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Revised by

Index:
- Important
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- Doctor's notes
- Only in female slides
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Glomerular Filtration

Lecture 1+2

RENAL BLOCK

PHYSIOLOGY TEAM 437

Editing file

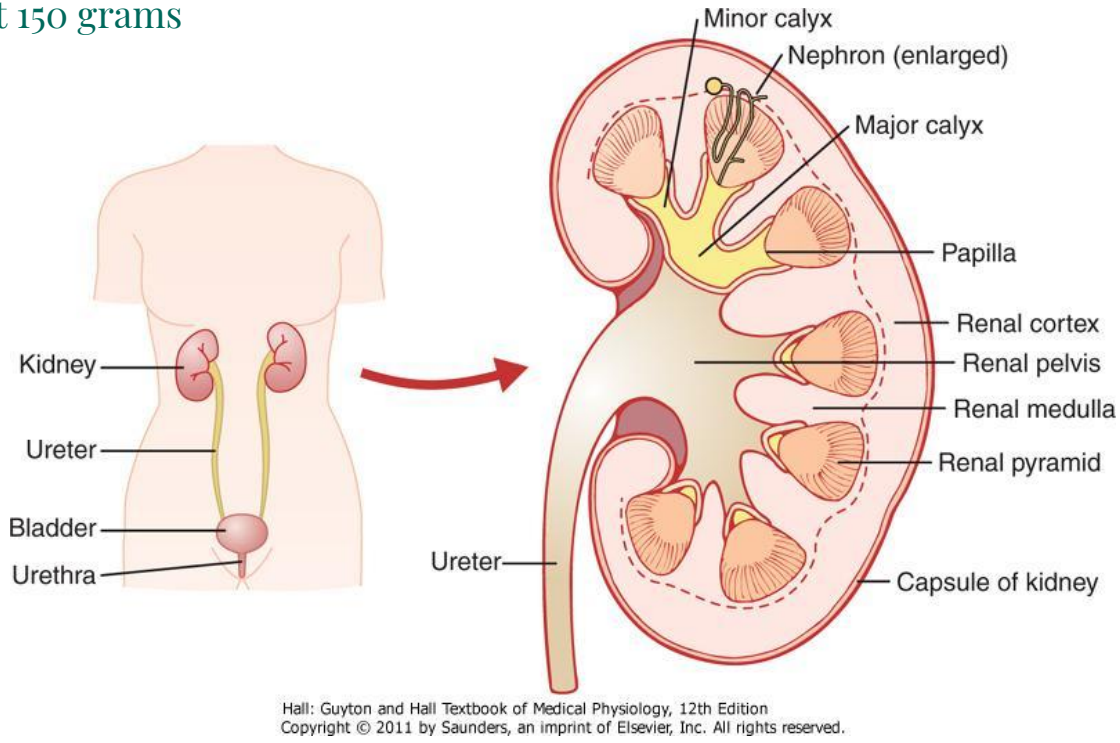
Objectives:

by the end of this lecture you will be able to:

- Enumerate general functions of the kidney.
- Identify and describe that the nephron is the structural and function unit of the kidney.
- Describe that the mechanism of urine formation include three basic processes; glomerular filtration, tubular reabsorption and tubular secretion.
- Explain glomerular filtration membrane & filtration forces.
- Describe mechanism of filtration & composition of the glomerular filtrate.
- Calculate the net filtration pressure using parameters of Starling forces.
- Define GFR and quote normal value.
- Identify and describe the factors controlling GFR in terms of starling forces, permeability with respect to size, shape and electrical charges and ultra-filtration coefficient.
- Describe Intrinsic and extrinsic mechanism that regulate GFR.
- Describe autoregulation of GFR & tubuloglomerular feedback mechanism.

Physiologic Anatomy of **KIDNEYS:**

- Size Clenched Fist
- Weight 150 grams



Urinary System:

Kidney — perform the functions of the urinary system.

Ureter — Transport urine from the kidneys to the bladder

Urinary bladder — temporary storage of urine.

Urethra — conveys urine out of the body.

Video of kidney-nephron overview, Duration 8:38 mins

Kidney Functions:

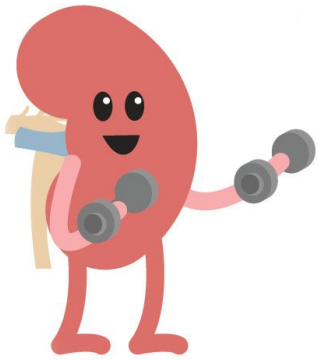
1-Filtration

2-Regulation of blood pressure

3-Regulation

4-Excretion

5-Synthetic Function



1-Filtration

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200 liters of blood daily, allowing toxins, metabolic wastes, and excess ions to leave the body in urine.

2-Regulation of blood pressure

By controlling the rate at which water is excreted in the urine ↠ regulate plasma volume ↠ total blood volume -> blood pressure.
By release of renin ↠ vasoactive agents.

3-Regulation

1-water and electrolyte balance: Maintain the proper balance between water and salts, and acids and bases.
By ↟ or ↡ the excretion of specific ions in the urine, the kidneys regulate the concentration of the following ions in the plasma:
Na^+, K^+, Ca^{2+}, Mg^{2+}, Cl^-, HCO_3^-, H^+ and phosphates.
2-RBC production by bone marrow by controlling **erythropoietin** hormone levels.

4-Excretion

Excretion of bioactive substances (hormones and many foreign substances, such as: metabolic waste products: Urea, Creatinine, Uric acid, Bilirubin, drugs and Pesticides that affect body function.

5-Synthetic Function

1. active form of vit D (D3)= 1,25 dihydroxycholecalciferol.
2. Erythropoietin production.
3. Renin formation.
4. Synthesis of glucose from amino acids and glycerol during prolonged fasting

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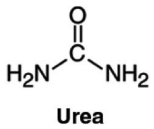
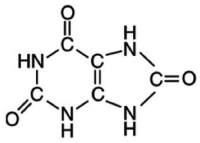
Nitrogenous Wastes:

- Urea : protein > amino acids > NH_2 removed > forms ammonia, liver converts to urea



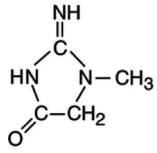
Urea

- Uric acid



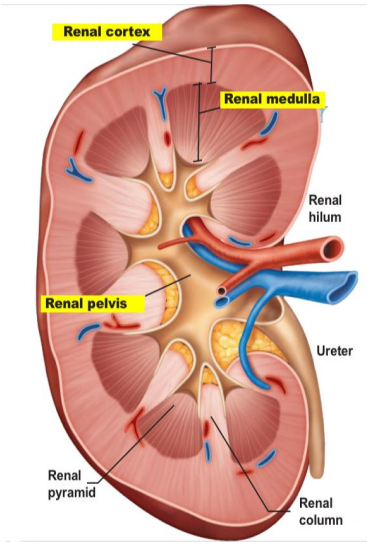
Uric acid

- Creatinine



Creatinine

The Kidney Consists of Three Distinct Regions:



Cortex: granular superficial region

Medulla: exhibits cone-shaped pyramids

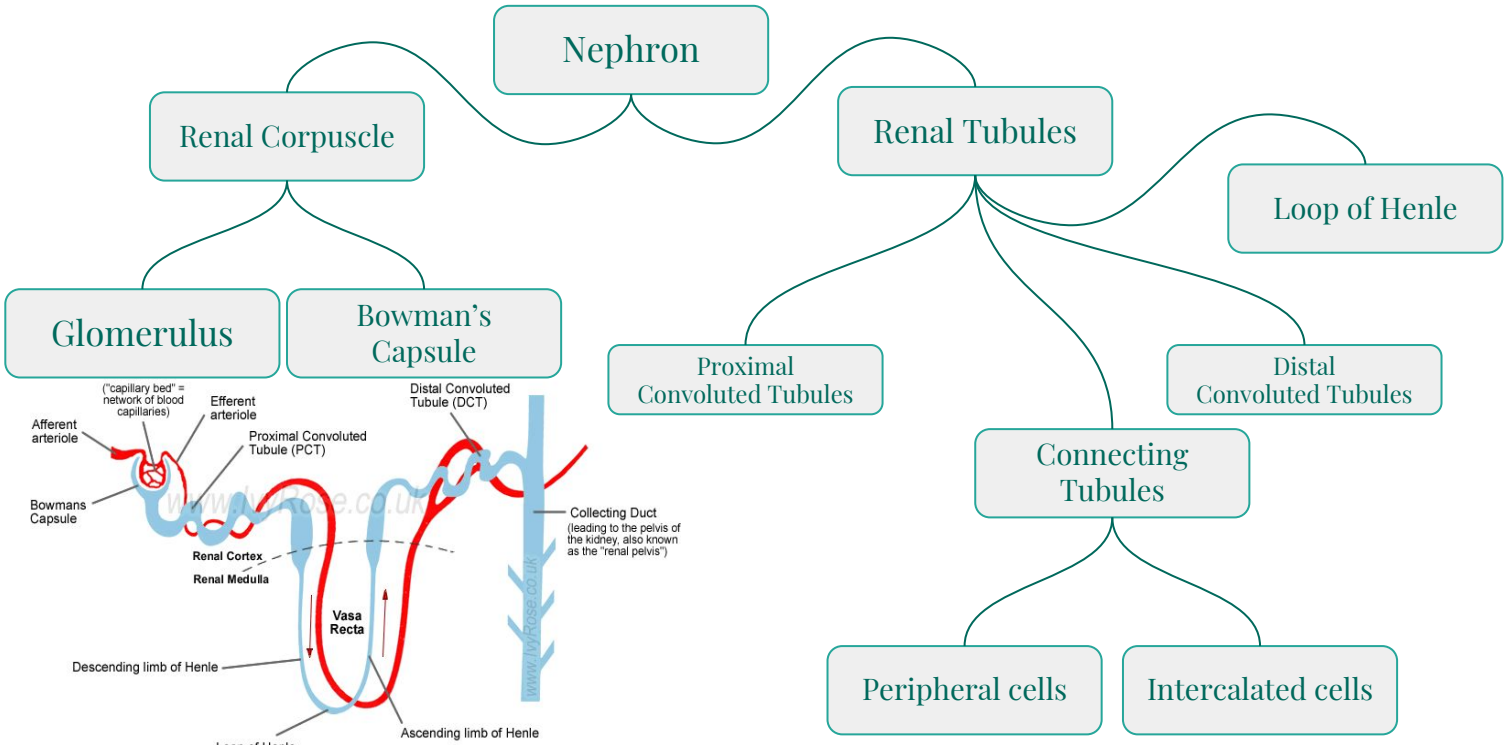
Pyramids are bundles of collecting tubules

Renal pelvis: flat, funnel-shaped tube

What is the Functional Unit of the Kidney?

- The nephron is the functional and structural unit of the kidney.
- Each kidney has 1 million nephrons, each nephron is capable of urine formation.

Nephron: The Functional Unit of The Kidney



Structure of Nephron:

- The **Glomerulus**: capillary tuft: in which large amount of fluid is filtered from blood.
- **Bowman's capsule**: Blind end of the tubule completely surrounds glomerulus and receives the filtrate.
- **Tubules**: in which filtered fluid eventually is converted into urine.

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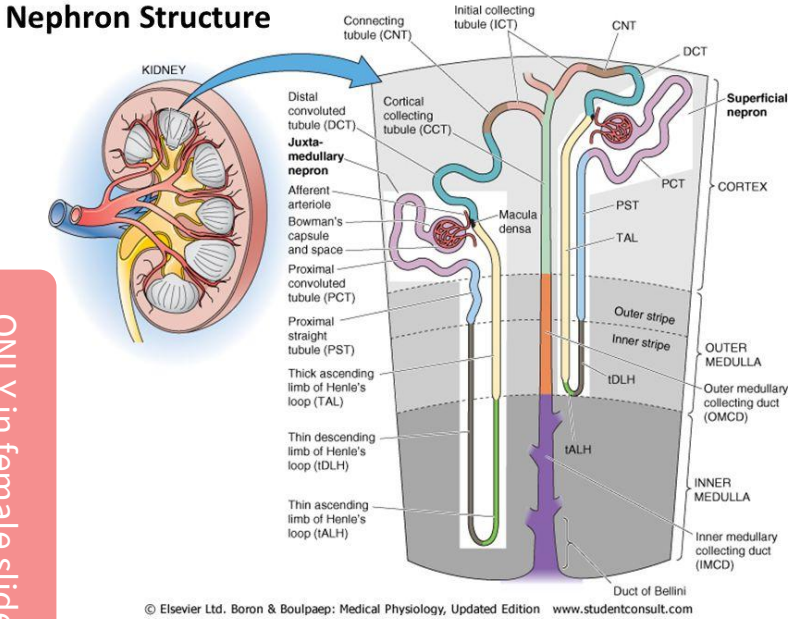
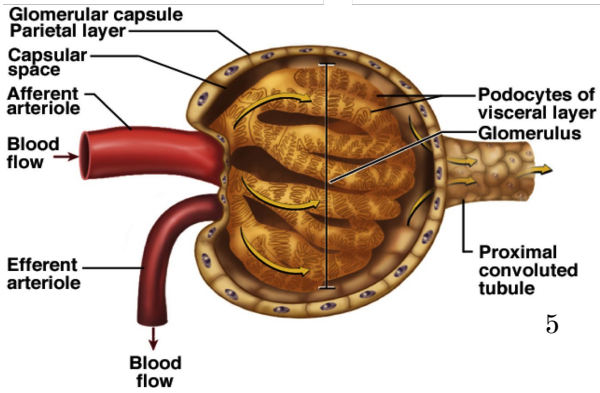


The Glomerulus

- Glomerular filtrate collects in capsular space, flows into renal tubule.
- **Glomerulus:** A tuft of capillaries associated with a renal tubule.



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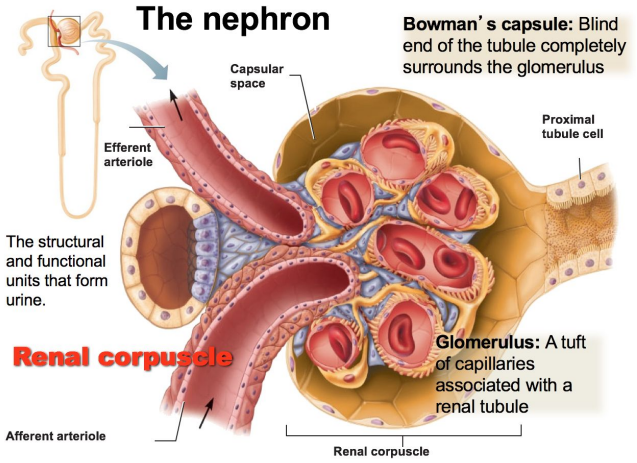
The **Nephron** consist of :

