RENAL PHYSIOLOGY

PLASMA CLEARANCE

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

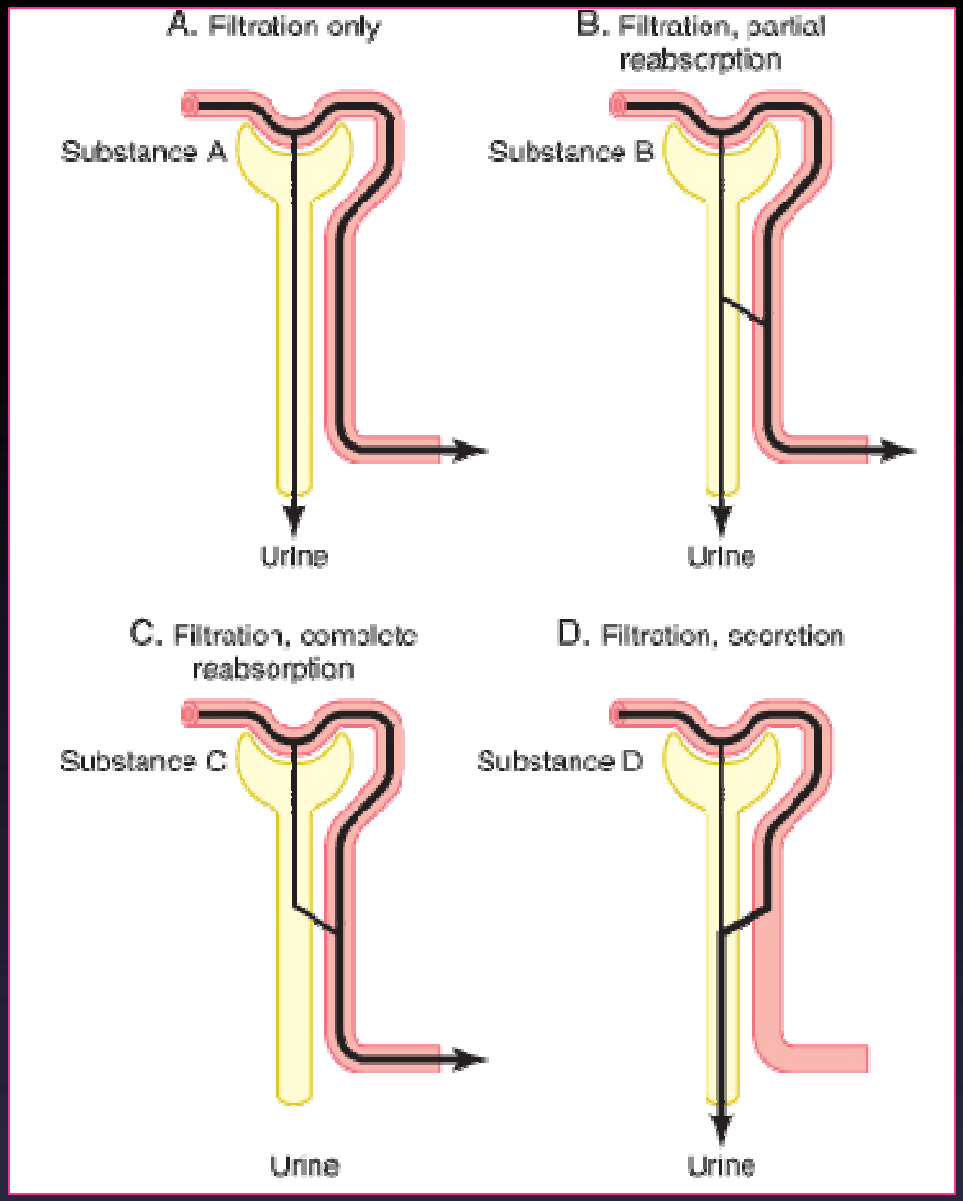
PLASMA CLEARANCE

- 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

FOUR POSSIBILITIES

1. **Freely filtered – Not Reabsorbed – Not Secreted**
2. **Freely filtered – All Reabsorbed – Not Secreted**
3. **Freely filtered – Partially Reabsorbed – Not Secreted**
4. **Freely filtered – Not Reabsorbed – Secreted**


