

Determinants and Regulation of GFR

Learning Objective

To understand -

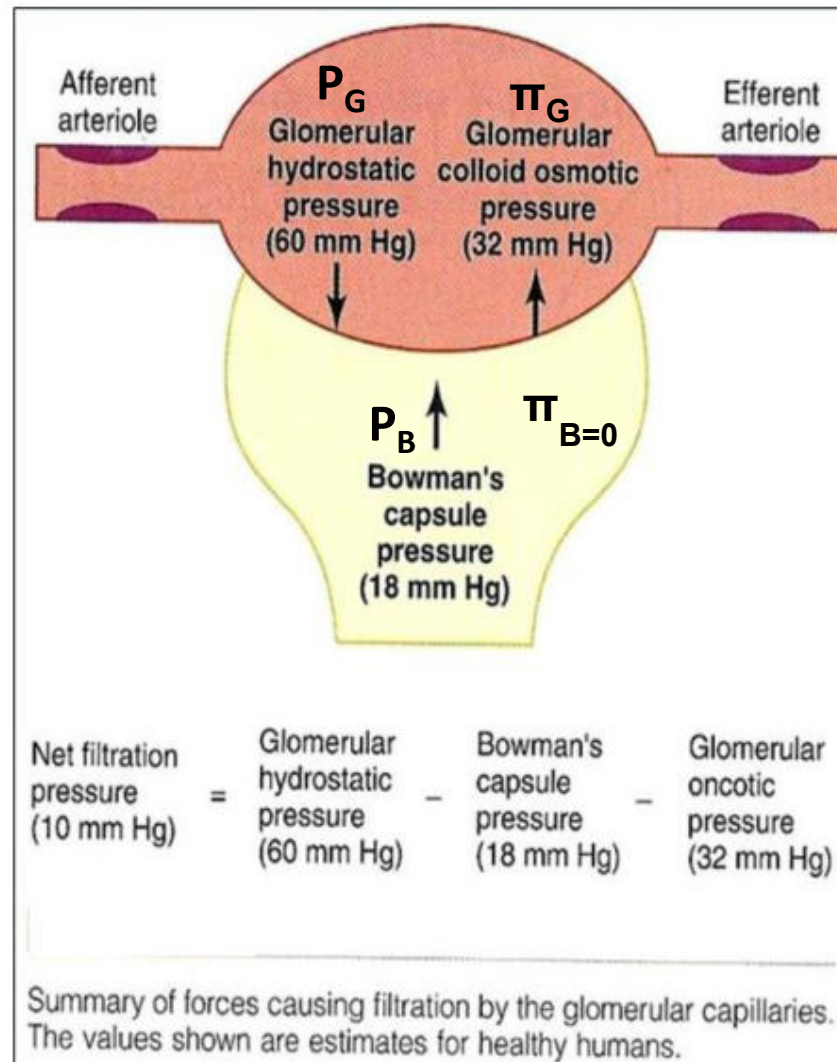
- The forces that determine glomerular filtration rate.
- The regulation of glomerular filtration
- Autoregulation and its mechanism
- Juxta glomerular apparatus (JGA)

Determinants of GFR

The GFR is determined by

Sum of the hydrostatic and colloid osmotic forces across the glomerulus –

Starling forces inform us about net fluid movement:



Determinants of GFR

$$GFR = K_f \times [(P_G - P_B) - (\pi_G - \pi_B)]$$

Net filtration pressure = 10

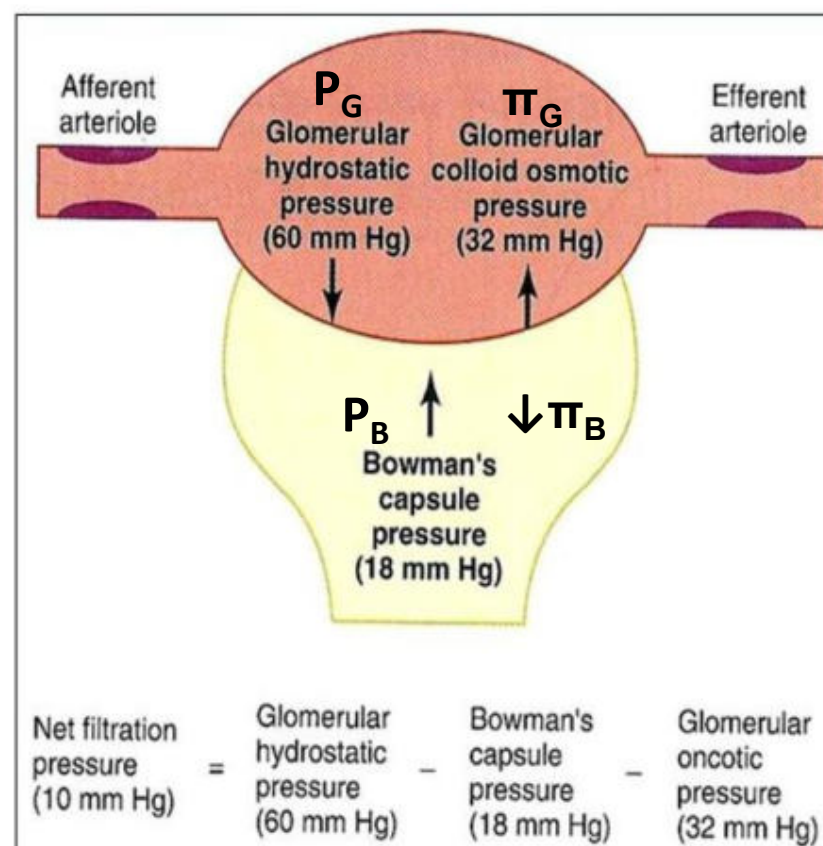
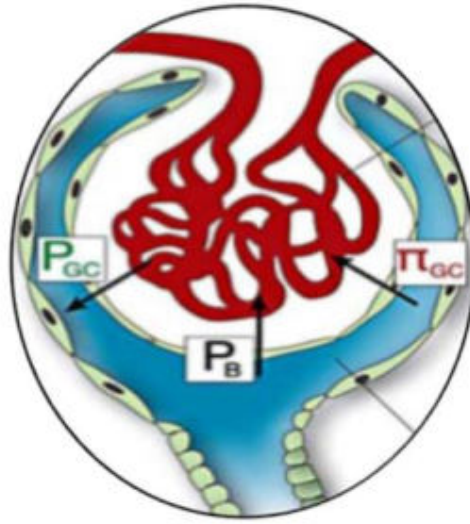


