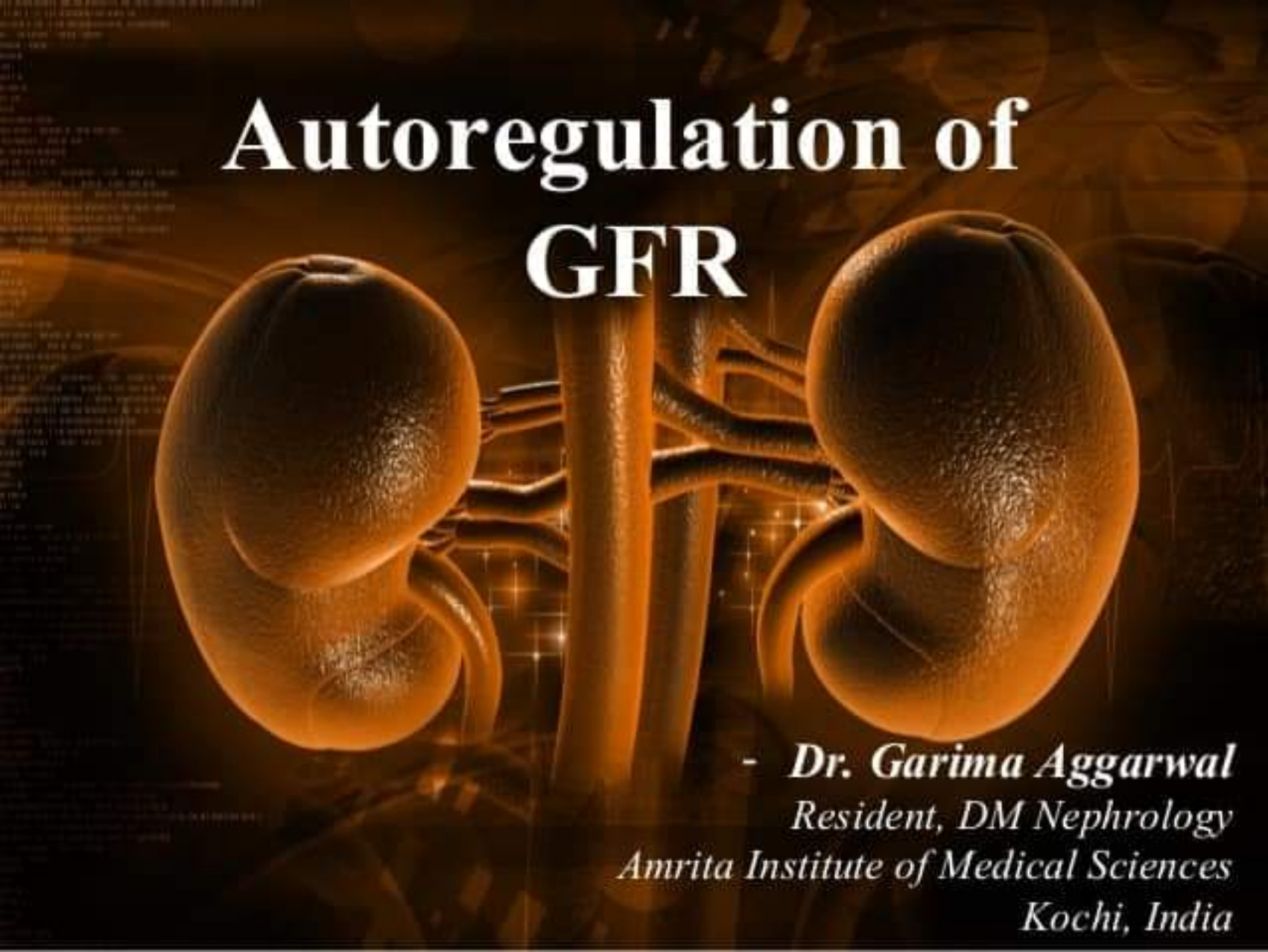
Autoregulation of GFR



- ***Dr. Garima Aggarwal***
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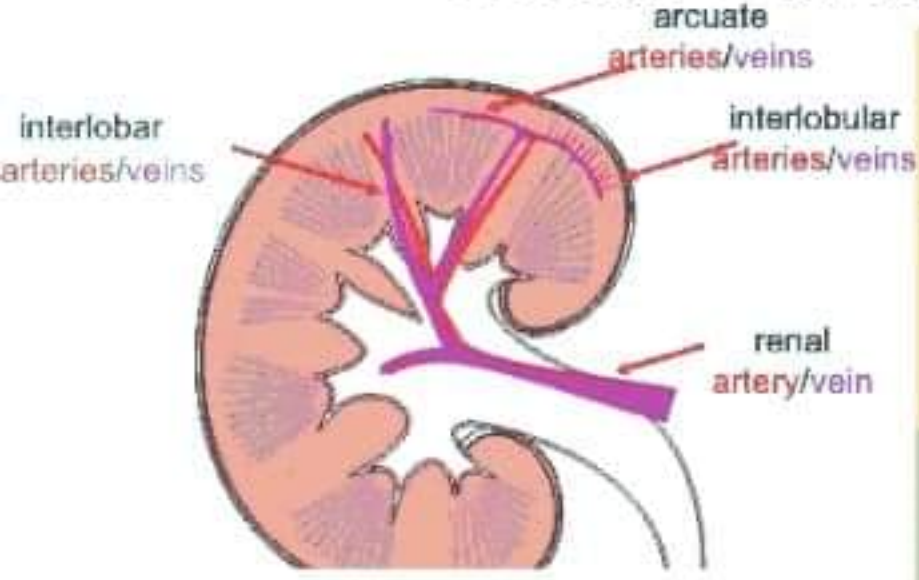
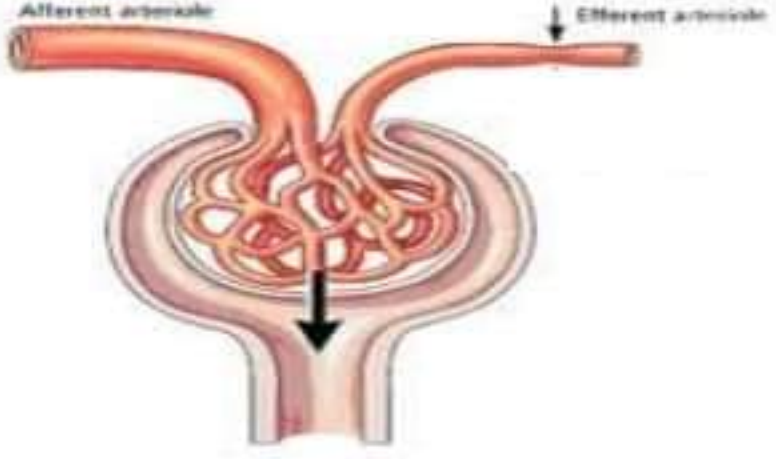
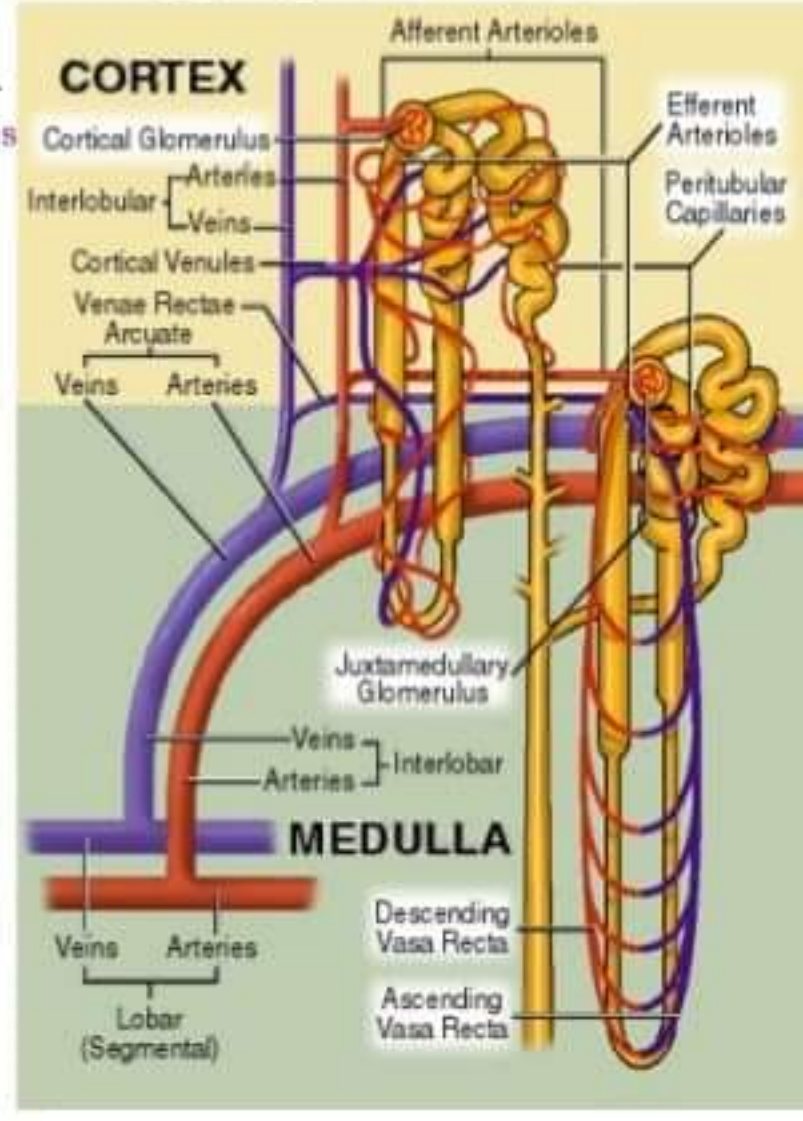