A. Filtration only
Substance A
Urine
B. Filtration, partial reabscrption
Substance B
Urine
C. Filtration, complete reabsorption
Substance C
Urine
D. Filtration, secretion
Substance D
Urine

CLEARANCE

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

$$Cs \times Ps = Us \times V$$

$$Cs = Us \times V / Ps$$

- Cs is the clearance rate of a substance s
- Ps is the plasma concentration of the substance
- Us is the urine concentration of that substance
- V is the urine flow rate

EXAMPLE

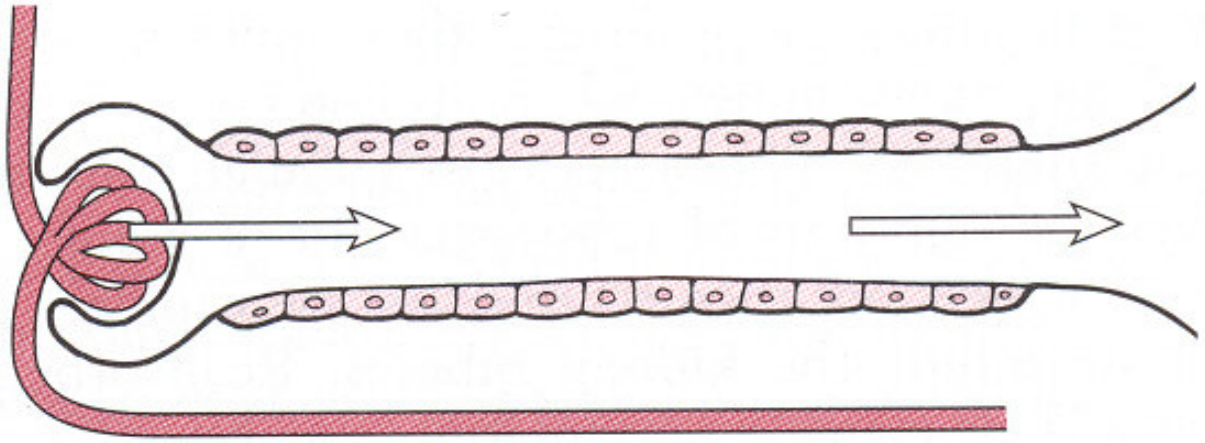
If

- Ps = 1 mg/ml
- Us = 1 mg/ml
- V = 1 ml/min

WHAT IS THE CLEARANCE OF THIS SUBSTANCE ?

CAN YOU CORRELATE IT TO GFR ?