- Bowman's capsule
- PCT
- Loop of Henle.
- DCT
- Collecting tubules and ducts

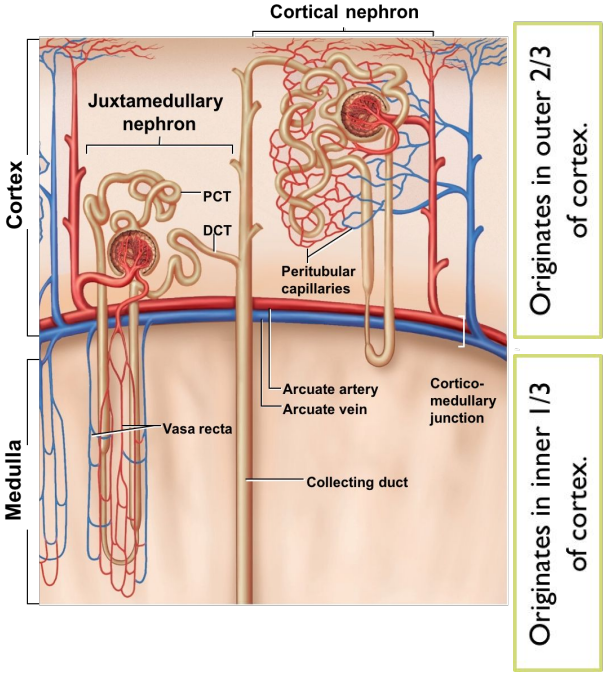


The **renal tubule** is divided into different sections with different structural and functional characteristics:

- Proximal tubules (in the cortex).
- Loop of Henle.
- Distal tubule (in the renal cortex).
- Connecting tubule, cortical collecting, and the cortical collecting ducts, which run downward in the medulla and become: Medullary collecting ducts.

Types of Nephrons:

Cortical Nephrons	**Juxtamedullary Nephrons**: (15%) 1-2% of Blood Flows Through Them
Their glomeruli in the outer portion of cortex	Located at the Cortex-medulla junction They're located in the cortex within the border of the medulla. Only loop of Henle extend to the medulla.
---	Maintain salt gradient, helps conserve water
Have short loops of Henle	Have long loops extended into the medulla with extensive thin segments. are involved in the production of **concentrated urine.**
Continues from efferent as Peritubular capillaries	Continues from efferent as Vasa recta



- Juxtamedullary nephrons are counter current in structure like this: Allowing more water reabsorption.
- Juxtamedullary nephrons work during prolonged fasting.

Filter that lies between the blood and the interior of glomerular capsule.

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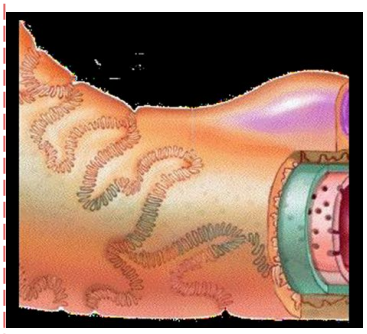
Glomerular Membrane

Blood in the glomerulus is separated from the fluid in the Bowman's space by a filtration barrier (glomerular membrane) consisting of three layers:

1- Single epithelial lining of Bowman's capsule (Podocytes) During filtration the fluid moves between their foot processes (pseudopodia).

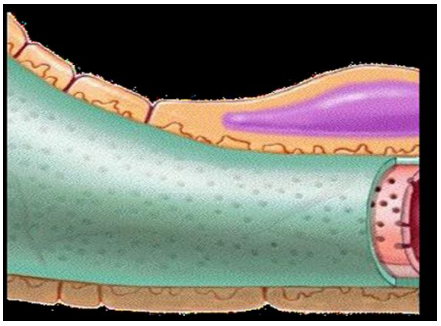
2- Basement membrane between endothelium and epithelium.

3- Single layer of capillary endothelium.



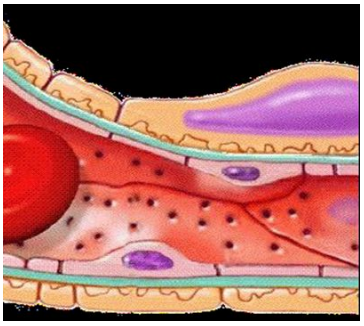
Podocytes
(cell body with nucleus)

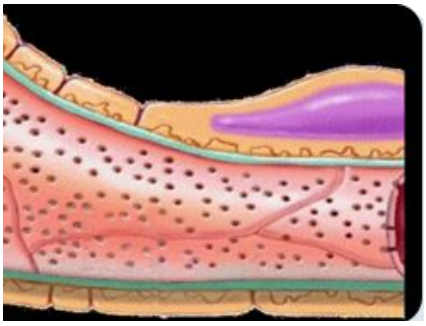
3



Basement Membrane

2



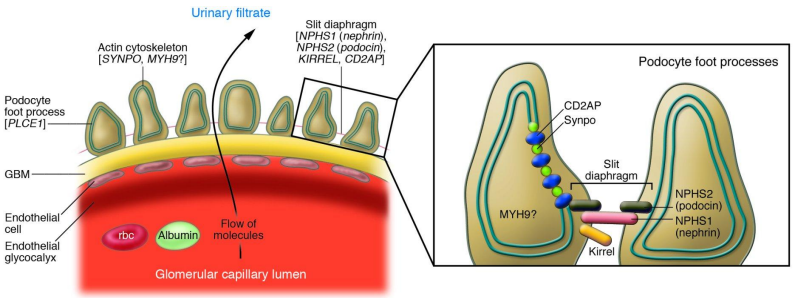


Capillary Endothelium

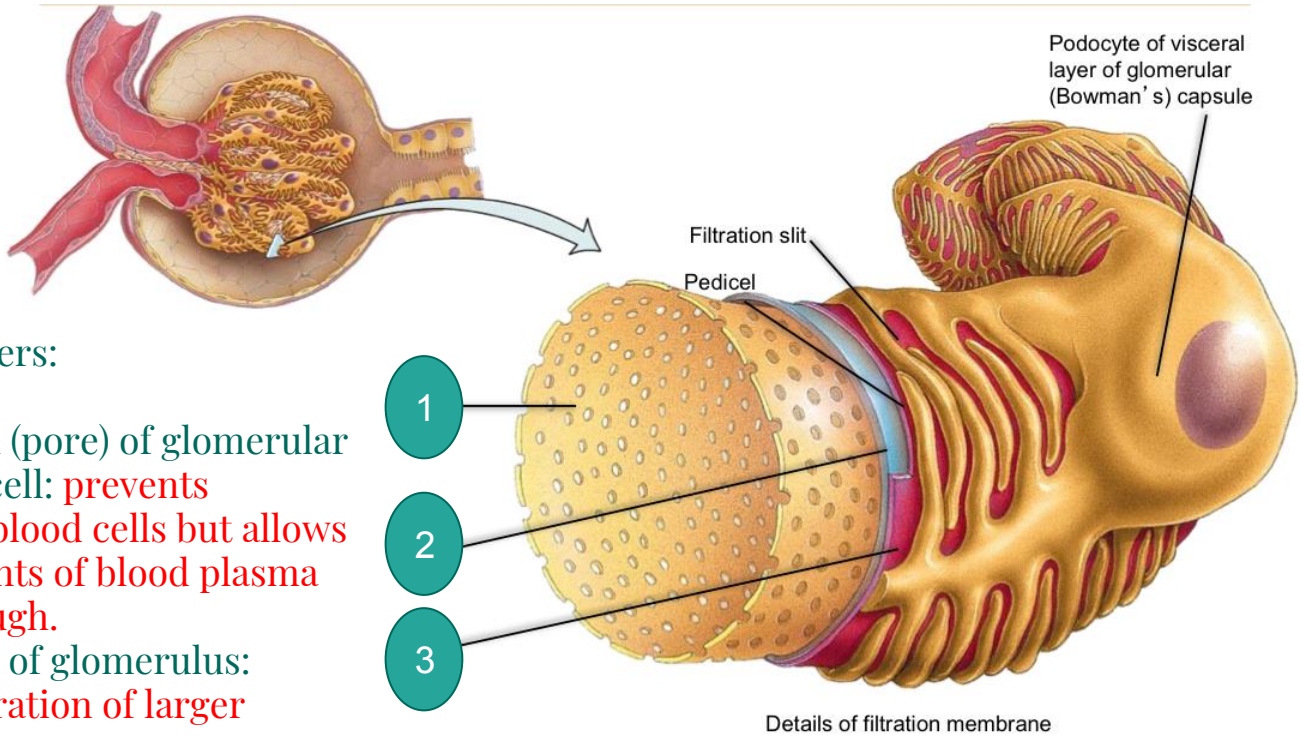
1

Characteristics of Glomerular Membrane:

- Allow passage of molecules up to 70,000 D.
- Albumin does not normally pass as they are repelled by the negative charge of the **glycoproteins** material of basement membrane.
- Blood cells do not normally pass through the membrane.