Figure 26-12

Summary of forces causing filtration by the glomerular capillaries. The values shown are estimates for healthy humans.

Pressures & causes–Decreased Glomerular Filtration Rate (GFR)

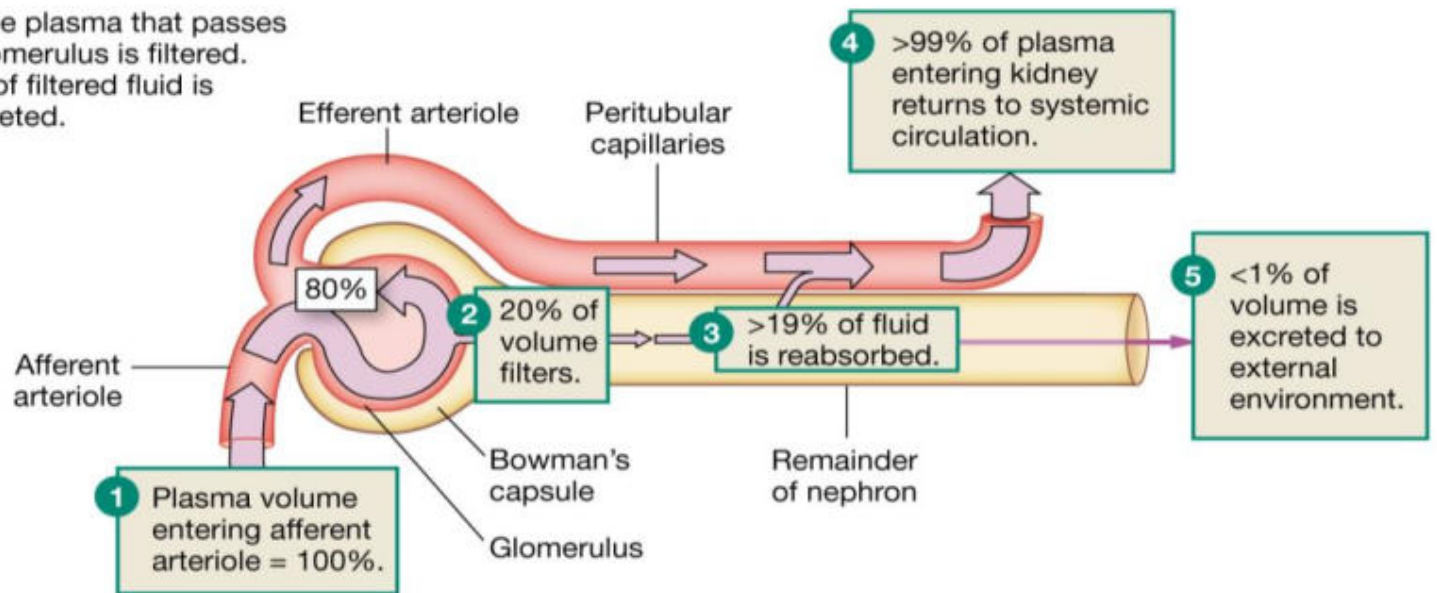
$$\text{GFR} = K_f \times [(P_G - P_B) - (\pi_{GC} - \pi_B)]$$



REGULATION OF GFR

GFR must be precisely regulated

Only 20% of the plasma that passes through the glomerulus is filtered. Less than 1% of filtered fluid is eventually excreted.