INULIN CLEARANCE EQUALS GFR



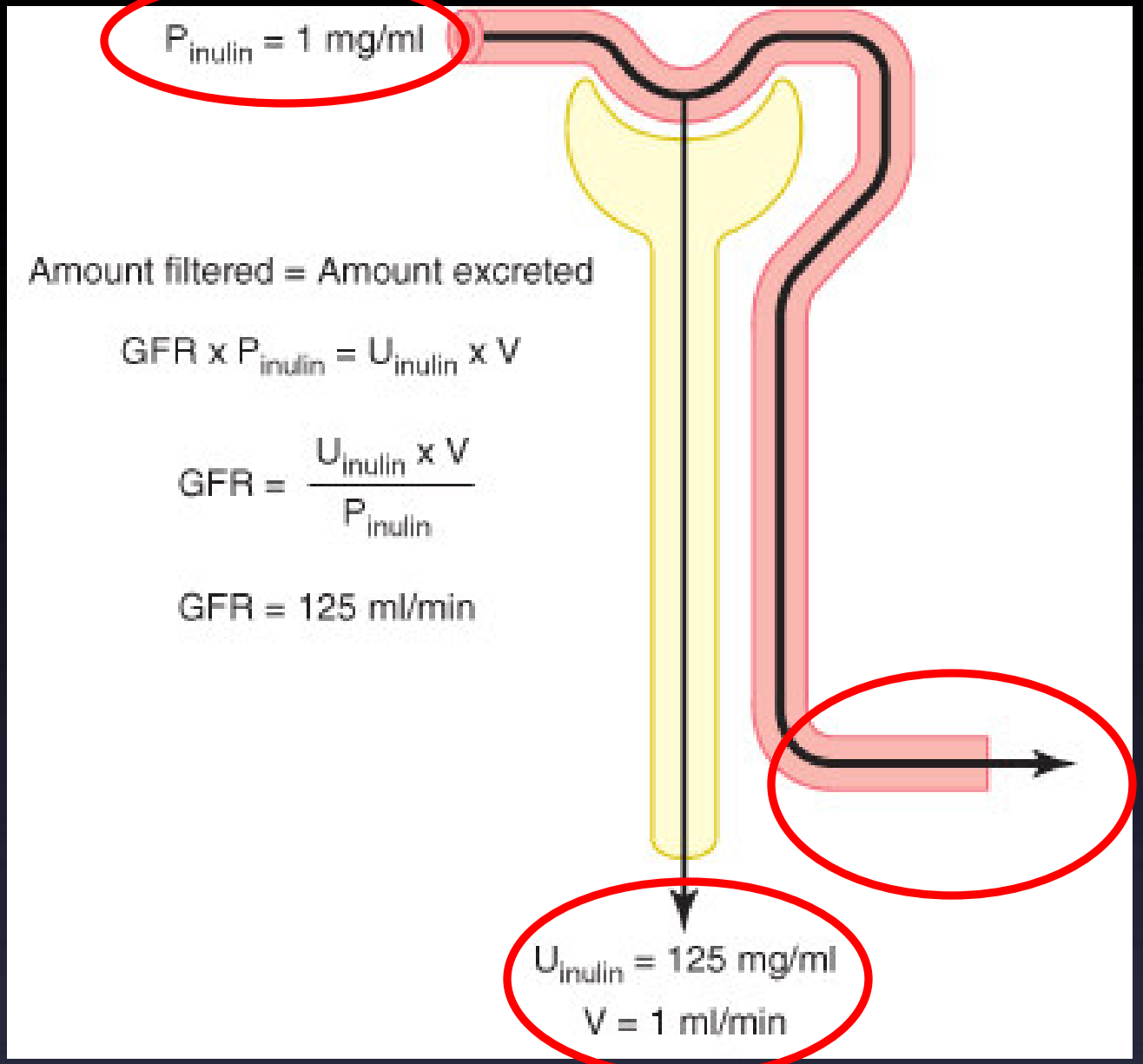
Filtered inulin
$P_{IN} \times GFR$

=

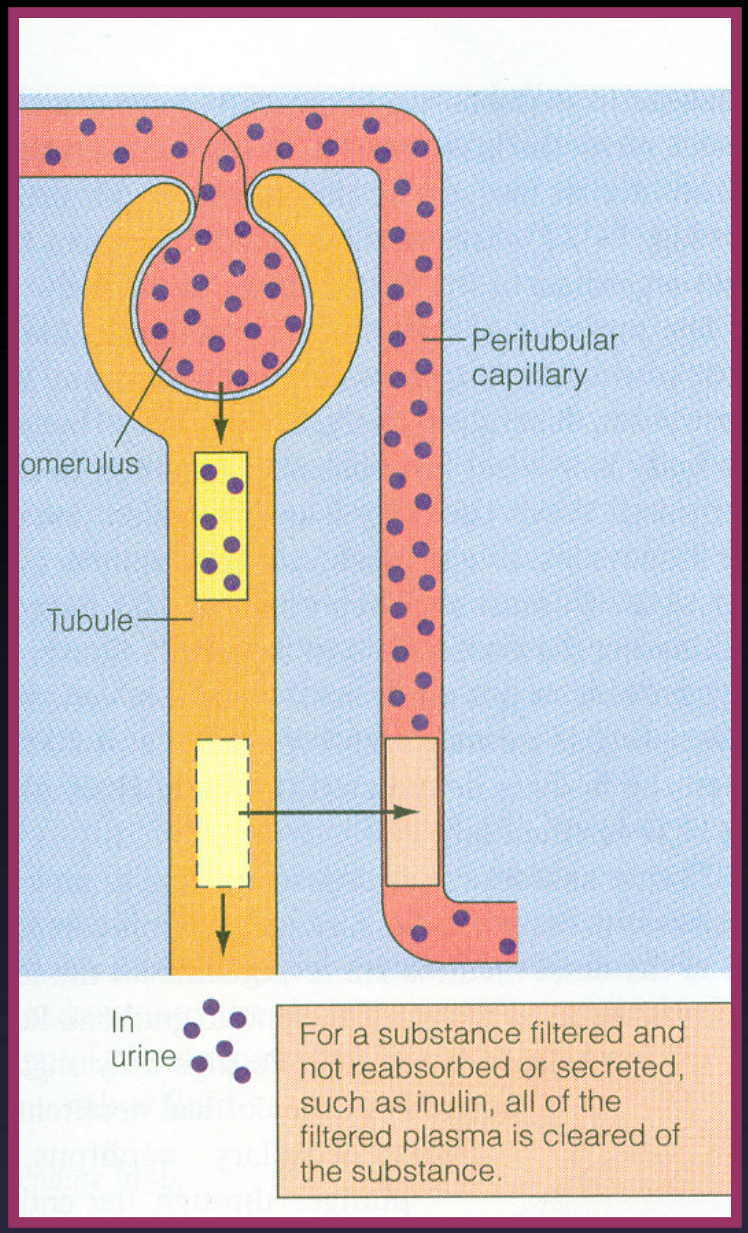
Excreted inulin
$U_{IN} \times \dot{V}$

$$GFR = \frac{U_{IN}\dot{V}}{P_{IN}} = C_{IN}$$