Renal Blood Supply



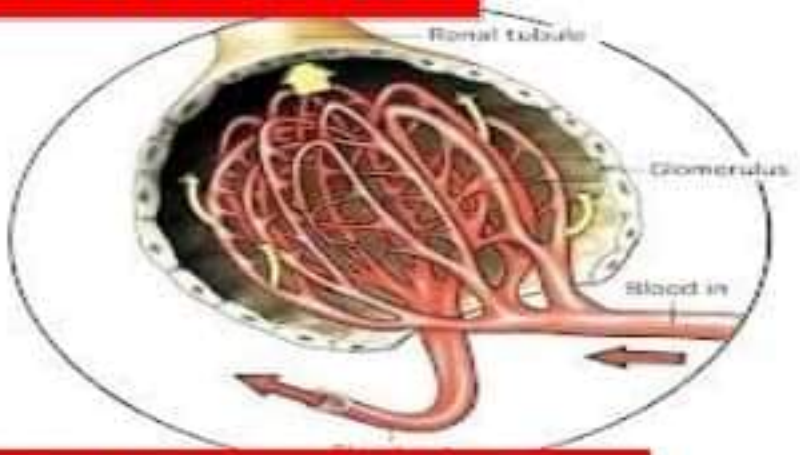




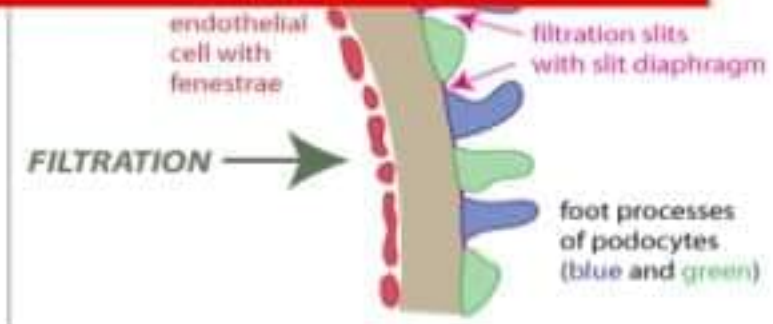
Glomerular Filtration

- Glomerular Filtration Rate - Volume of fluid filtered from glomerular capillaries into Bowman's per unit time.