Intrinsic and Extrinsic Control of GFR

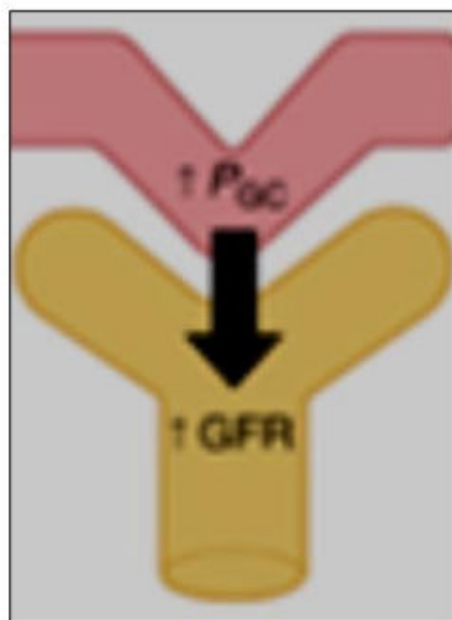
Intrinsic Control mechanisms of GFR

1) Autoregulation

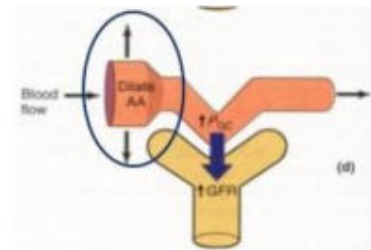
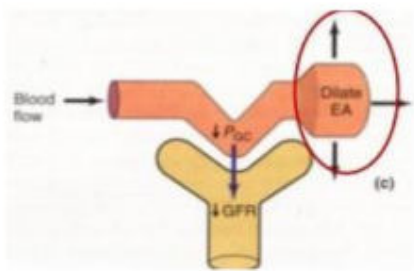
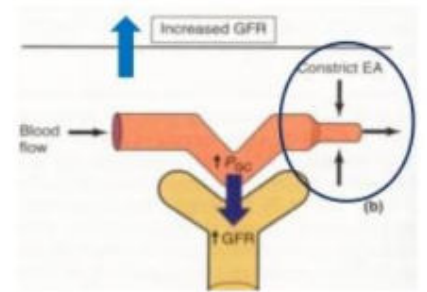
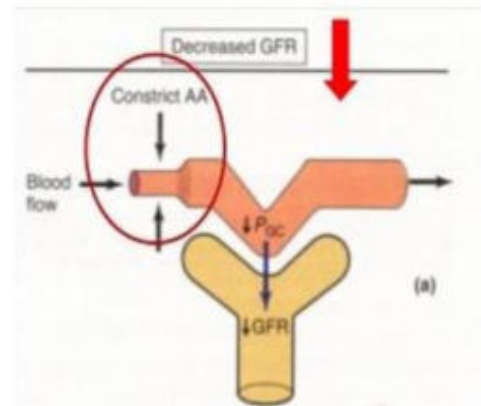
2) Extrinsic Control mechanisms of GFR

Renal Auto regulation - Intrinsic Control

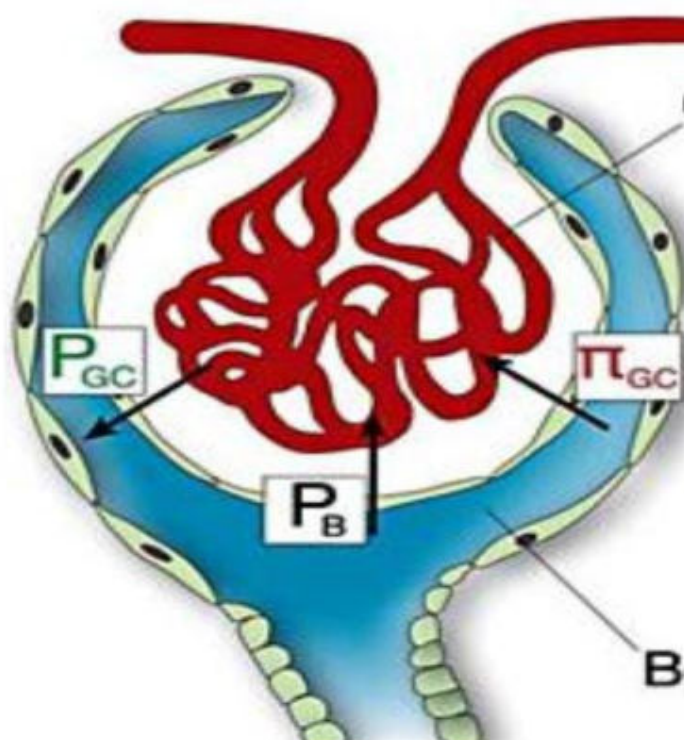
**Some concepts regarding control of GFR
(flow in glomerulus)**



