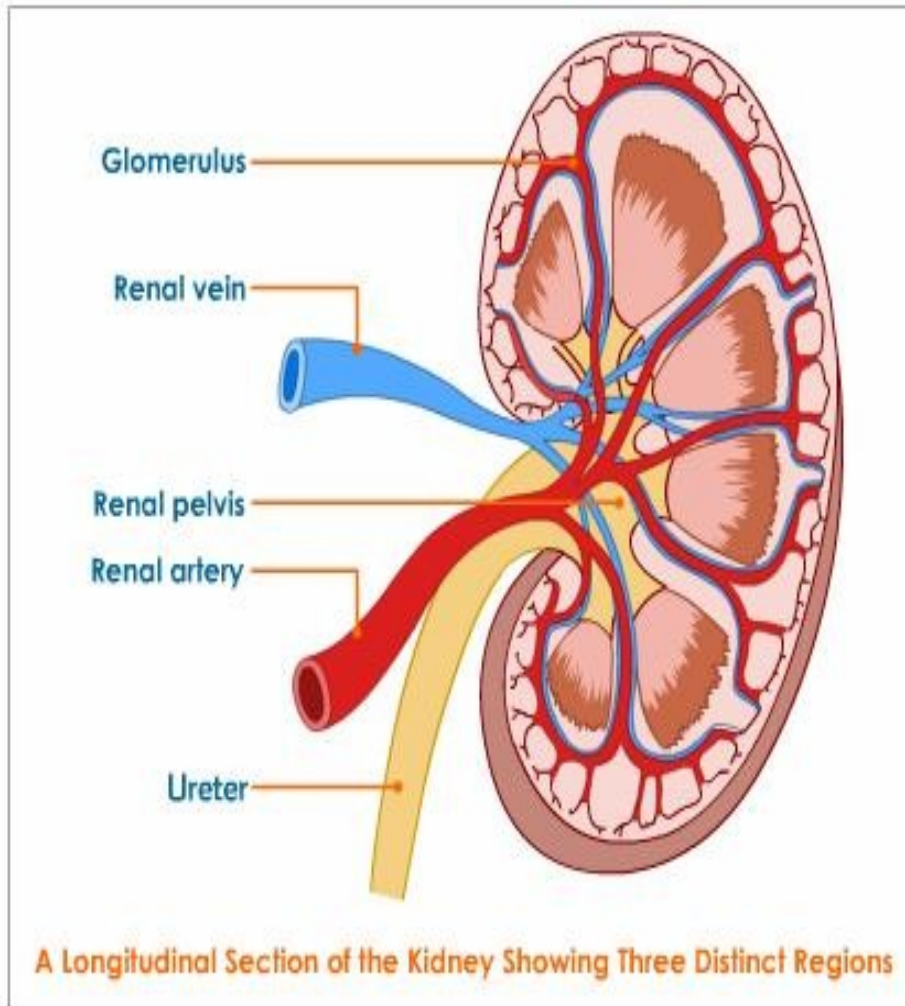


Renal excretion

The major organ for the excretion of drugs is the **KIDNEY**. The functional unit of the kidney is the **nephron**.