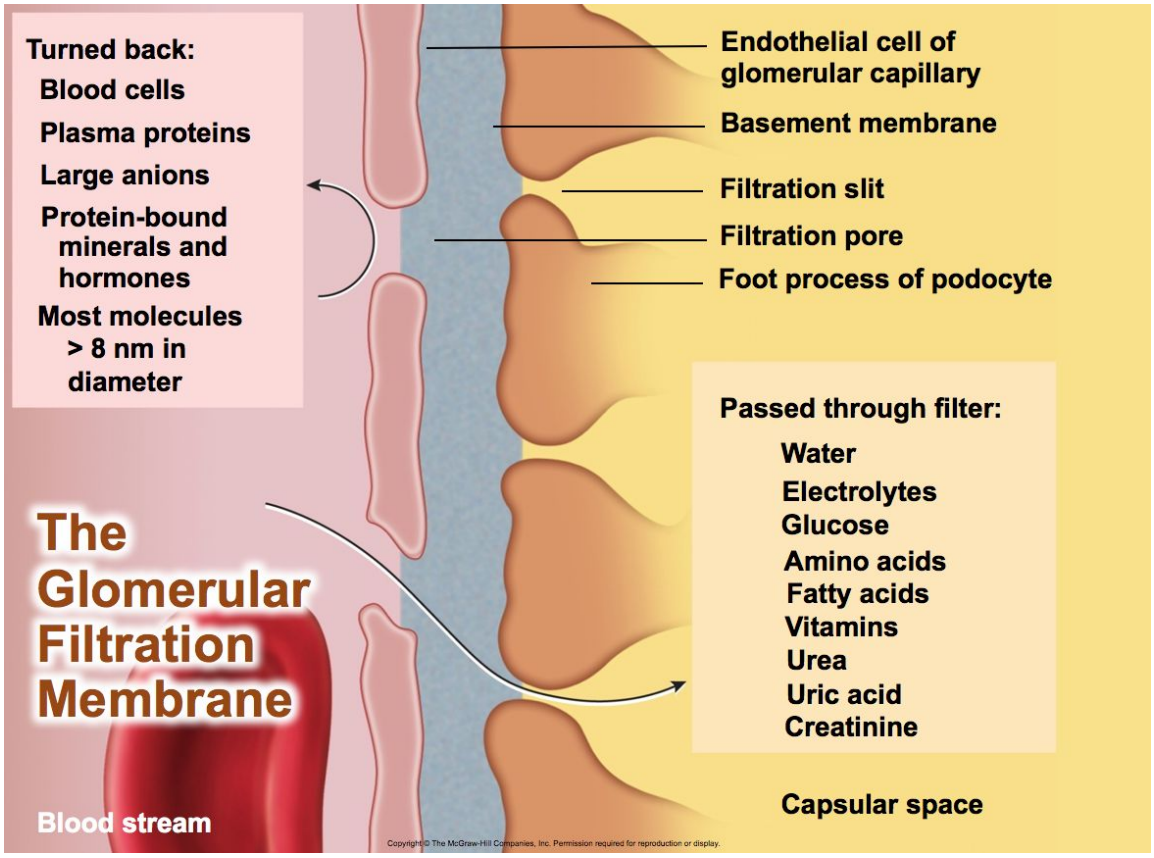


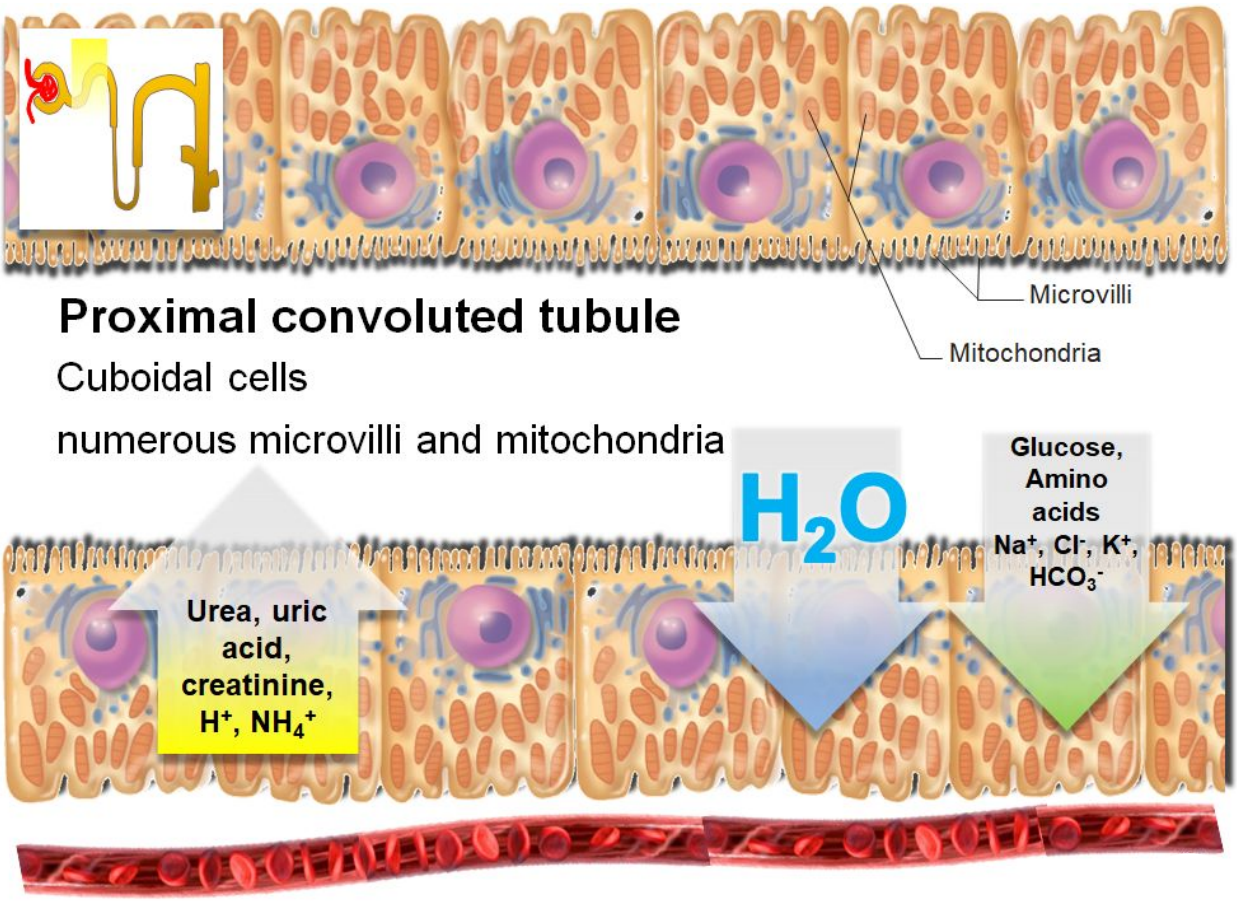
Video of overview of histology of glomerular and GFR, Duration 7 mins



Composed of 3 layers:

1. Fenestration (pore) of glomerular endothelial cell: prevents filtration of blood cells but allows all components of blood plasma to pass through.
2. Basal lamina of glomerulus: prevents filtration of larger proteins.
3. Slit membrane between pedicels: prevents filtration of medium-sized proteins.