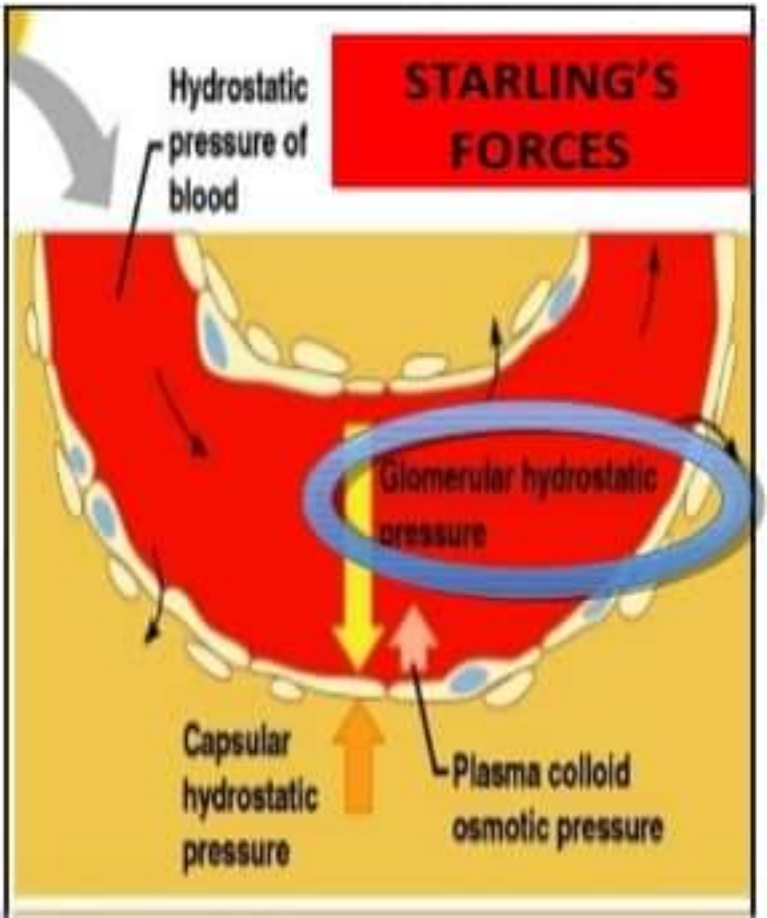
RENAL PLASMA FLOW



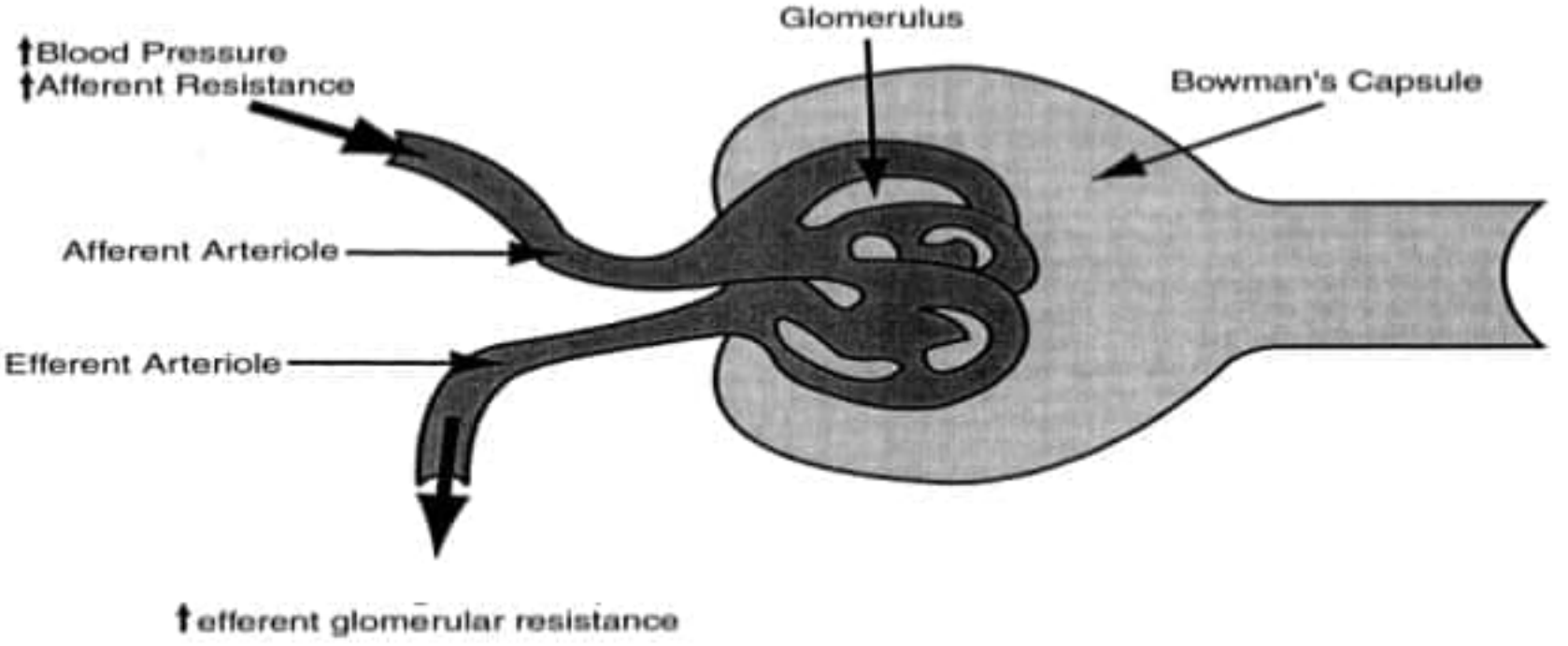
FILTRATION COEFFICIENT



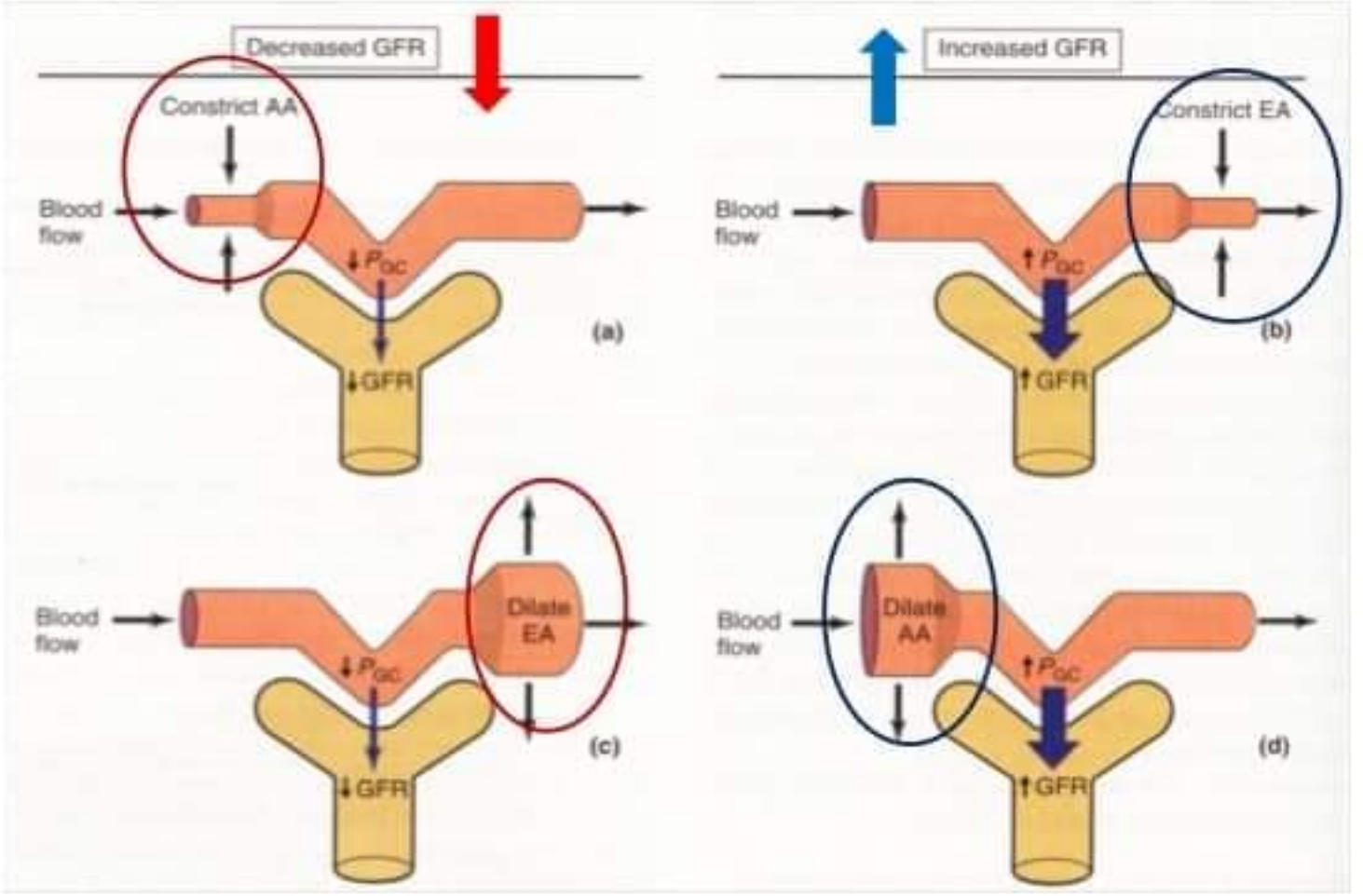
STARLING'S FORCES



- Glomerular Hydrostatic Pressure is determined by 3 variables, each of which is under physiological control
  - Arterial Pressure
  - Afferent arteriolar resistance
  - Efferent arteriolar resisitance



Changes in GFR by constriction or dilation of afferent (AA) or efferent (EA) arterioles