FIGURE 23.6 **The principle behind the measurement of glomerular filtration rate (GFR).** P_{IN} = plasma [inulin], U_{IN} = urine [inulin], $\dot{V}$ = urine flow rate, C_{IN} = inulin clearance.


P_{inulin} = 1 mg/ml
Amount filtered = Amount excreted
GFR x P_{inulin} = U_{inulin} x V
GFR = $\frac{U_{inulin} \times V}{P_{inulin}}$
GFR = 125 ml/min
U_{inulin} = 125 mg/ml
V = 1 ml/min

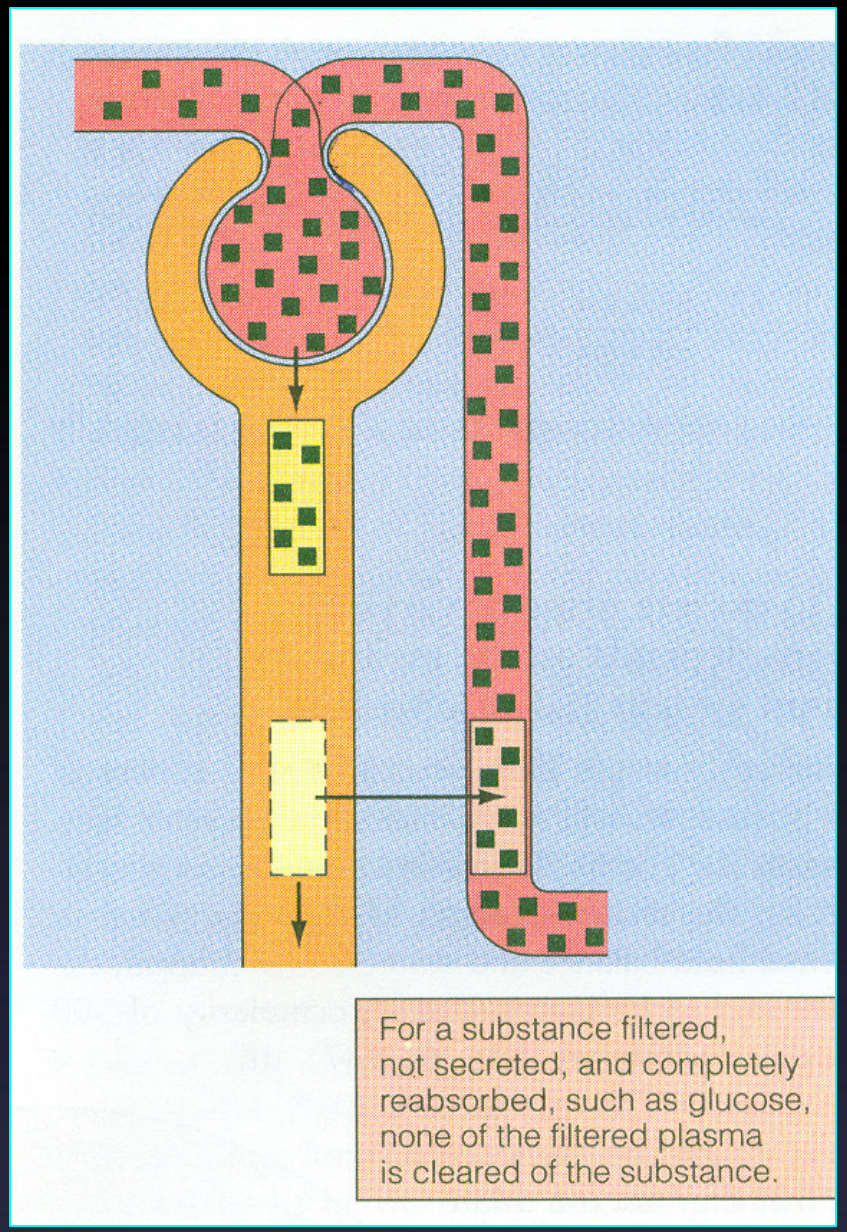
Freely filtered
Not Reabsorbed
Not Secreted



