

# RENAL PHYSIOLOGY

## PLASMA CLEARANCE

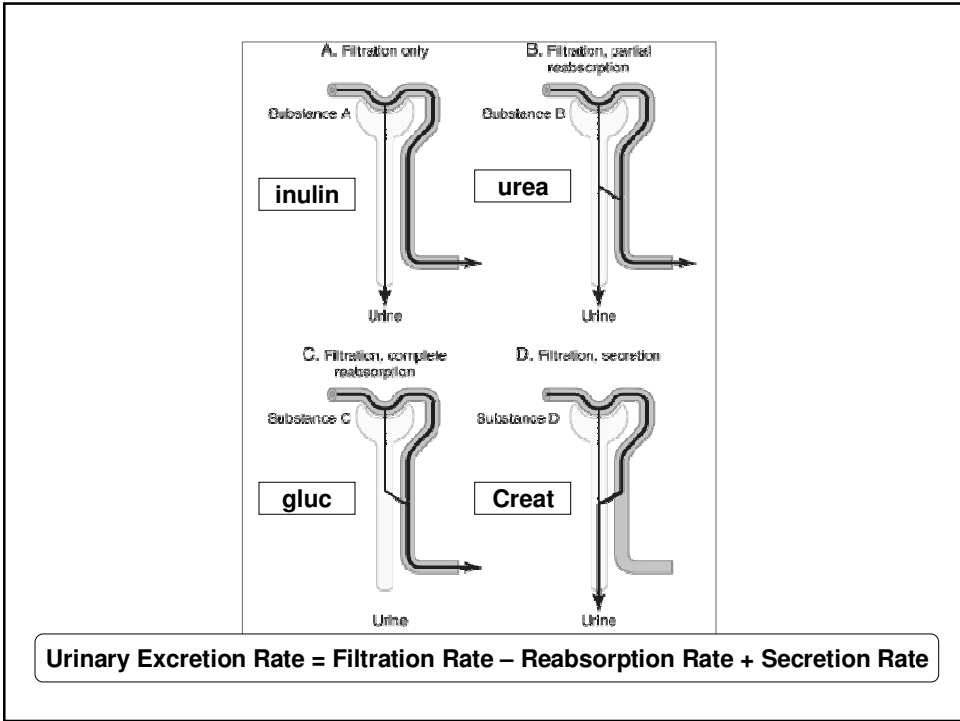


**DR SYED SHAHID HABIB**  
**MBBS DSDM FCPS**  
Assistant Professor  
Dept. of Physiology  
College of Medicine & KKHU

## PLASMA CLEARANCE

- **The Volume of Plasma that is completely cleared of any substance by the Kidneys per minute is called the clearance of that particular substance**

**Clearance = Urine Conc. X Vol of Urine/ Plasma Conc**



# FILTRATE HANDLING

Relative Concentrations of Substances in the Plasma, Glomerular Filtrate, and Urine			
Concentrations (mEq/l)			
Substance	Plasma	Glomerular filtrate	Urine
Sodium (Na <sup>+</sup> )	142	142	128
Potassium (K <sup>+</sup> )	5	5	60
Calcium (Ca <sup>+2</sup> )	4	4	5
Magnesium (Mg <sup>+2</sup> )	3	3	15
Chloride (Cl <sup>-</sup> )	103	103	134
Bicarbonate (HCO <sub>3</sub> <sup>-</sup> )	27	27	14
Sulfate (SO <sub>4</sub> <sup>-2</sup> )	1	1	33
Phosphate (PO <sub>4</sub> <sup>-3</sup> )	2	2	40
Concentrations (mg/100ml)			
Substance	Plasma	Glomerular filtrate	Urine
Glucose	100	100	0
Urea	26	26	1820
Uric acid	4	4	53

# CLEARANCE

Vol. of Plasma to be Cleared x Plasma Conc  
 =  
 Vol. of Urine x Urine Conc (ml/min)

$$P_s \times C_s = U_s \times V$$

$$C_s = U_s \times V / P_s$$

- $C_s$  is the clearance rate of a substance  $s$
- $P_s$  is the plasma concentration of the substance
- $U_s$  is the urine concentration of that substance
- $V$  is the urine flow rate