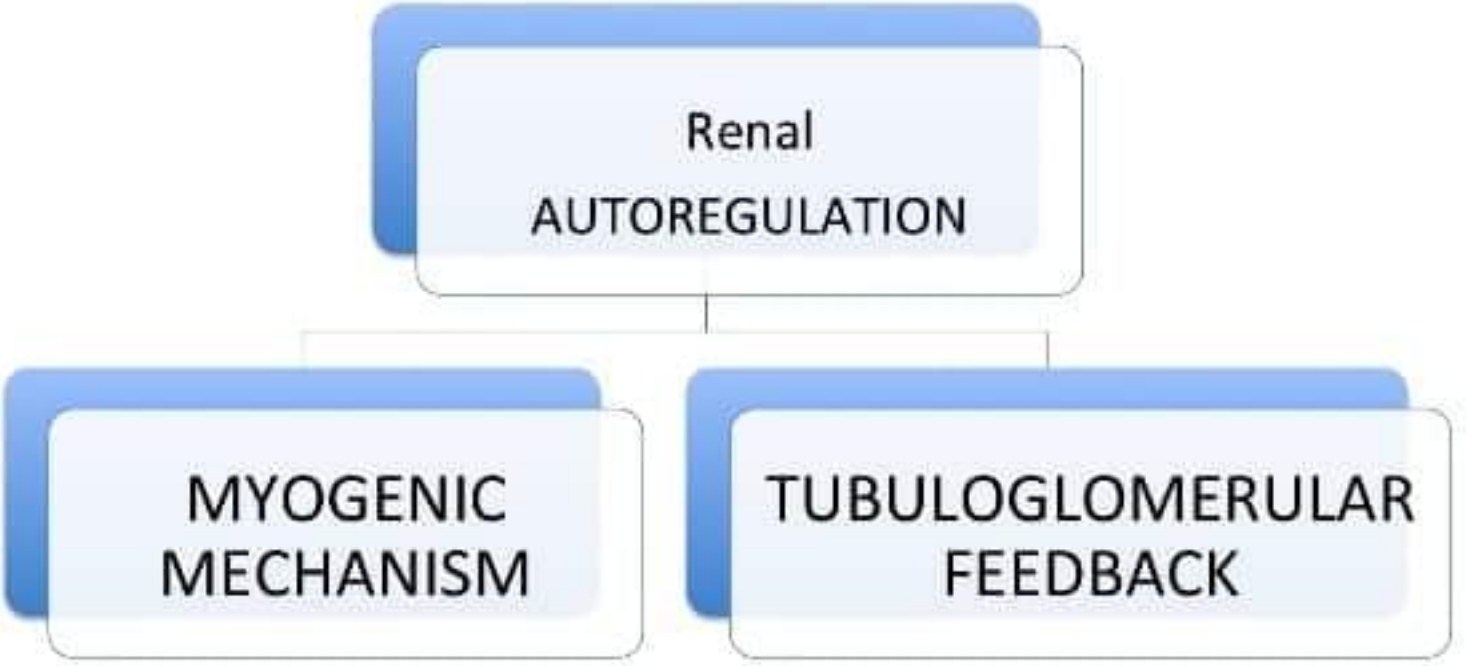


Autoregulation of GFR

- Feedback mechanisms which are intrinsic to the kidney and keep the Renal Blood flow and GFR relatively constant despite marked changes in arterial blood pressure.
- Within a range of 70- 160 mmHg
- Without autoregulation even a slight change in BP would cause a significant change in GFR
  - For eg at 100mmHg – 180l/day GFR, 1 l/day of urine

    If 25% rise in BP to 125mmHg – 225l/day of GFR

    46l/day of Urine !!!!