Some concepts regarding control of GFR regarding flow of glomerulus

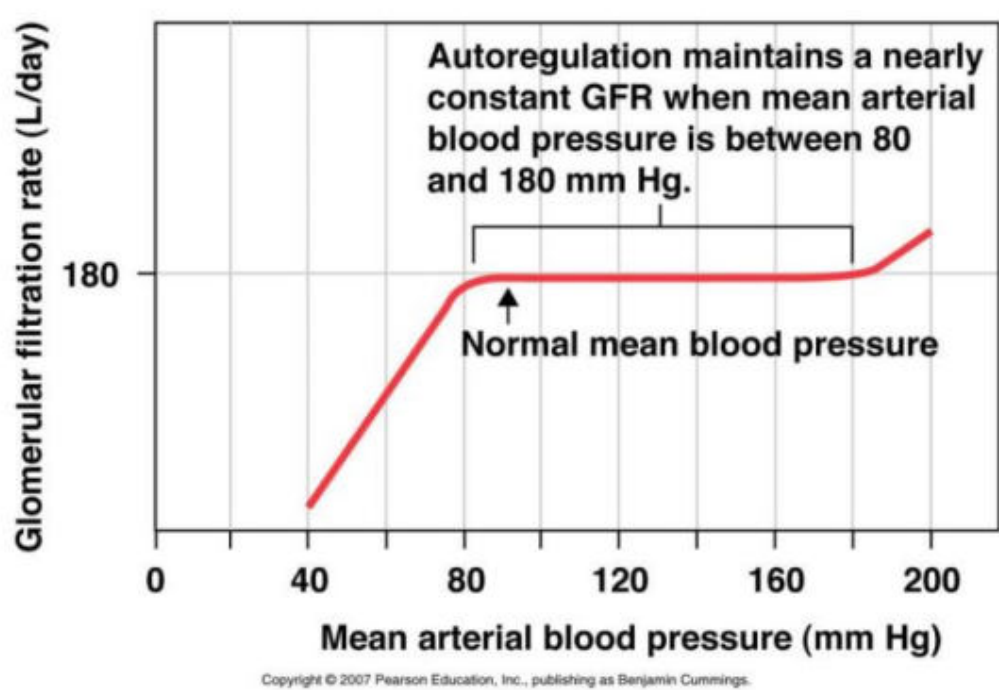


Principle concept : Autoregulation

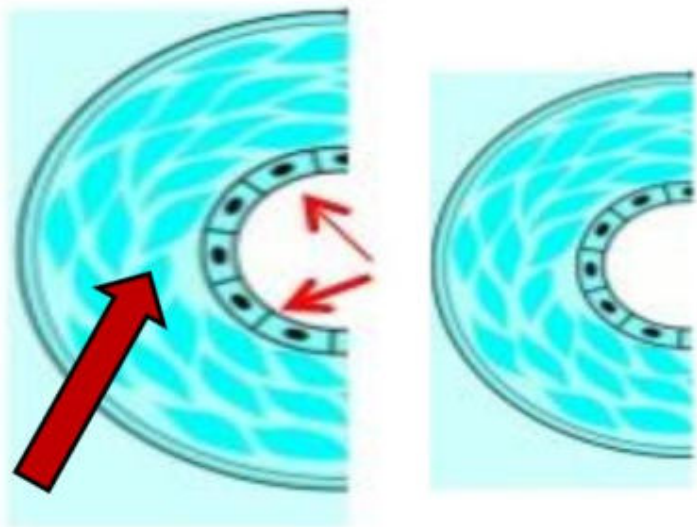


Renal Auto regulation - Intrinsic Control

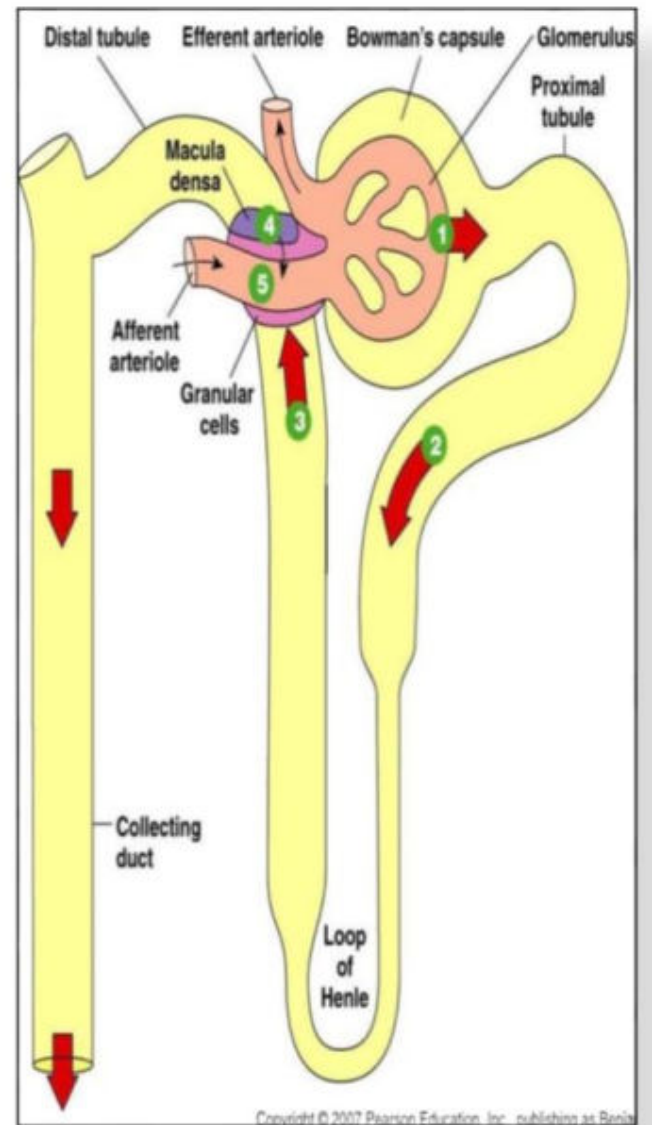
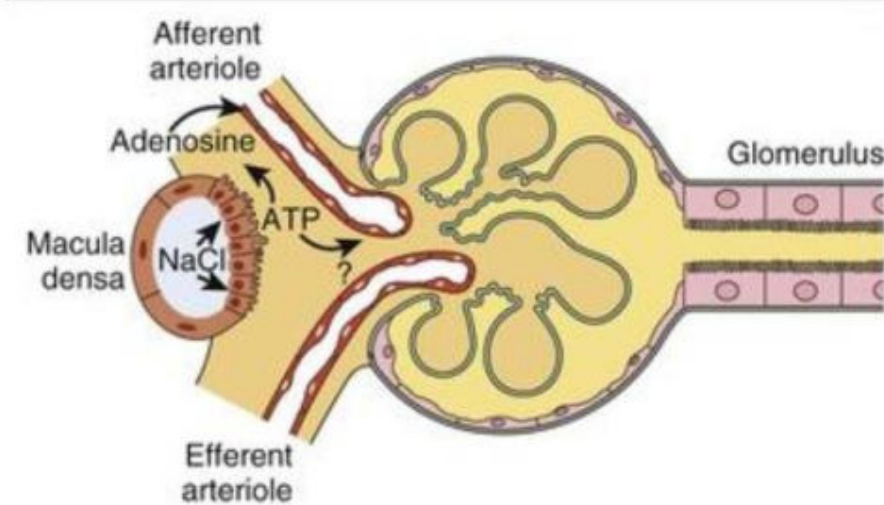
- a. Myogenic mechanism:
- b.Tubulo-glomerular feedback:



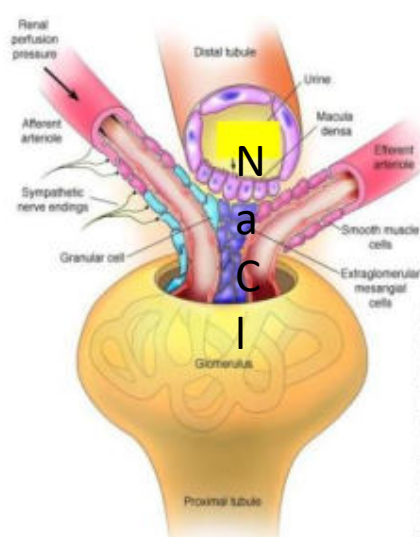
a. Myogenic mechanism of Autoregulation



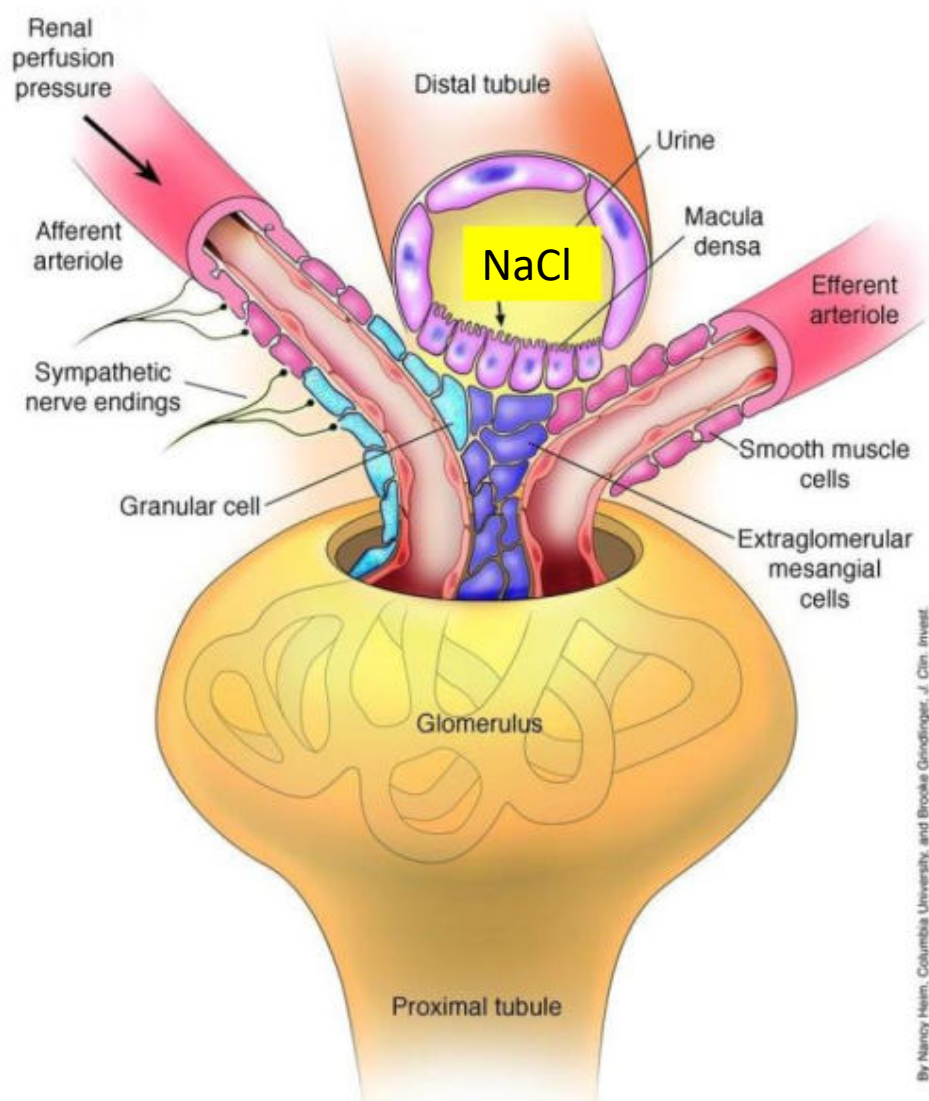
b. Tubulo-glomerular Feedback response



- Juxta Glomerular Apparatus– RAAS (Renin-Ag-Aldosterone system)