Freely filtered

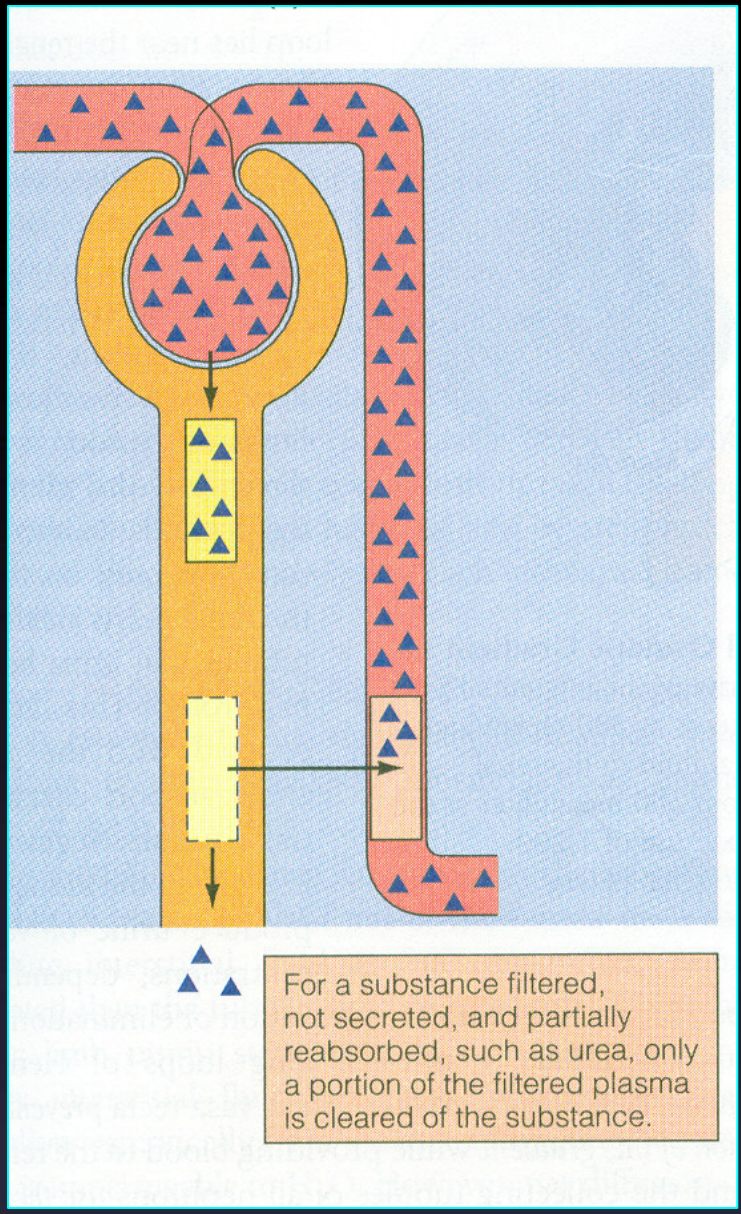
All Reabsorbed

Not Secreted

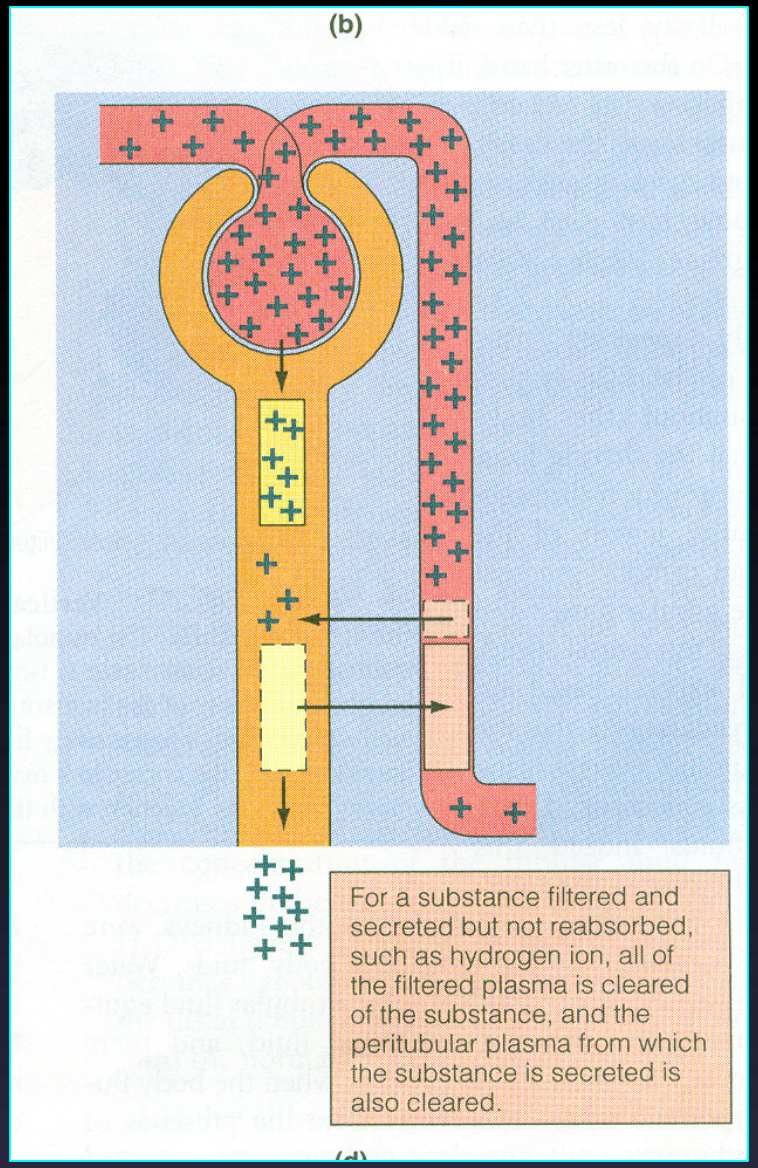


For a substance filtered, not secreted, and completely reabsorbed, such as glucose, none of the filtered plasma is cleared of the substance.

