# Renal Blood Flow & Renal Plasma Flow

Q

RBF = 1250 ml/min

[Kidneys recieves 20-25% of CO]

↓ But, as Blood cells are not filtered
∴ RPF is of more importance

Q

RPF = 55% of RBF

RPF = 625 ml/min

$$RBF = RPF \times \frac{1}{1 - Hct}$$

(Hct ≈ 45%)

## * Relation b/w RBF & $O_2$ consumption

↳ Depends on $Na^+$ reabsorption

RBF ↓ → GFR ↓ → $Na^+$ filtration ↓
↓
**$Na^+$ reabsorption ↓**
↓
**$O_2$ consumption by kidneys ↓**


## * Determinants of RBF :-

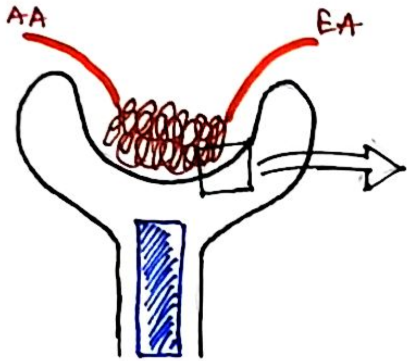
$$RBF \propto \frac{(\text{Renal artery press}) - (\text{Renal vein press.})}{(\text{Total renal vasc. resistance})}$$

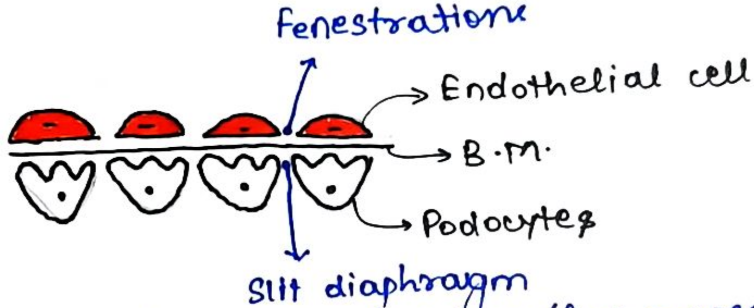
Renal artery press → similar to systemic arterial press.

Renal vein press. → 3-4 mm Hg

| | const. | Dilat. |
|---|---|---|
| • interlobular artery | Res. ↑ RBF ↓ | Res. ↓ RBF ↑ |
| • EA | Res ↑ RBF ↓ | Res. ↓ RBF ↑ |
| • AA | Res. ↑ RBF ↓ | Res. ↓ RBF ↑ |

# Glomerular Capillary Membrane




(space b/w footplates/foot processes of adjacent podocytes)

**Proteins & cellular components are not filtered by GC**

① **Size barrier** ⇒ Fenestrations i.e. small gaps in capillaries (size :- 4-8 nm)

⇓

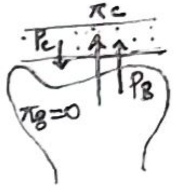
Doesnot allows large protein molecules to pass through.

② **Charge barrier** ⇒
- Proteins (−ve)
- GC (−ve)
  - Endoth.⊖
  - BM⊖
  - Podocyte⊖

{Mainly d/t proteoglycan (Heparan sulphate)}

③ Slit diaphragm ⇒ formed by food process of podocytes

# Determinants of GFR




determined by

- **Starling forces** ⇓ Net filtration Press. **(NFP)**
- **$K_f$** (Glomerular capillary filtration coefficient)

$$GFR = K_f \times NFP$$

$K_f$:
- hydraulic conductivity
- S.A. of GC

⇓ Property of GC

NFP → starling forces (forces required for filtration)

**Favoring force**

1.) Hydrostatic press. in GC ($P_c$) = 60 mmHg

2) Oncotic press in B.C. ($\pi_B = 0$)

**Opposing forces**

1.) Oncotic press of GC ($\pi_c$) = 32 mmHg

2.) Hydrostatic press in BC ($P_B$) = 18 mmHg

$$GFR = 125\ ml/min$$

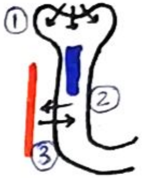
$$NFP = \text{Favoring} - \text{Opposing}$$

$$= (P_c + \pi_B) - (\pi_c + P_B)$$

$$= (60 + 0) - (32 + 18) = 10\ mmHg$$

# Use of CLEARANCE to quantify GFR & RBF :-

↳ volume of plasma completely cleared of a substance by kidneys per unit time.




Kidney filters INULIN completely → Inulin cleared from plasma

∴ INULIN is gold standard for measuring GFR
- → freely filtered
- → No secretion
- → No reabsorption

Procedure :-

i.v. inulin → Plasma inulin conc (P)
↓
Kidneys
↓
Filtration

$$\text{Clearance (inulin)} = \frac{\text{urine inulin conc (U)} \times \text{Vol. of urine (V)}}{\text{Plasma inulin conc (P)}}$$

QQ

$$\text{Clearance (inulin)} = \frac{U \times V}{P} = GFR = 125\ ml/min$$

Practical method for GFR measurement :-
Plasma creatinine

$$\downarrow GFR = \frac{U.V}{P \uparrow}$$

# Clearance = GFR — Eg:- Inulin
- No secretion
- No reabsorption

# Clearance > GFR — Eg:- PAH
- Net secretion

# Clearance < GFR — Eg:- Glucose
- Net reabsorption

PAH is almost completely secreted into renal tubules

⇓

∴ Gold standard for RPF measurement = PAH

**Effective RPF = 625 ml/min** Q

(PAH gives low value of RPF bcoz → 90% of PAH is extracted by kidneys)

**Extraction ratio (PAH) = 0·9** Q

**Filtration fraction :-**

$$= \frac{GFR}{RPF} = \frac{125 \text{ ml/min}}{625 \text{ ml/min}}$$

**FF = 20%** Q

$$\text{True RPF} = \frac{\text{Effective RPF}}{\text{Ex. Ratio}} = \frac{625}{0\cdot9}$$

**True RPF = 700 ml/min** Q

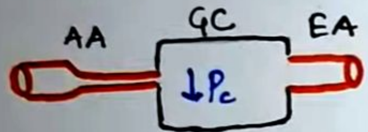
# Physiological control of GFR & RPF :-

Remember

All constriction ↓ses RBF
All dilatations ↑ses RBF

## Case I :- Constriction of AA

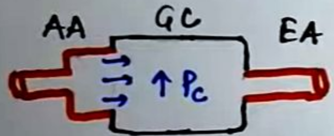
- Epi
- NE
- Endothelin




RBF = ↓
GFR = ↓

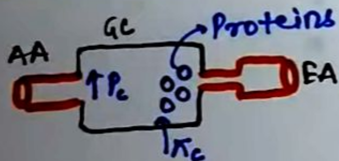
## Case II :- Dilatation of AA

(• Bradykinin
• Prostaglandin)




RBF = ↑
GFR = ↑

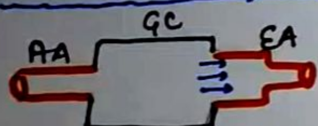
## Case III :- Constriction of EA (• Angiotensin II)




RBF = ↓
GFR = Biphasic (↑ then ↓)

- Initial ↑ GFR (d/t ↑ $P_c$)
- Later ↓ GFR (d/t ↑ $\pi_c$)

## Case IV :- Dilatation of EA (ACE ⊖)




RBF = ⬆
GFR = ↓