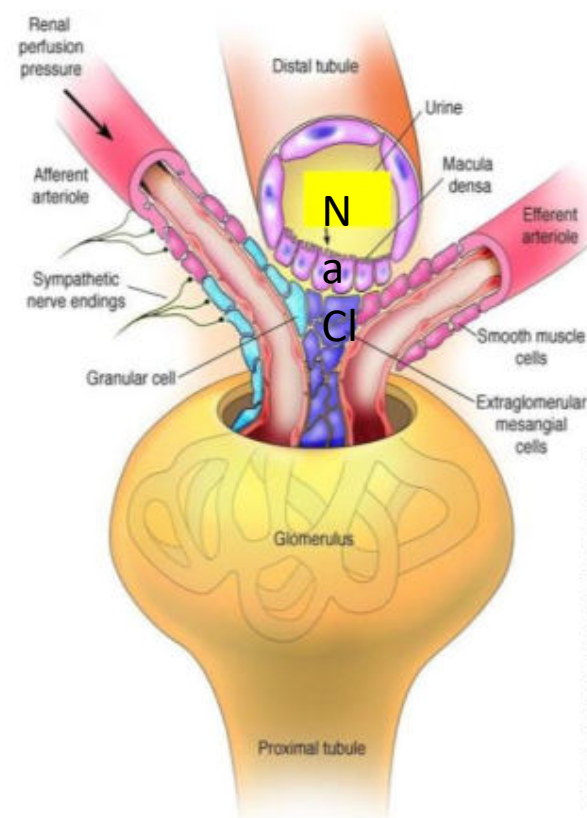


Tubulo-Glomerular Feedback-TGF – Apparatus- (Juxta Glomerulus Apparatus)



Sensor: Macula Densa cells –

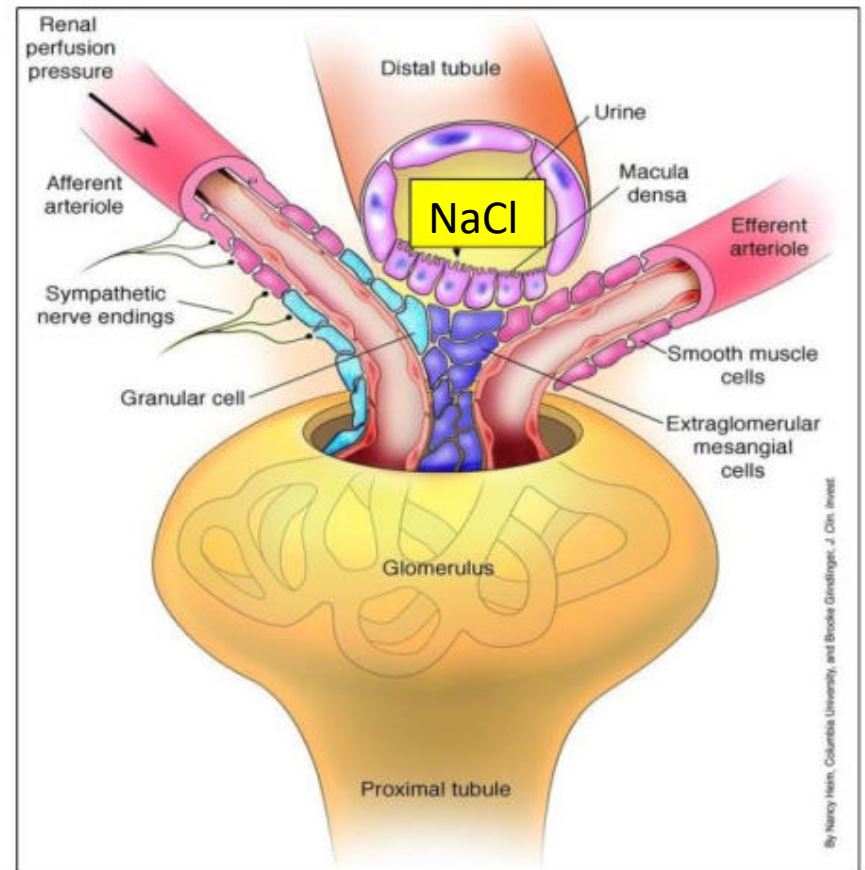
Tubulo-Glomerular Feedback-TGF – Apparatus- (Juxta Glomerulus Apparatus)