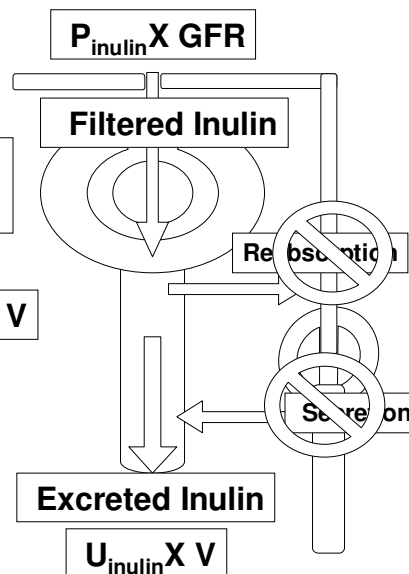
## INULIN CLEARANCE

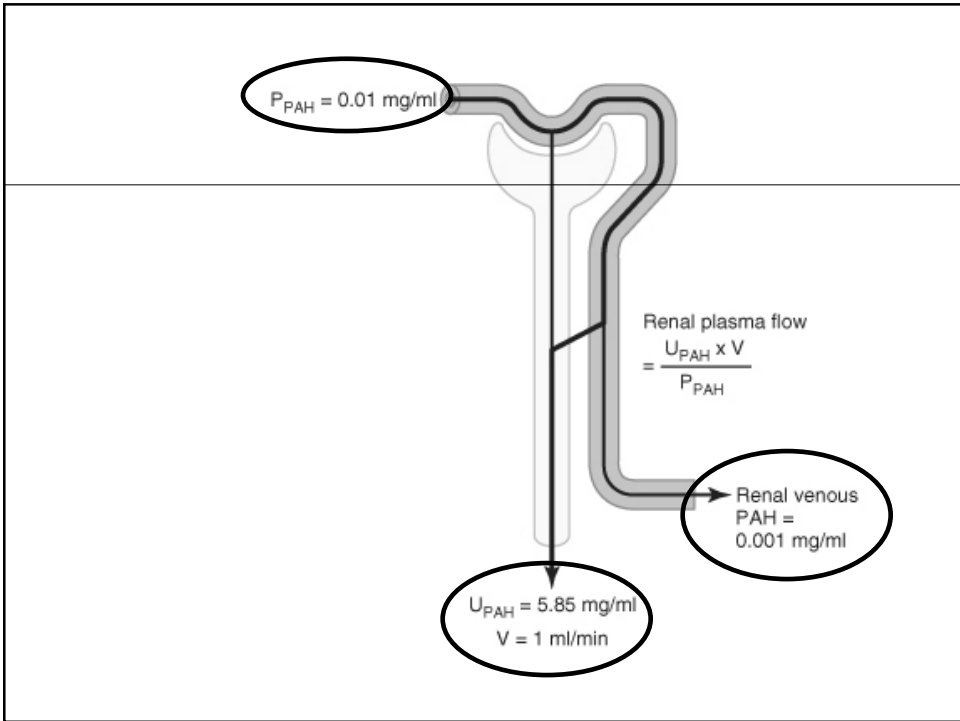
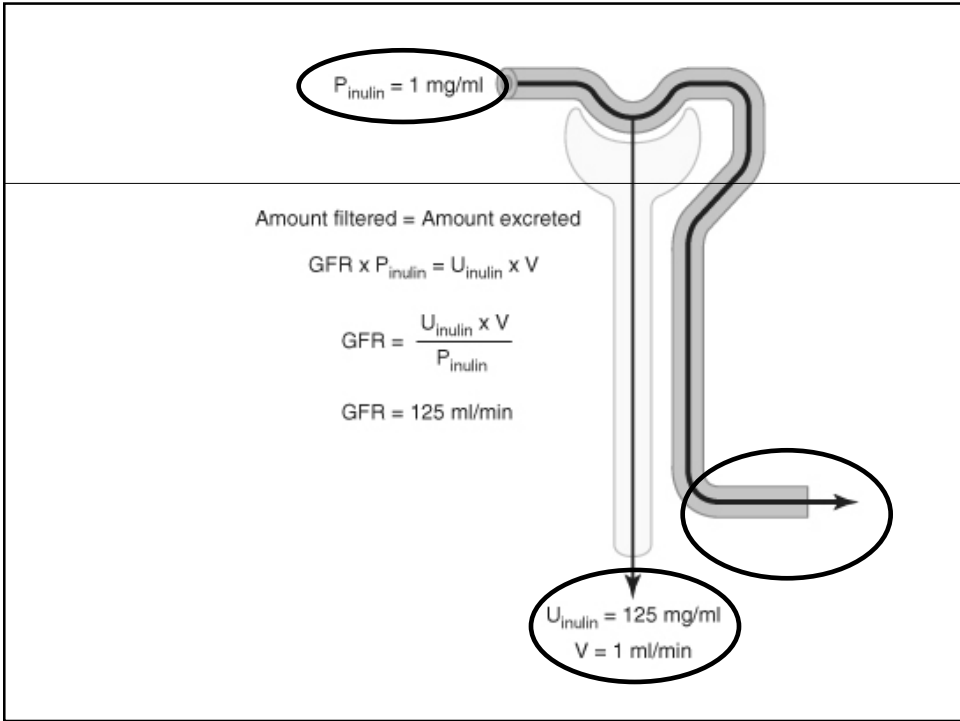
Filtered Inulin = Excreted Inulin