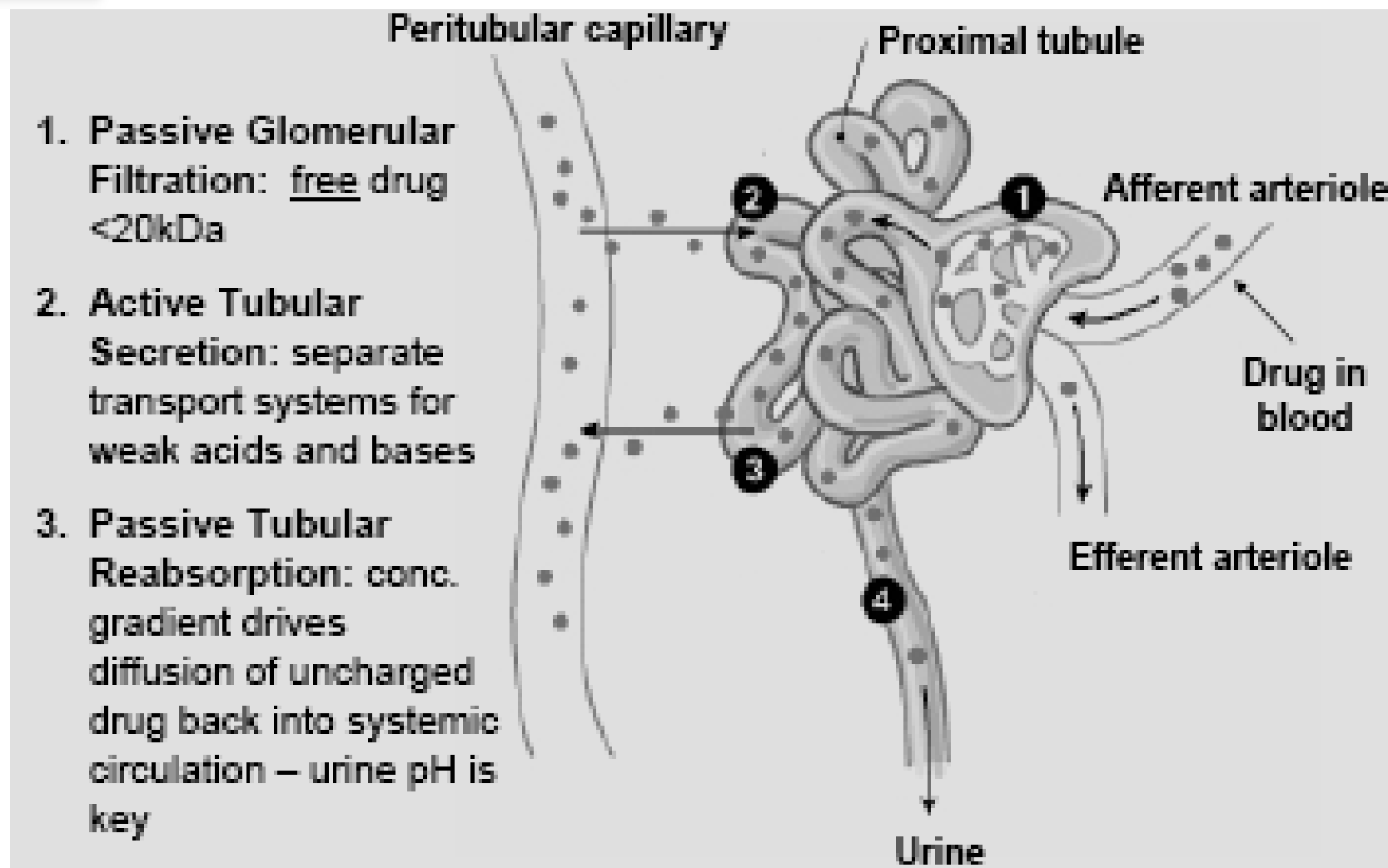


Renal excretion



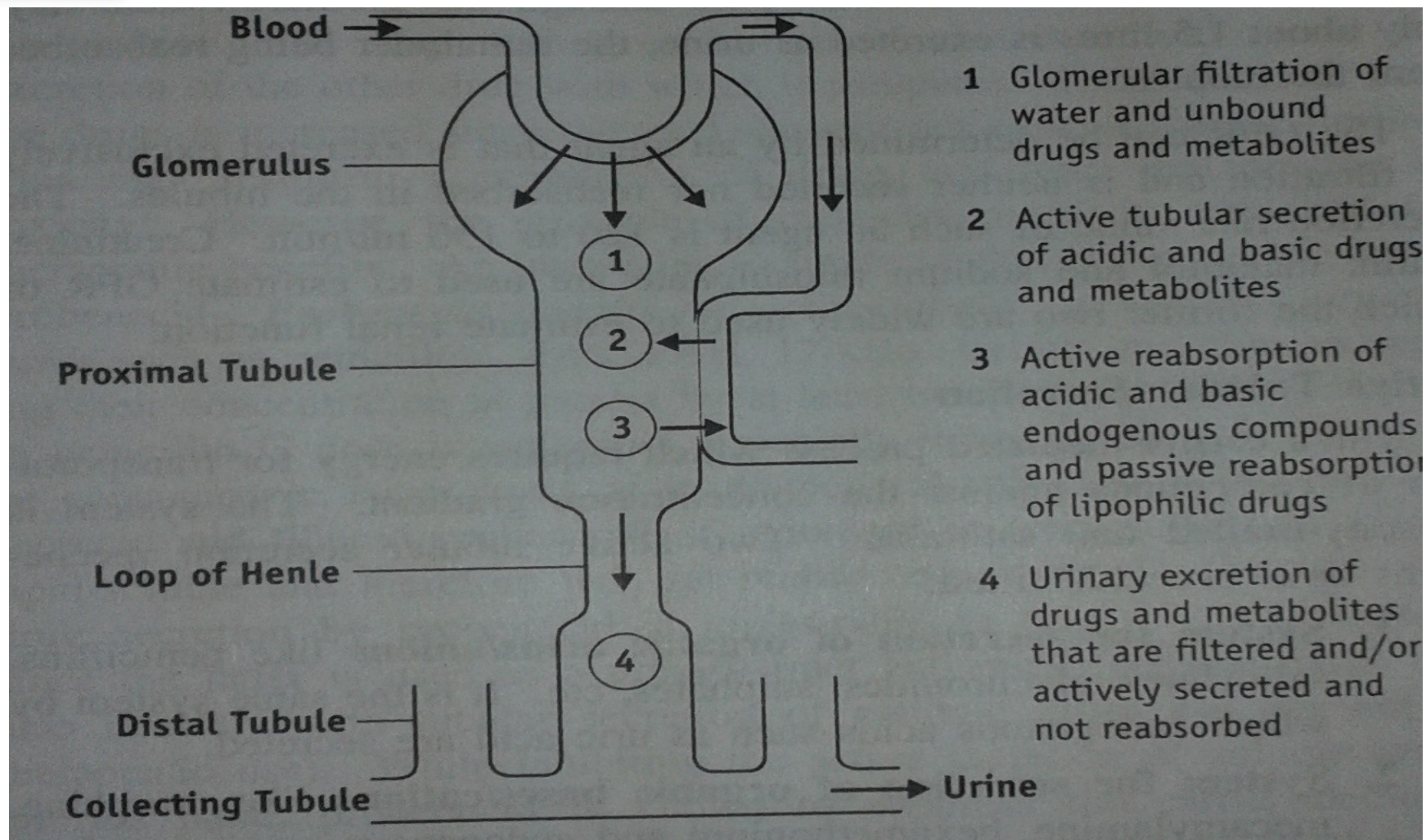


Renal excretion





Renal excretion





THANK YOU

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