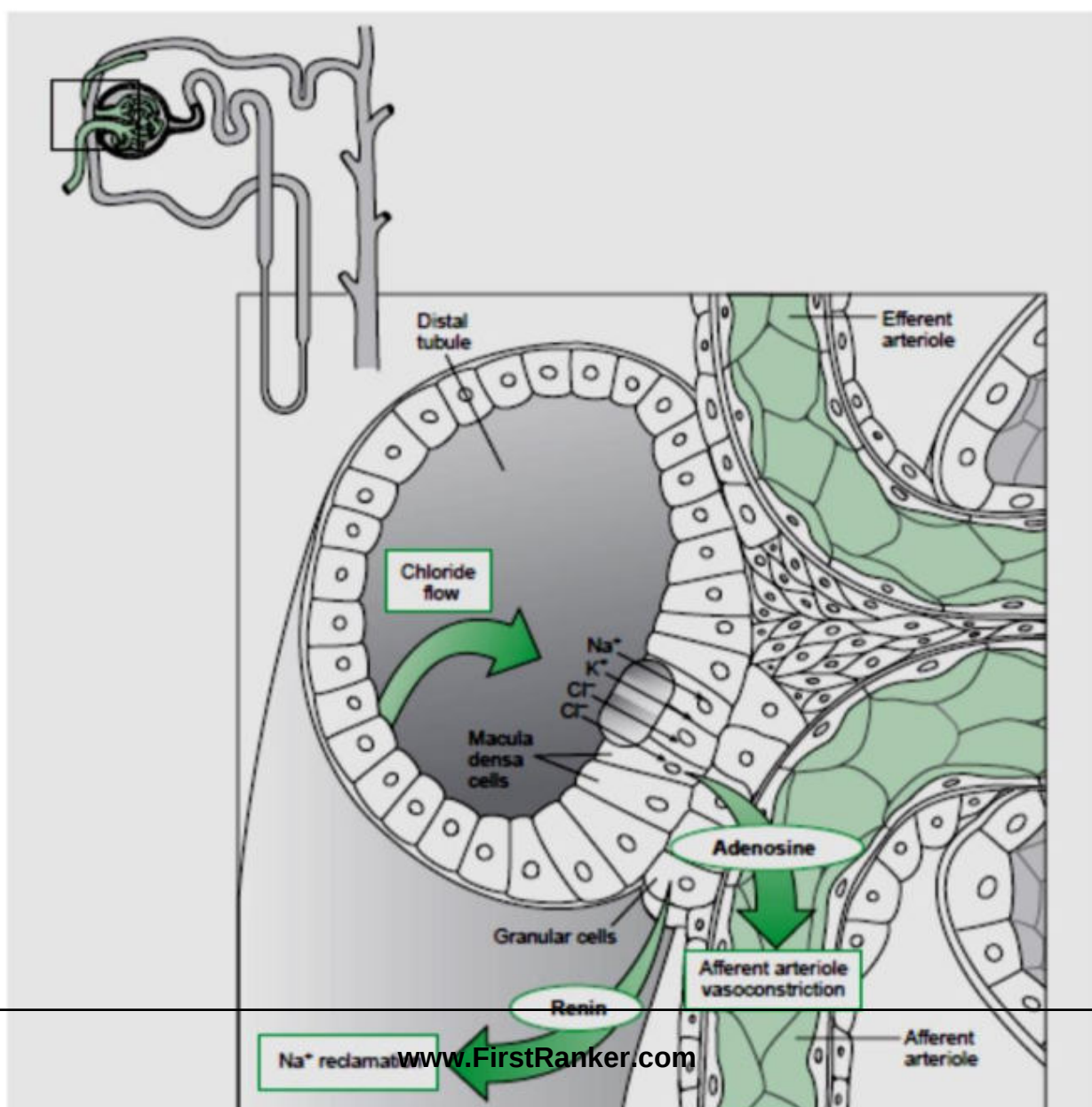
**Integrator: Juxta-glomerular cells
(JG or Granular cells) –**

Tubulo-Glomerular Feedback-TGF – Apparatus- (Juxta Glomerulus Apparatus)

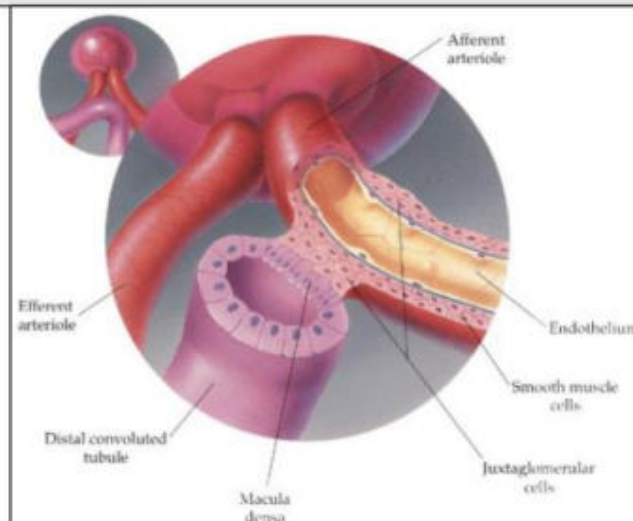
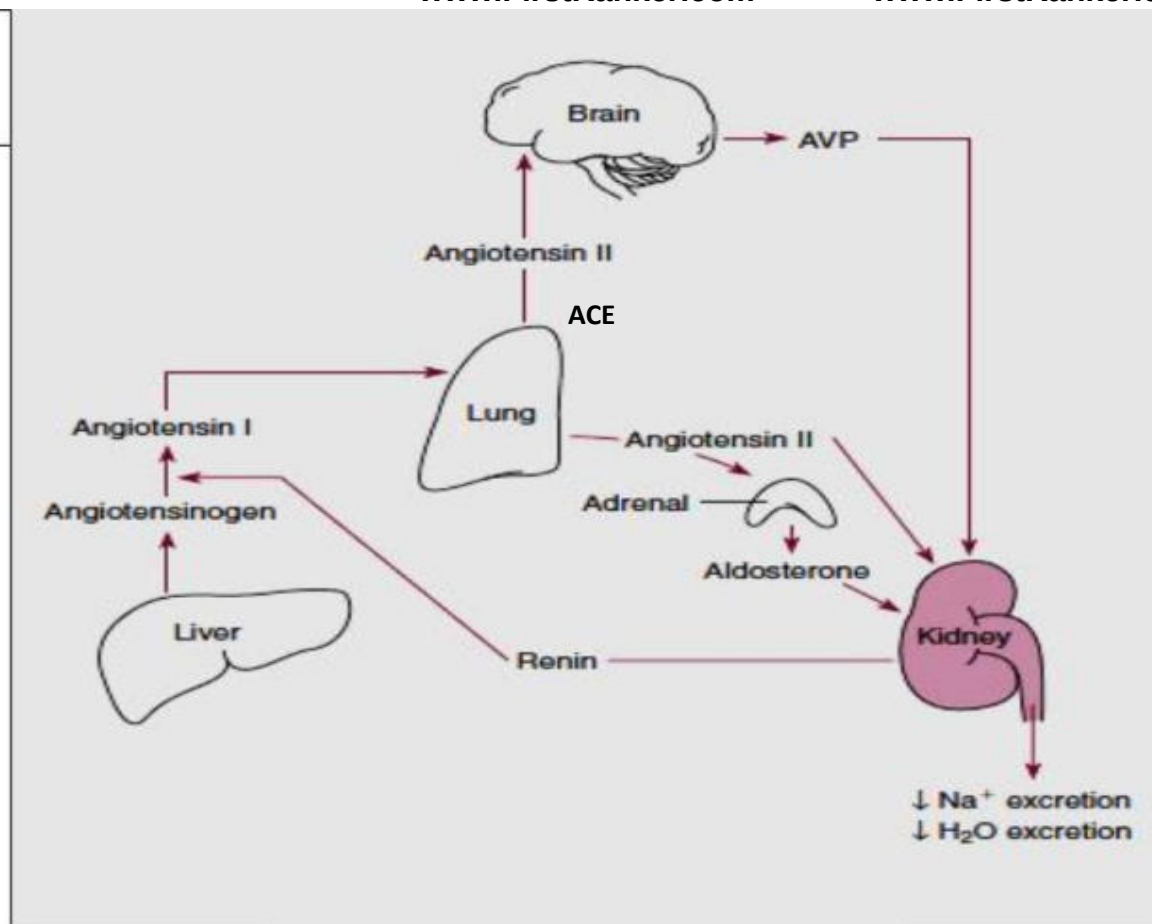
**Effectors:
Renal Afferent and
Efferent Arterioles**