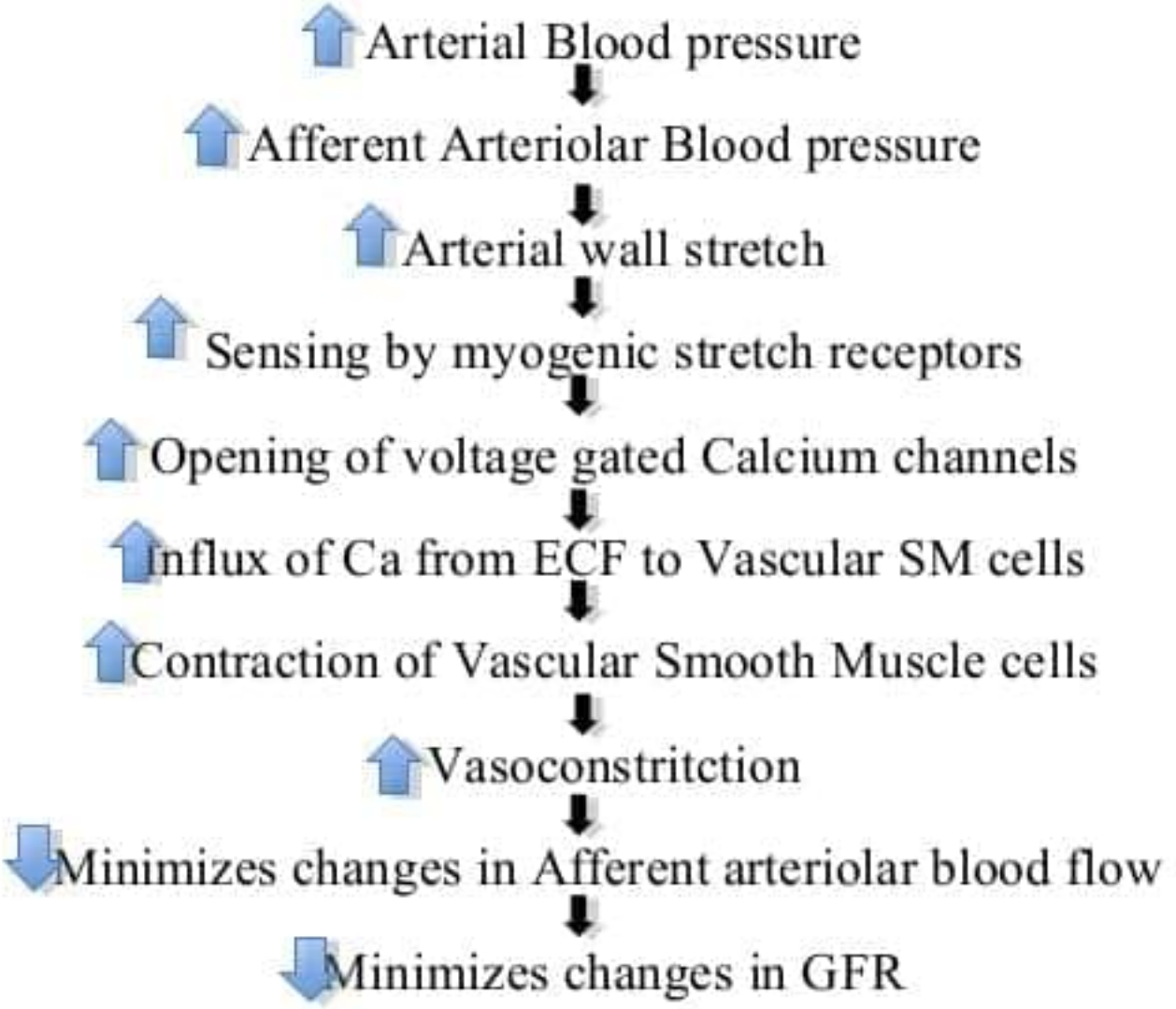


- Other Factors involved in Autoregulation
  - Neural
  - Hormonal
  - Vasoactive Substances

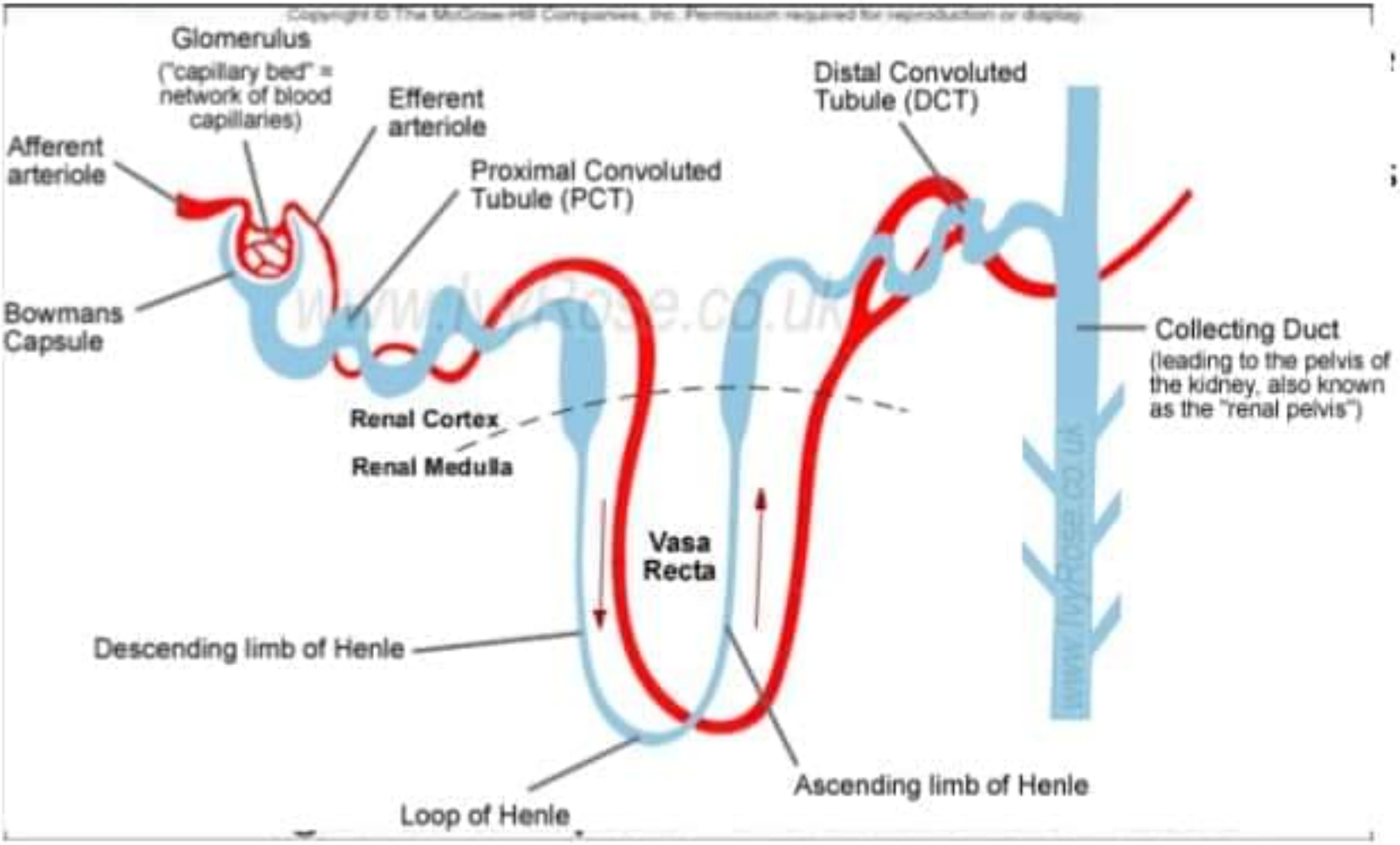
Myogenic Mechanism

- Arterial smooth muscle contracts and relaxes in response to increases and decreases in vascular wall tension.
- It contributes upto 50% of total autoregulatory response
- Occurs very rapidly, reaching a full response in 3-10 seconds
- It is a property of the preglomerular resistance vessels – arcuate, interlobular and the afferent
- It is not seen in efferent arterioles, probably because of lack of voltage gated Ca channels