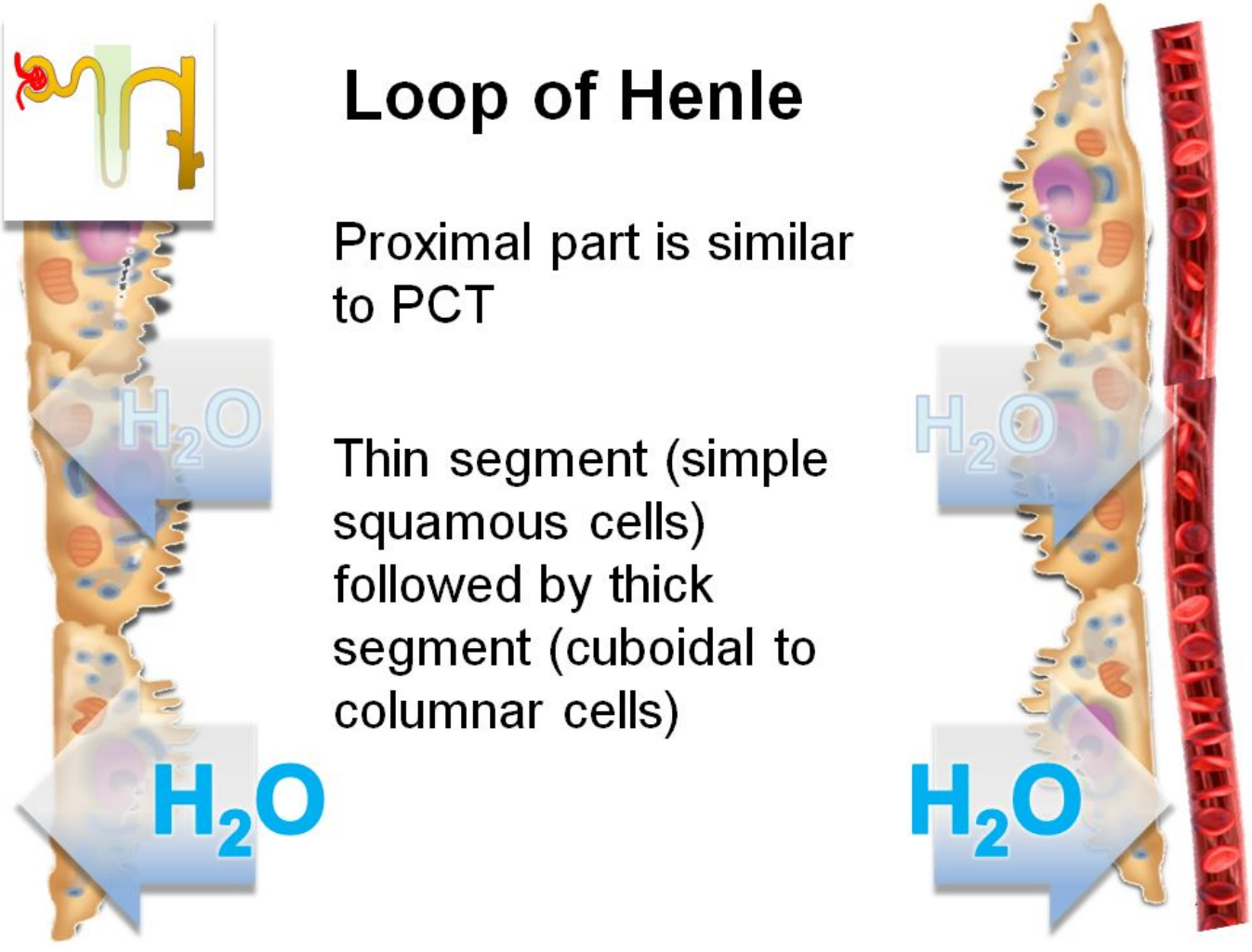




Proximal convoluted tubule

Cuboidal cells

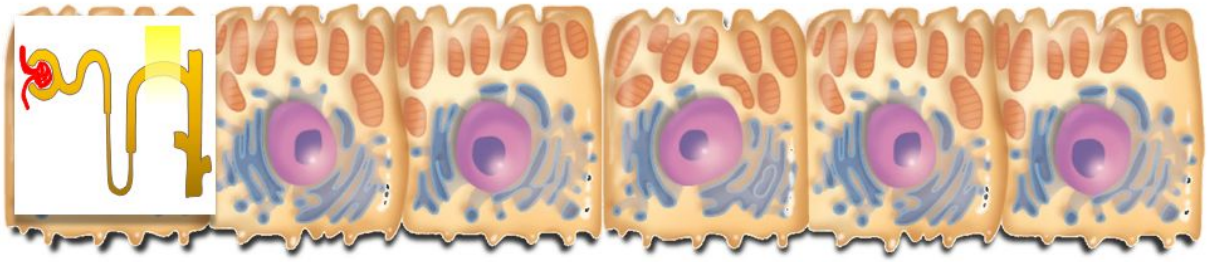
numerous microvilli and mitochondria



Loop of Henle

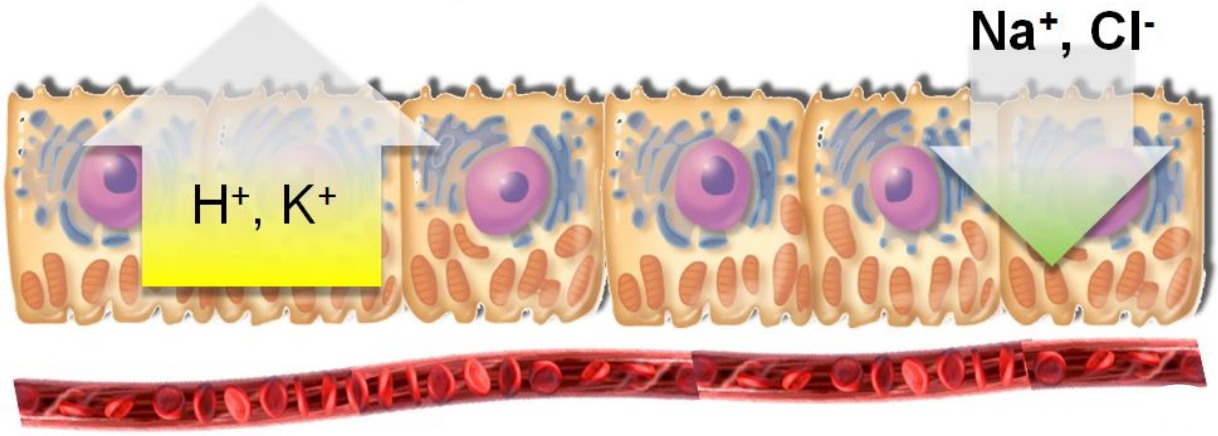
Proximal part is similar to PCT

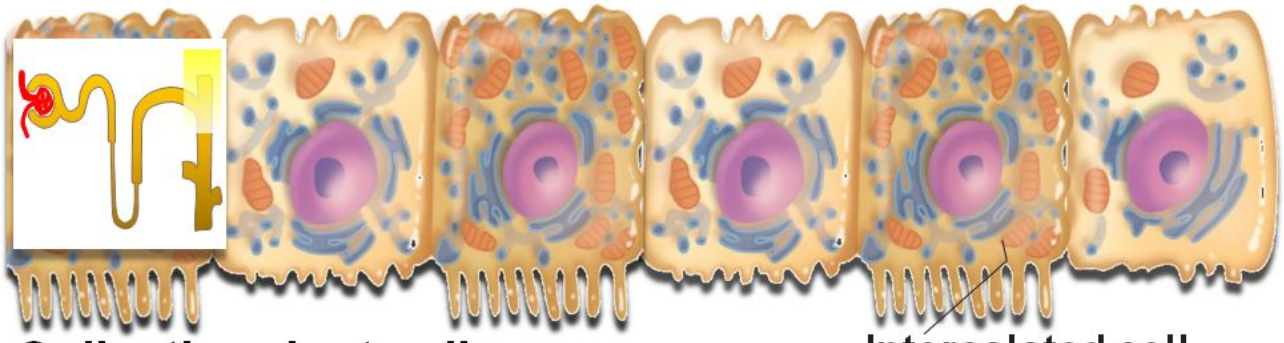
Thin segment (simple squamous cells) followed by thick segment (cuboidal to columnar cells)