Tubulo-Glomerular Feedback Mechanism



Renin



Important physiologic functions of Angiotensin II

- **Arteriolar vasoconstriction**
- **↑ antidiuretic hormone**
- **↑ thirst**
- **↑ aldosterone**
- **↑ NaCl reabsorption**
- **Constrict the glomerular mesangium,**

Hormones that Influence Glomerular Filtration Rate

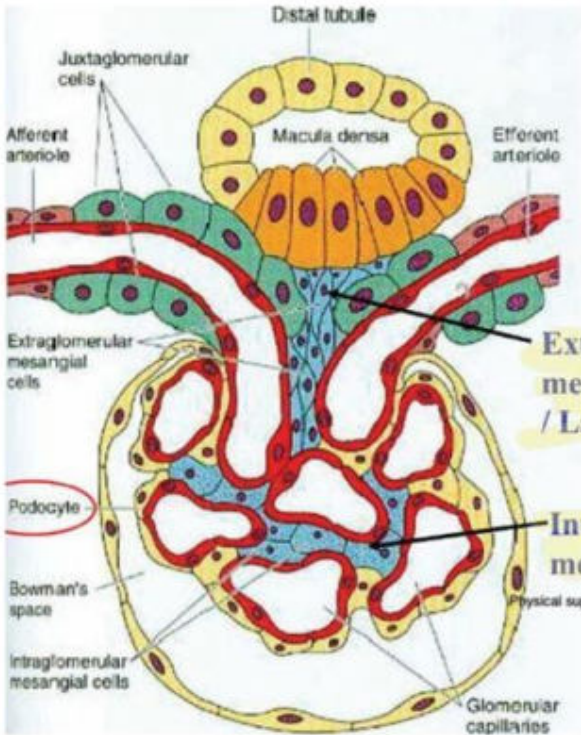
	STIMULUS	GFR
Vasoconstrictors		
Sympathetic nerves	↓ ECFV	↓
Angiotensin II*	↓ ECFV	↓
Endothelin	↑ Stretch, All, bradykinin, epinephrine, ↓ ECFV	↓
Adenosine (AA)	↑ Macula densa NaCl	↓
Vasodilators		
Prostaglandins (PGE1, PGE2, PGI2)	↓ ECFV, ↑ shear	↑
Nitric oxide	Stress, All ↑ shear stress, acetylcholine, histamine, bradykinin, ATP	↑
Bradykinin	Prostaglandins, ↓ ACE	↑
Natriuretic peptides (ANP, BNP)	↑ ECFV	↑

These effects of angiotensin II are evident with concentrations that constrict the afferent and efferent arterioles.

ACE, Angiotensin-converting enzyme; All, angiotensin II; ANP, atrial natriuretic peptide; ATP, adenosine triphosphate; BNP, brain natriuretic peptide; ECFV, extracellular fluid volume; GFR, glomerular filtration rate; PGE, prostaglandin E; PGI2, prostacyclin; RBF, renal blood flow.

Mesangial Cells

Mesangial cell



- Support
- Contraction
- Phagocytosis
- Secretion

Applied

ACE inhibitors (e.g. captopril, enalapril) -

Acute **kidney** injury (AKI) from **NSAIDs**

Important points of the lecture

Forces **Favoring and opposing glomerular** Filtration

1 cause of each $\uparrow P_B$ and $\uparrow P_{GC}$

What will happen if GFR is too high or too low?

Efferent arteriole constriction cause increase or decrease in GFR.

What is principle of myogenic autoregulation and range of fluctuation of MAP for it?

Tubulo-Glomerular Feedback Mechanism

Functions of Angiotensinogen II

Self Assessment



Macula densa cells of D_xCT are a type of

- 1) Chemoreceptors
- 2) Osmoreceptors
- 3) Baroreceptors
- 4) Nociceptors

ACE inhibitors are used in the treatment of

- 1) Hemolytic anemia
- 2) Hypertension
- 3) Hyperthyroidism
- 4) Hydatid cyst

Tubulo-glomerular feedback mechanism is mediated by:

- 1) Adrenaline
- 2) Acetylcholine
- 3) Adenosine
- 4) Prostacycline

Thank you