$$P_{\text{inulin}} \times \text{GFR} = U_{\text{inulin}} \times V$$

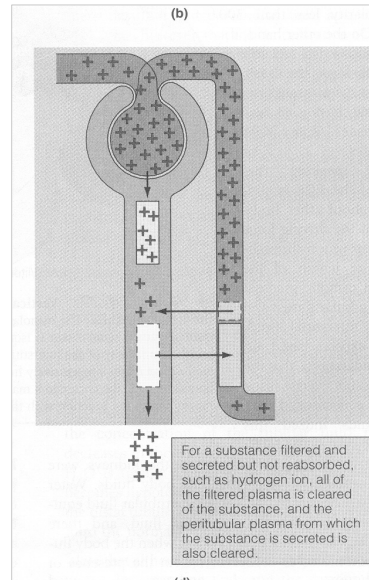
OR

$$\text{GFR} = \frac{U_{\text{inulin}} \times V}{P_{\text{inulin}}}$$

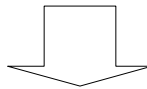




**Freely filtered  
Not Reabsorbed  
Secreted**



$$\text{Renal Blood Flow} = \text{RPF} / 1 - \text{Hematocrit}$$



$$650 / 1 - 0.45 = 1182 \text{ ml/min}$$

<b>Substance</b>	<b>Clearance rate ml/min</b>
Glucose	0
Sodium	0.9
Chloride	1.3
Potassium	12.0
Phosphate	25.0
Inulin	125.0
Creatinine	140.0

## **RENAL FUNCTION TESTS**

### **CREATININE CLEARANCE AS A TEST OF RENAL FUNCTION**

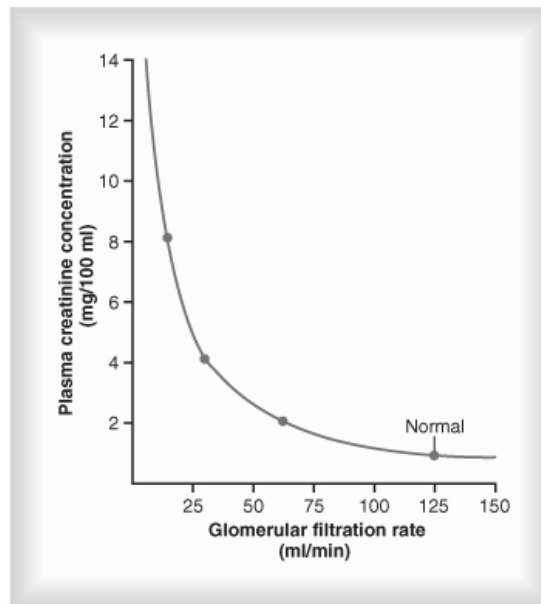
# EXAMPLE

**Clearance = Urine Conc. x Vol of Urine/ Plasma Conc  
FOR PAH**

$$\begin{aligned} \text{CPAH} &= \text{UPAH} \times V / \text{PPAH} \\ 5.85 \text{ mg/ml} \times 1 \text{ ml/min} / 0.01 \text{ mg/ml} &= 585 \text{ ml/min} \\ &= \text{ERPF} \end{aligned}$$

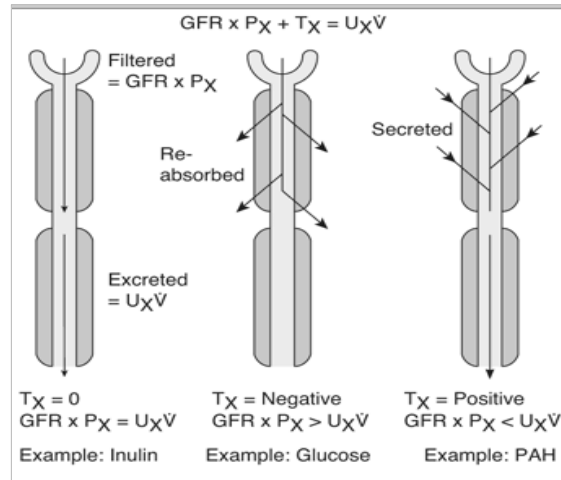
$$\begin{aligned} \text{Actual Renal Plasma Flow} &= \text{ERPF} / \text{Extraction Ratio} \\ &= 585 / 0.9 = 650 \text{ ml/min} \end{aligned}$$

Extraction ratio (EPAH) is calculated as the difference between the renal arterial PAH (PPAH) and renal venous PAH (VPAH) concentrations, divided by the renal arterial PAH concentration



© Elsevier. Guyton & Hall: Textbook of Medical Physiology 11e - www.studentconsult.com

$$U_x V = GFR \times P_x + T_x$$



**$T_x$  = net amount transferred by the tubules**