Distal convoluted tubule

Cuboidal cells without microvilli that function more in secretion than reabsorption

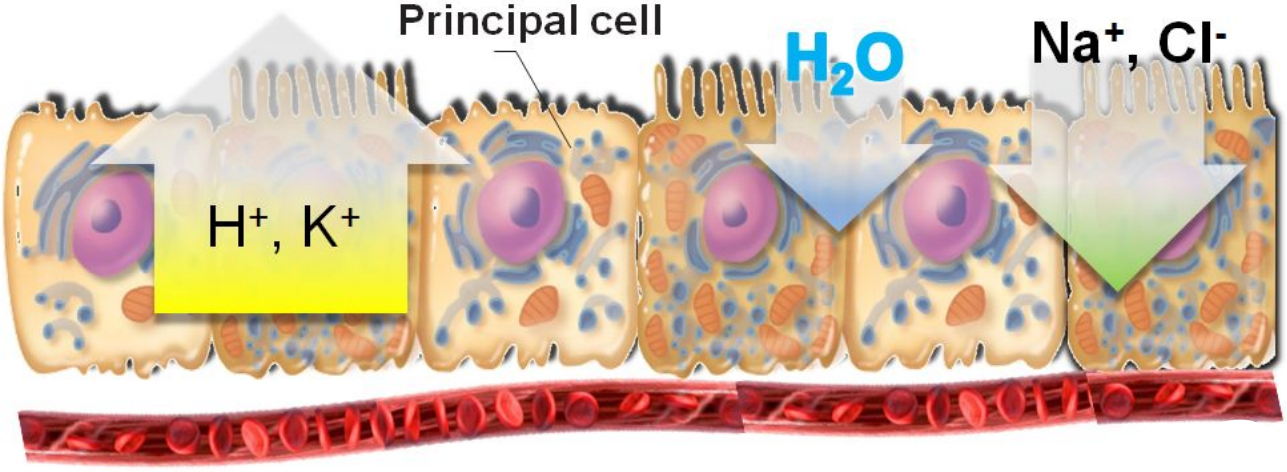




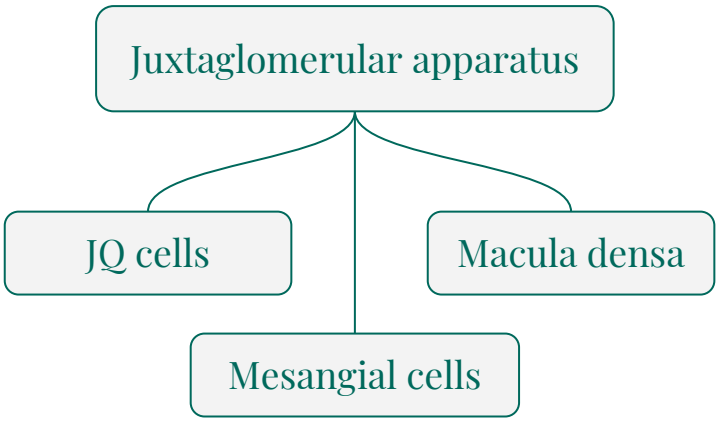
Collecting duct cells

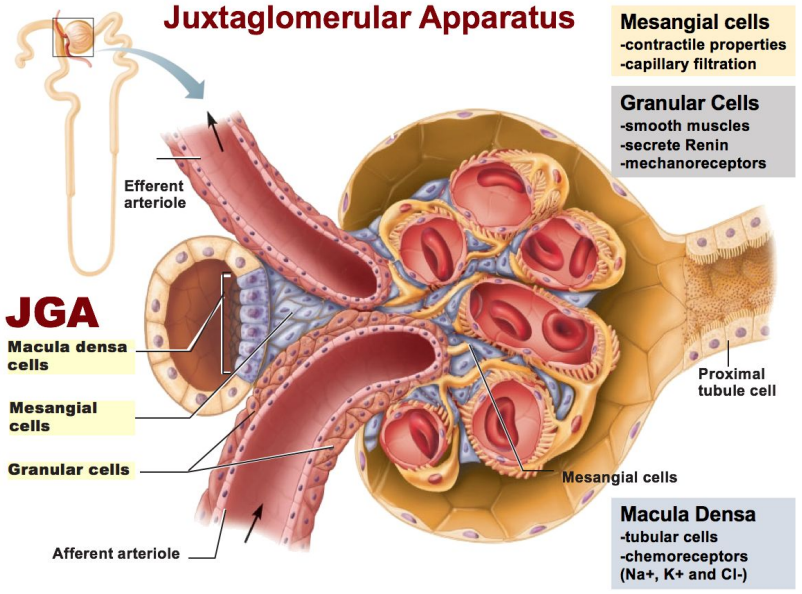
Intercalated cell
Acid-base balance

Water and salt balance
Principal cell



Juxtaglomerular Apparatus (JGA)





Mesangial Cells:

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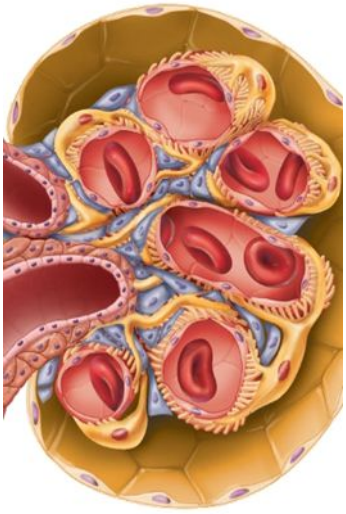
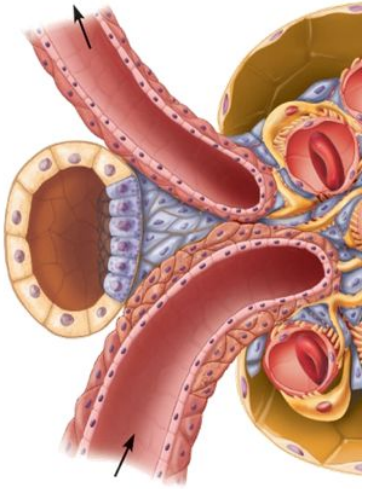
- Irregularly shaped cells in the central part of the glomerular tuft.
- Phagocytic function ↠ prevent the accumulation of macromolecules in the basement membrane which have escaped from the capillaries.
- Hold the delicate glomerular structure in position.
- Contraction ↠ modifies the surface area of the glomerular capillaries available for filtration.