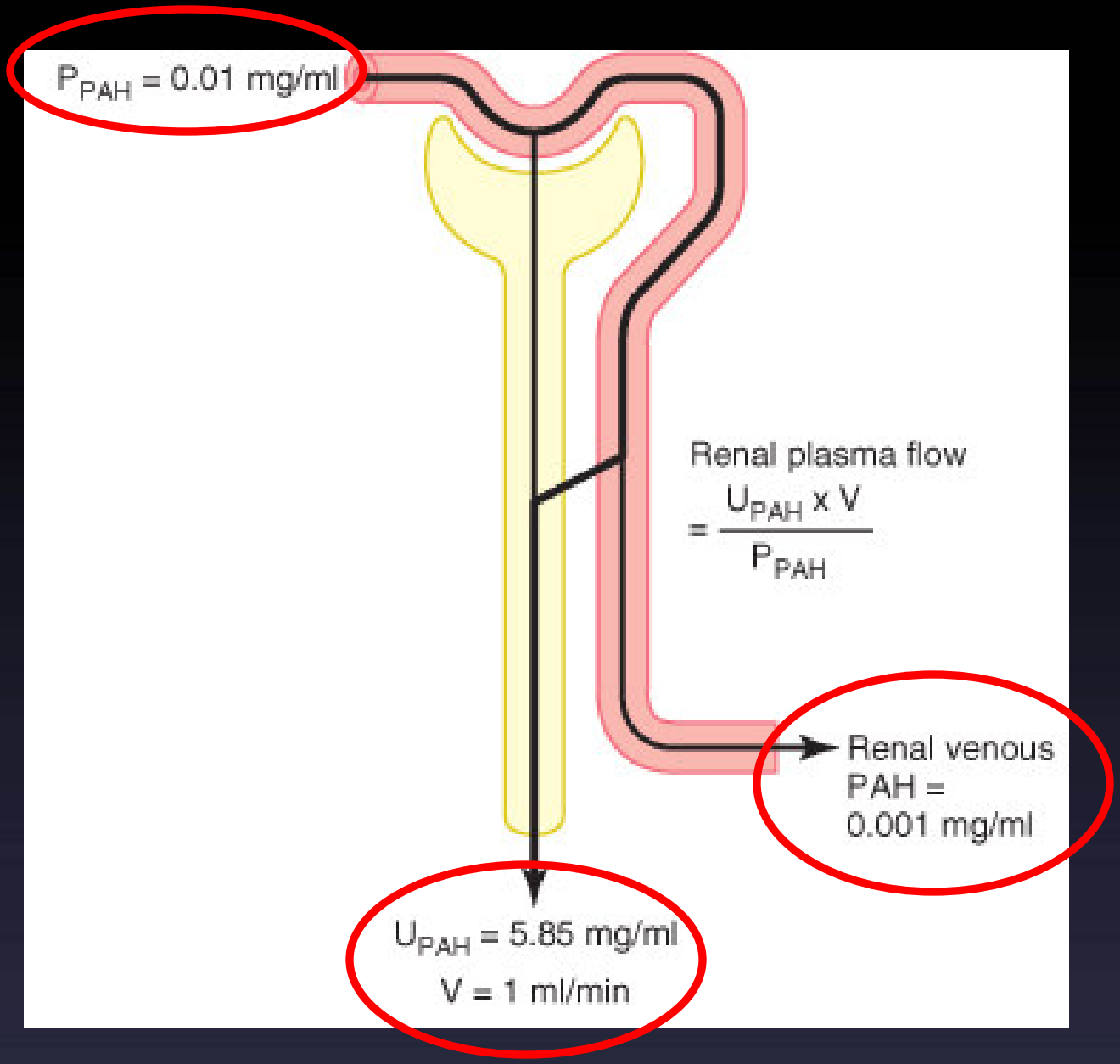
Freely filtered
Partially Reabsorbed
Not Secreted



Freely filtered
Not Reabsorbed
Secreted



CAN YOU CORRELATE IT TO RENAL PLASMA FLOW ?


P_{PAH} = 0.01 mg/ml
Renal plasma flow
$= \frac{U_{PAH} \times V}{P_{PAH}}$
Renal venous PAH = 0.001 mg/ml
U_{PAH} = 5.85 mg/ml
V = 1 ml/min

EXAMPLE

Clearance = Urine Conc. x Vol of Urine/ Plasma Conc

FOR PAH

CPAH = UPAH x V/ PPAH
5.85 mg/ml x 1 ml/min/ 0.01 mg/ml = 585 ml/min
= ERPF

Actual Renal Plasma Flow = ERPF/ Extraction Ratio
= 585/0.9 = 650 ml/min

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

CAN YOU CALCULATE RENAL BLOOD FLOW NOW ?