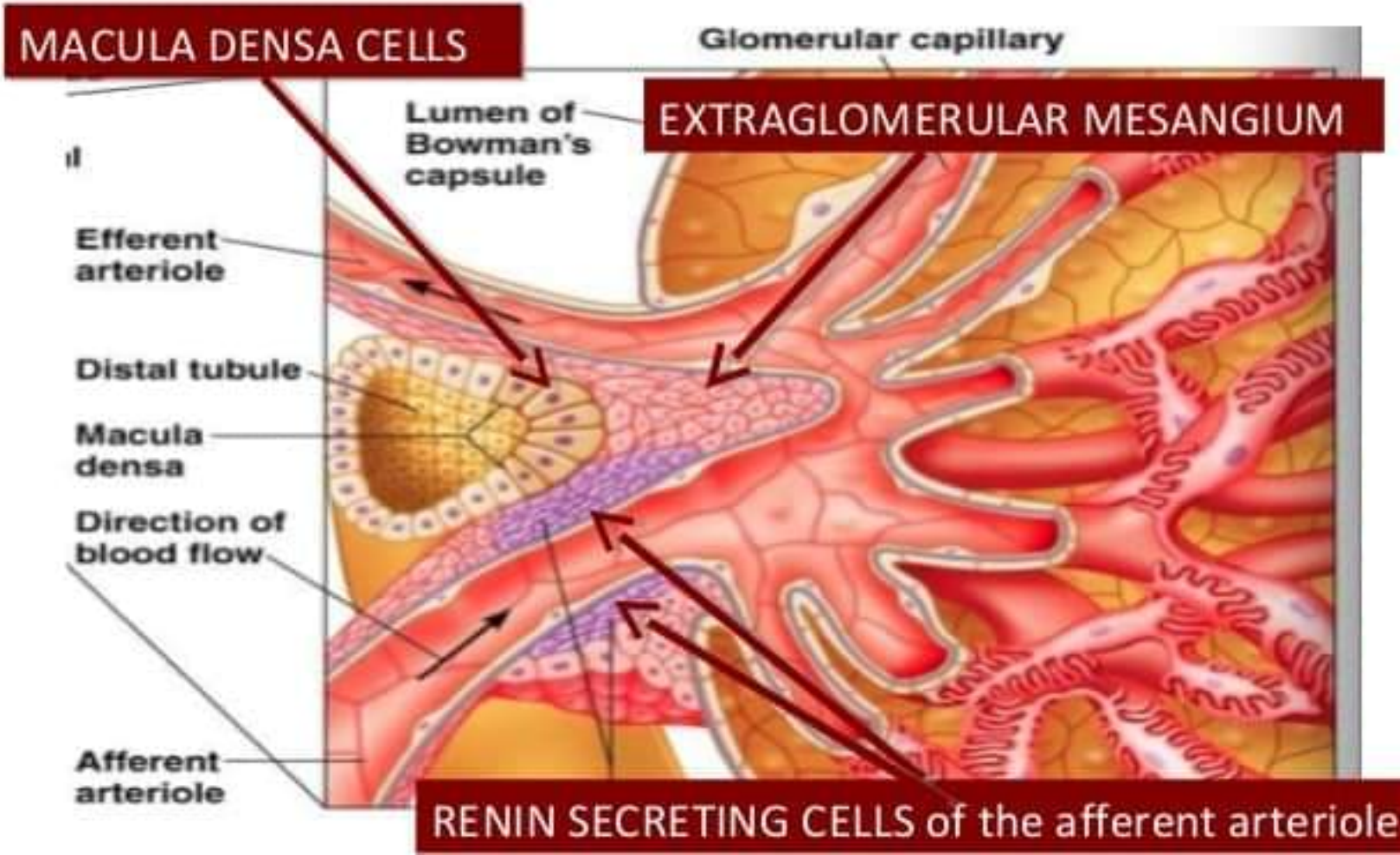
Mechanism of Myogenic Autoregulation



Tubuloglomerular Feedback



Juxtaglomerular Apparatus



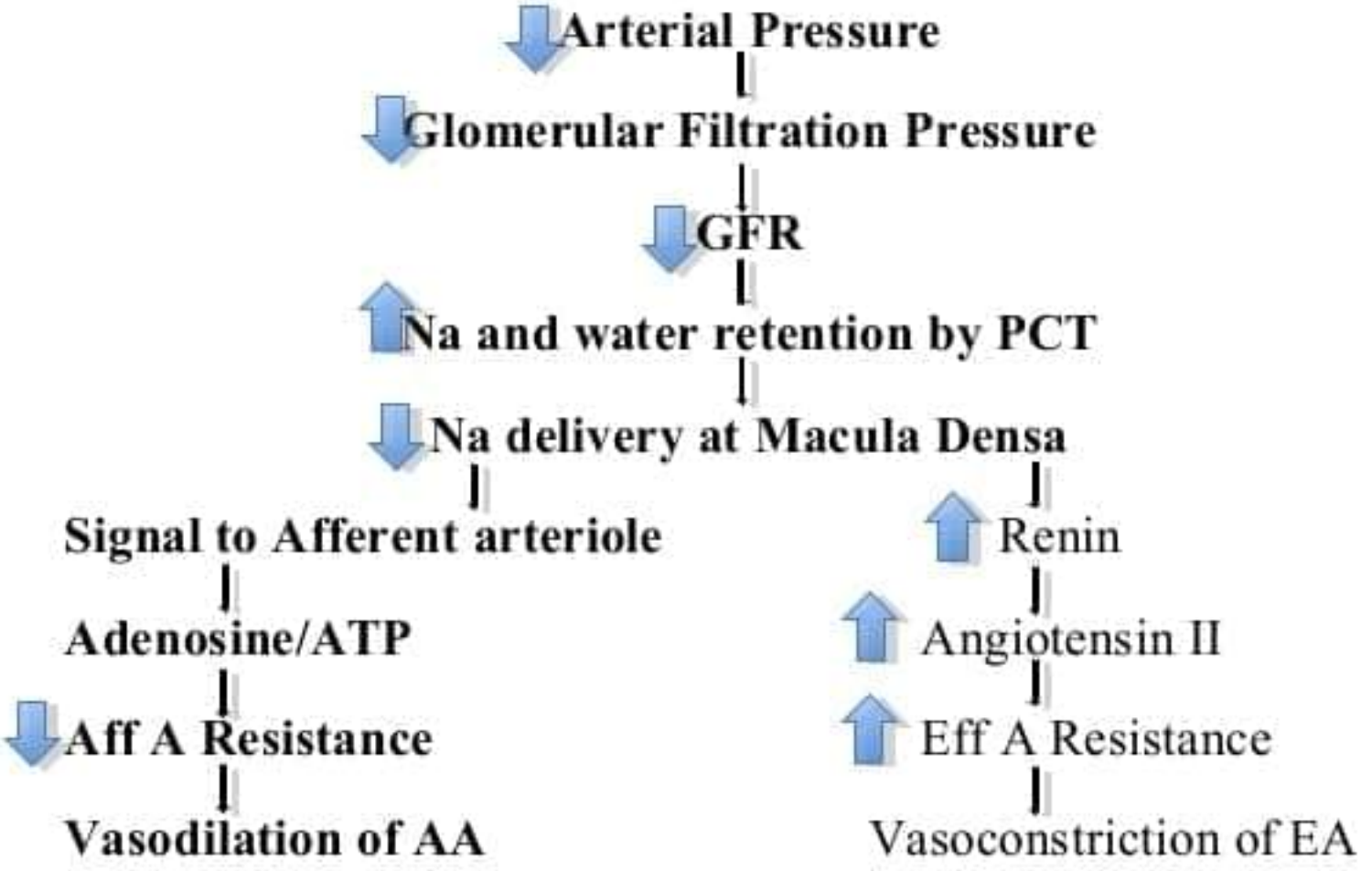
Mechanism of Tubuloglomerular feedback

- This is a feedback mechanism that links sodium and chloride concentration at the macula densa with control of renal arteriolar resistance.