Macula Densa:

- Tall, closely packed distal tubule cells
- Lie adjacent to JG cells
- Function as **chemoreceptors** or **osmoreceptors**
- The cells of the macula densa are sensitive to the **ionic content** and **water volume** of the fluid in the tubule.
- produce molecular signals that promote renin secretion by the juxtaglomerular cells



Juxtaglomerular apparatus:

- Is where distal tubule lies against the afferent (sometimes efferent) arteriole.
- Arteriole walls have **juxtaglomerular (JG) cells**, which:
  - Enlarged, smooth muscle cells.
  - Have secretory granules containing **renin.**
  - Act as mechanoreceptors

Extra Information

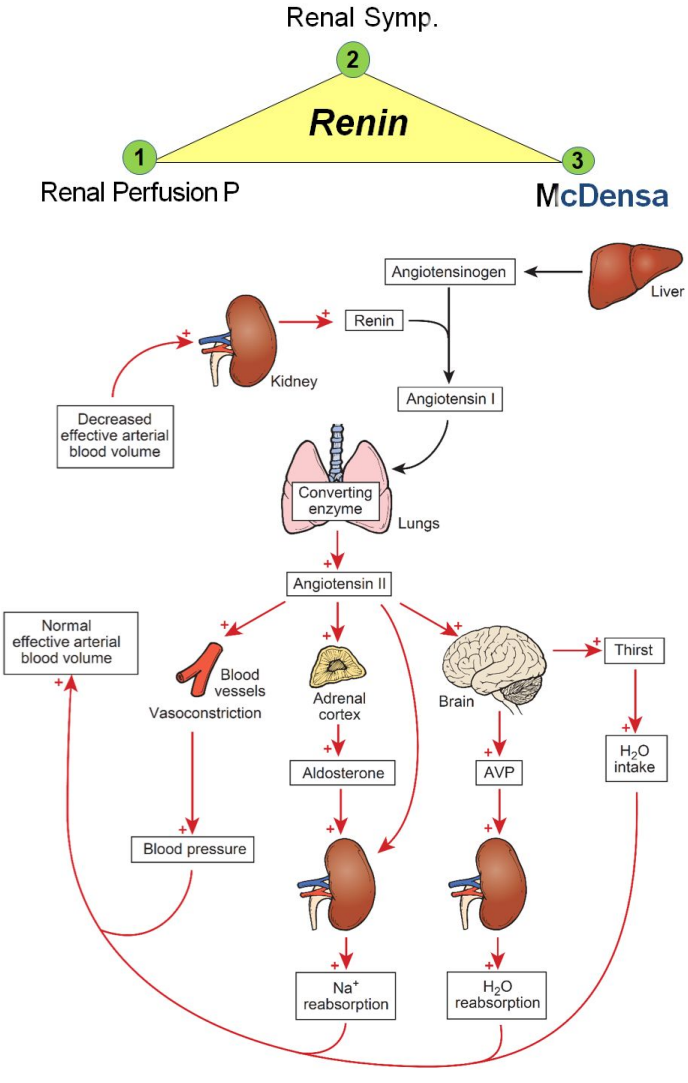
Innervation of the Kidney

- Only sympathetic nerves supply renal blood vessels
- Regulate blood flow, filtration, water reabsorption, renin secretion.
- ↑ sympathetic = constriction, ↓ blood flow
- There is no parasympathetic innervation

RAAS "Renin Angiotensin Aldosterone System"

- A hormone system that regulates BP and water balance.
- Day-to-day control of Na^+ excretion.

Three Main Stimuli for Renin Release



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RENAL BLOOD VESSELS

Afferent Arteriole:

Delivers blood into the glomeruli.

Glomeruli:

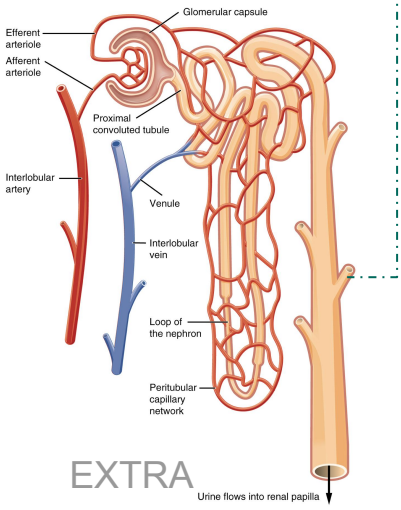
Capillary network that produces filtrate that enters the urinary tubules.

Efferent Arteriole:

Delivers blood from glomeruli to peritubular capillaries.

Peritubular Capillaries:

Vasa Recta.



Renal blood flow:

- ¨Renal blood flow to the kidney represents **20%** of cardiac output.
- ¨The blood flows to each kidney through a **renal artery**.
- ¨**Features** of renal circulation:

  1- High blood flow rate (1200 ml/min).

  2- Presence of two capillary beds: glomerular and peritubular.
- Efferent and afferent arterioles are major sites of **renal resistance**.

Urine formation

The primary function of the kidney is to 'clear' unneeded substances from the blood to be excreted in urine.

-Steps of urine formation (basic renal processes):

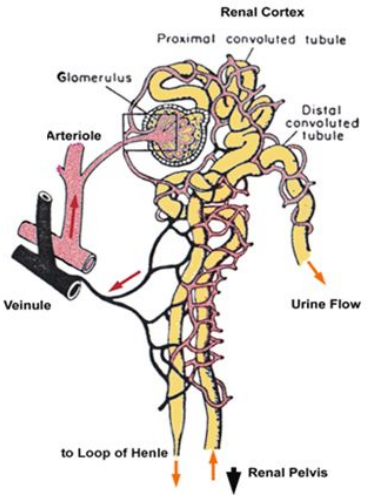
1- Glomerular filtration: Filtration of fluid from glomerular capillaries into the renal tubules.

2- Tubular reabsorption

3- Tubular secretion.

4- Excretion.

Urinary excretion rate = Filtration rate- reabsorption+secretion.



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Capillary Beds of the Nephron:

-Every **nephron** has (**Glomerulus** & **Peritubular** capillaries).
-Each **glomerulus** fed by afferent arteriole & drained by efferent arteriole.
-Blood pressure in the glomerulus is **high** because:
1- Arterioles are high-resistance vessels.
2- Afferent arterioles have larger diameters than efferent arterioles*.
-Fluids and solutes are forced out of the blood throughout the entire length of the glomerulus.

Capillary Beds & Resistance:

Peritubular beds are low-pressure, porous capillaries adapted for absorption that:

1- Arise from efferent arterioles

2- adhere to adjacent renal tubules

3- Empty into the renal venous system

-Resistance in afferent arterioles:

Protects glomeruli from fluctuations in systemic blood pressure.

-Resistance in efferent arterioles:

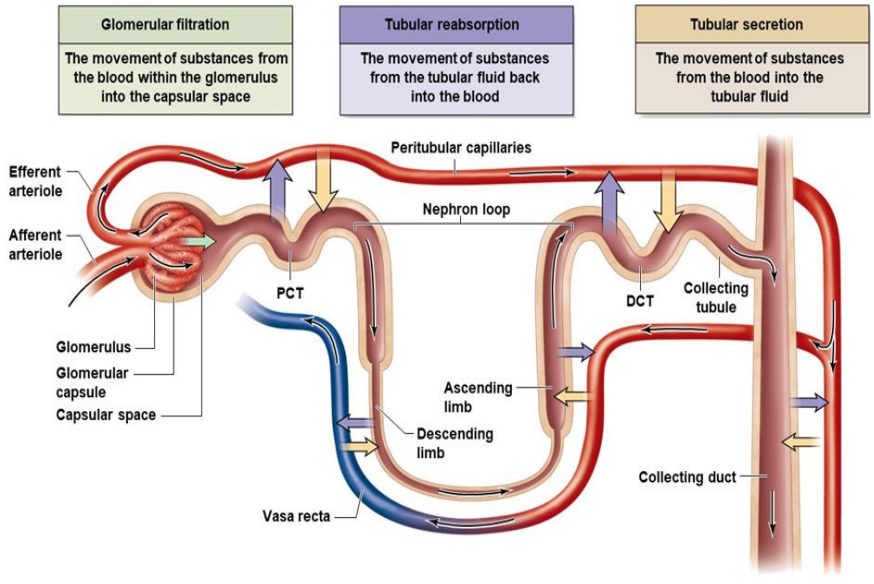
1- Reinforces high glomerular pressure.