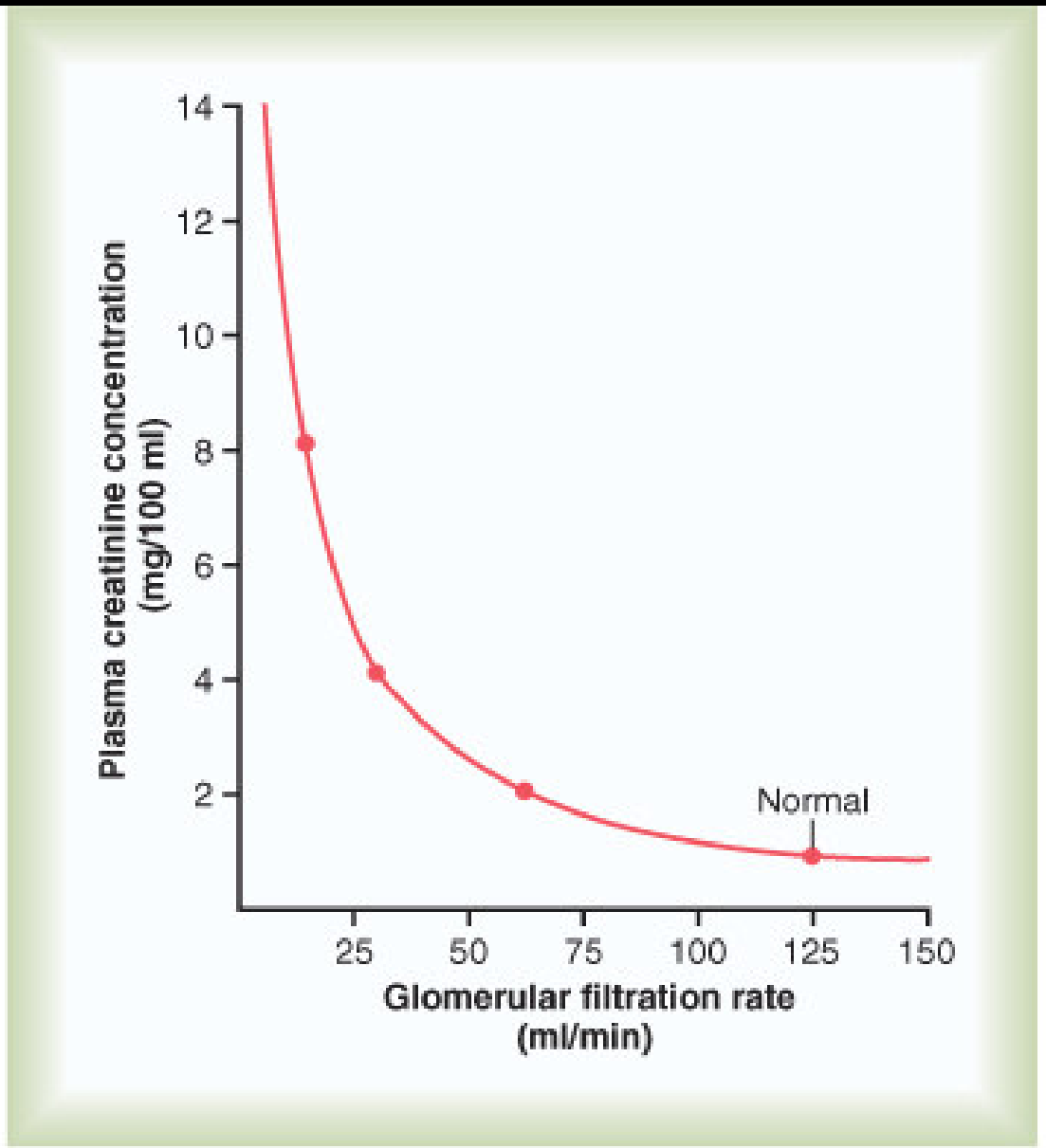
Renal Blood Flow = RPF/ 1 - Hematocrit

650 / 1 – 0.45 = 1182 ml/min

Substance	Clearance rate ml/min
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



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