- It acts in response to acute perturbations in delivery of fluid and solutes to the JGA.
- It has 2 components
  - **Afferent arteriolar feedback**
  - Efferent arteriolar feedback (hormonal)

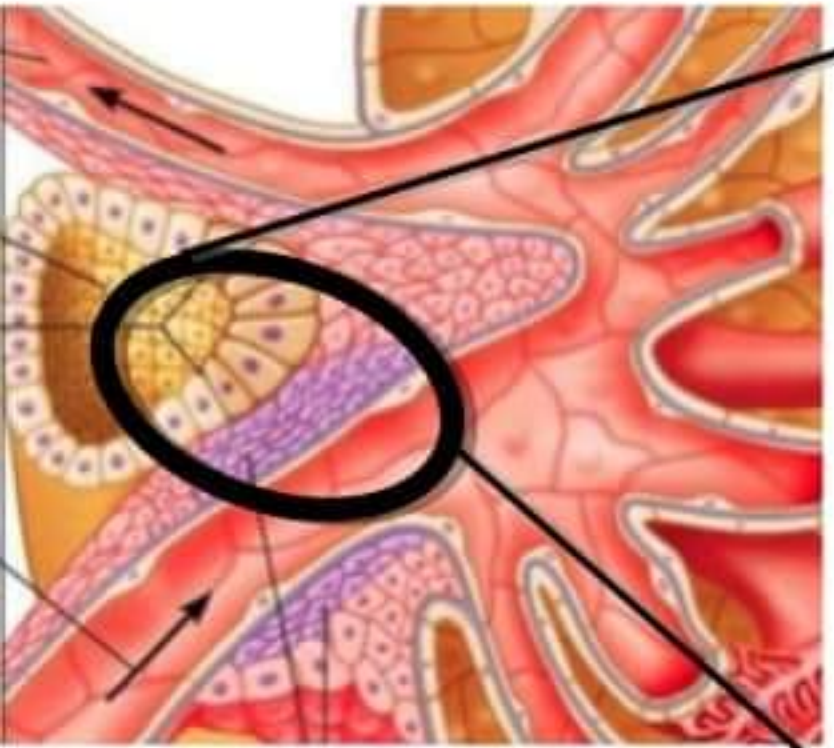
It helps in

- Autoregulation of GFR
- Controls distal solute delivery, hence Tubular Reabsorption

Tubuloglomerular feedback continued.



Tubuloglomerular feedback cellular level



TUBULE LUMEN

MACULA DENSA

INTERSTITIUM

MESANGIAL CELLS

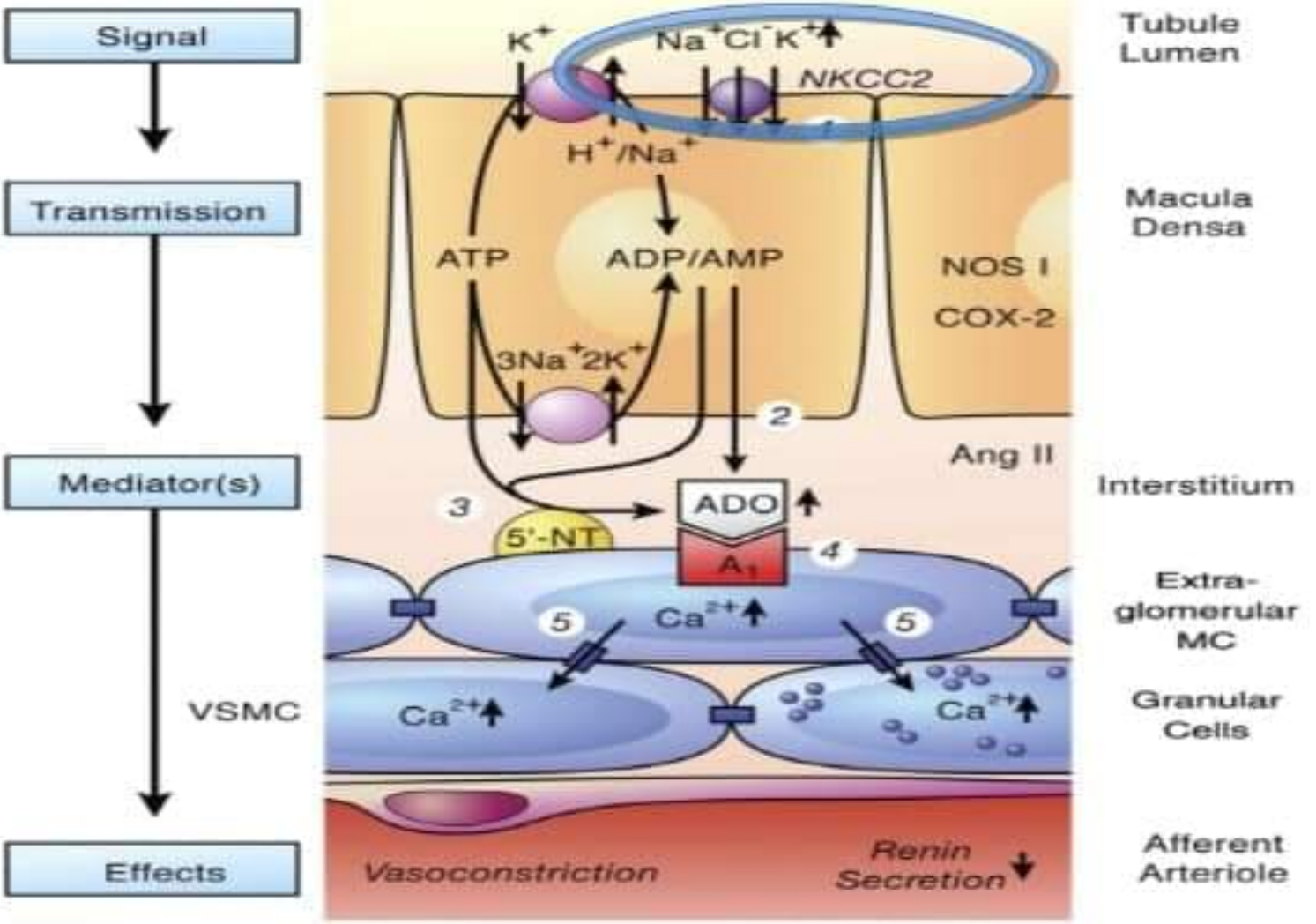
GRANULAR CELLS

AFFERENT ARTERIOLE

ARTERIAL PRESSURE

GFR

SOLUTE DELIVERY TO MACULA DENSA



Regulation of Tubuloglomerular feedback

- **Mediators**
  - Adenosine
  - ATP

- **Modulators**
  - Neuronal NOS
  - Angiotensin II
  - Endothelin

Neural regulation of GFR

- Sympathetic nerve fibers innervate afferent and efferent arteriole
- Normally sympathetic stimulation is low nd has no effect on GFR
- During excessive Sympathetic stimulation (Defense, Brain Ischemia, Severe Hemorrhage) lastin from few minutes to few hours can stimulate the Renal vessels
- Vasoconstriction occurs as a result which conserves blood volume(hemorrhage)and causes a fall in GFR.
- Parasympathetic Nervous System – Acetylcholine causes release of NO from the Endothelial cells, hence Vasodilation.

Hormonal regulation of GFR

VASOCONSTRICTORS

- Norepinephrine
- Epinephrine

Released in stressful situations, alongside the Sympathetic stimulation

- Endothelin

ARF, Toxaemia of pregnacy, Vascular Injury, Chronic uraemia

- Angiotensin II.

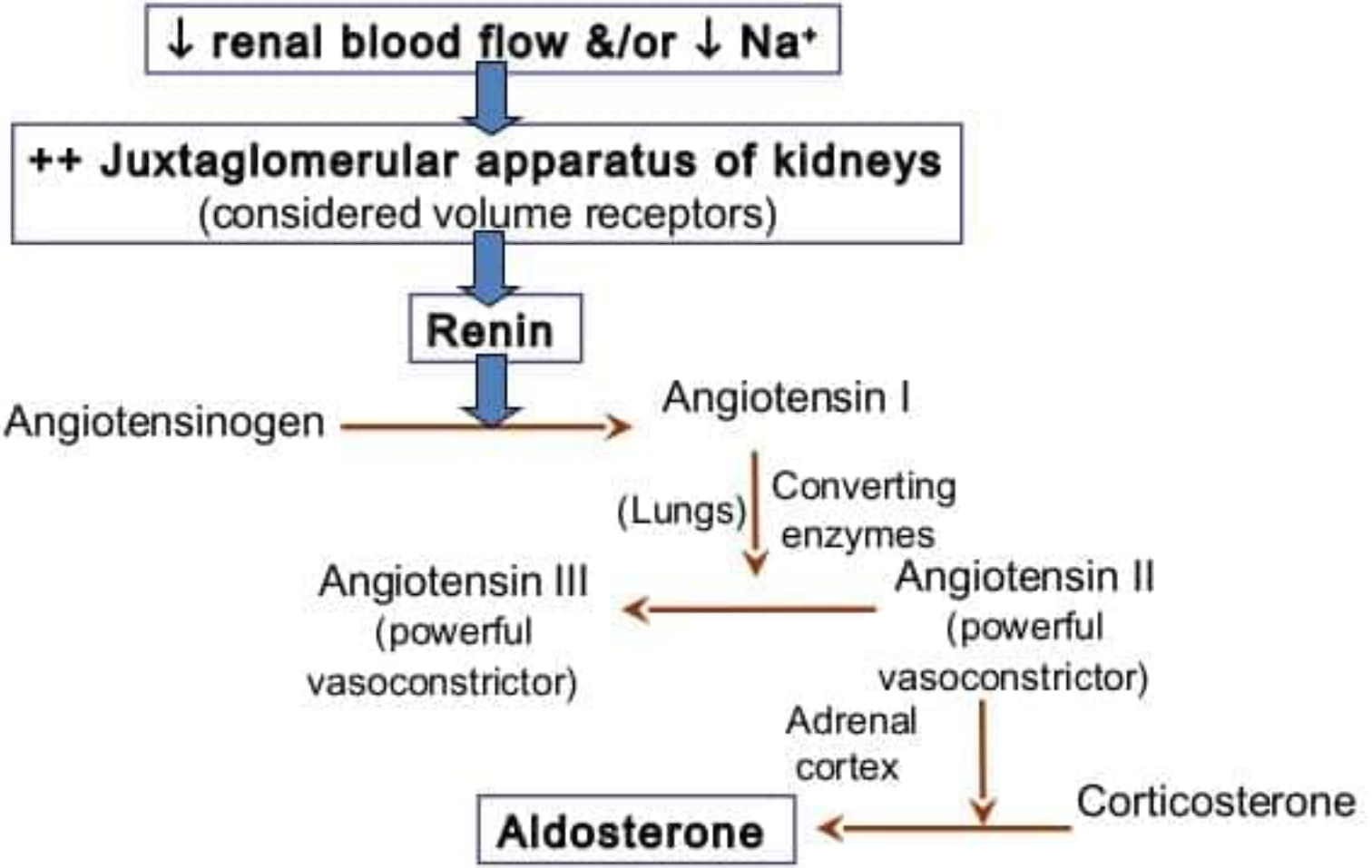
Produced by Renin, released by JGA cells

- Leukotrienes – LTC4, LTD4

VASODILATORS

- NO
- Prostaglandin E2
- Prostaglandin I2
- Bradykinin
- Leukotriene LTB4

Renin-Angiotensin System:



- **N.B. Aldosterone is the main regulator of Na^+ retention.**