2- Reduces hydrostatic pressure in peritubular capillaries.

*That's why the pressure between them is high

Filtrate: Movement of substance from glomerulus to capsular space and then to Proximal tubules.

Mechanisms of Urine Formation:



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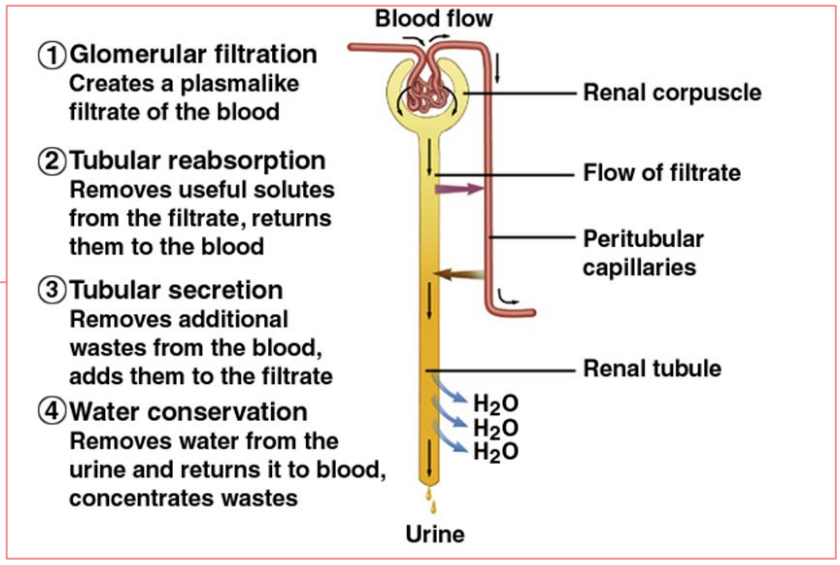

Glomerular filtration rate (GFR)

- The first step in urine formation is glomerular filtration.
- It is the filtration of fluid from the glomerular capillaries into the renal tubules.
- It contains all substances present in plasma except proteins.
- GFR is normally 125 ml/min = 20% renal plasma flow.

The GFR is determined by:

1- the **Net Filtration Pressure (NFP)** across the glomerular capillaries.

2- the **Glomerular Capillary Filtration Coefficient (K_f)**.

GFR = K_f x Net filtration pressure.

= 12.5 X 10 = 125 ml/min or 180 L/day

- The volume of filtrate produced by both kidneys per min.
- Filtration coefficient (K_f) depends on permeability and surface area of filtration barrier (Mesangial cells).
- 99% of filtrate reabsorbed, 1 to 2 L urine excreted.
- GFR is directly proportional to the NFP:
  - An increase in NFP → ↑GFR.
  - A decrease in NFP → ↓GFR.
- Changes in GFR normally result from changes in glomerular blood pressure.

Cont.

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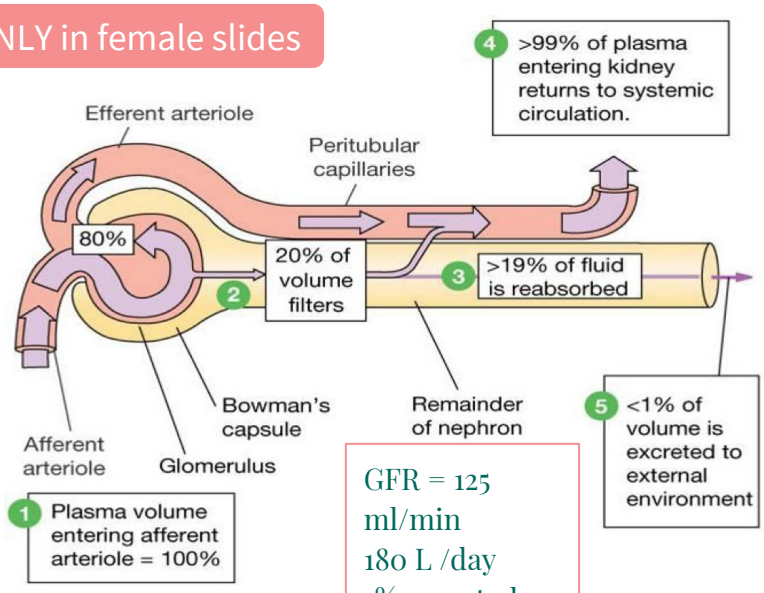
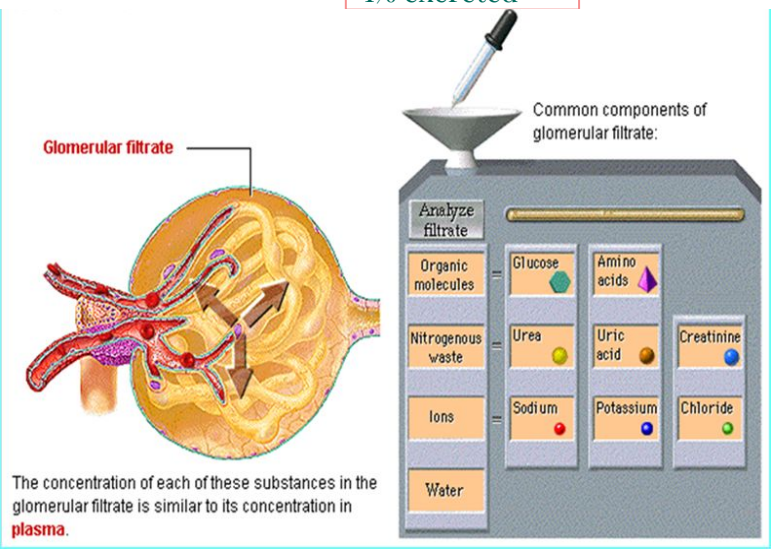


GFR = 125 ml/min
180 L /day
1% excreted



Factors governing filtration rate at the capillary bed are:

1-Total surface area available for filtration.

2-Filtration membrane permeability.

3-Net filtration Pressure.

ONLY in male slides

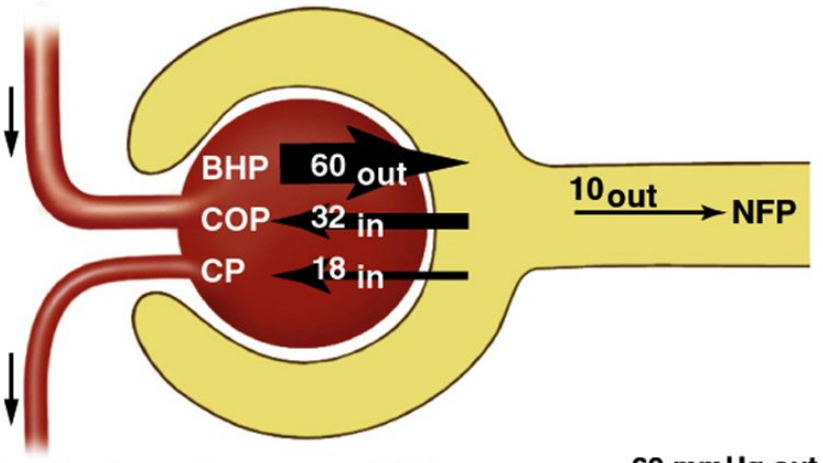
level depends on age, sex and body size

GFR (mL/min/1.73 m²)	Period of time	Kidney damage	Comment
>90		NO	Normal
60–89		NO	Normal (elderly or infants)
60–89	≥ 3 months	YES	Early kidney disease
<60	≥ 3 months	YES	Chronic kidney disease

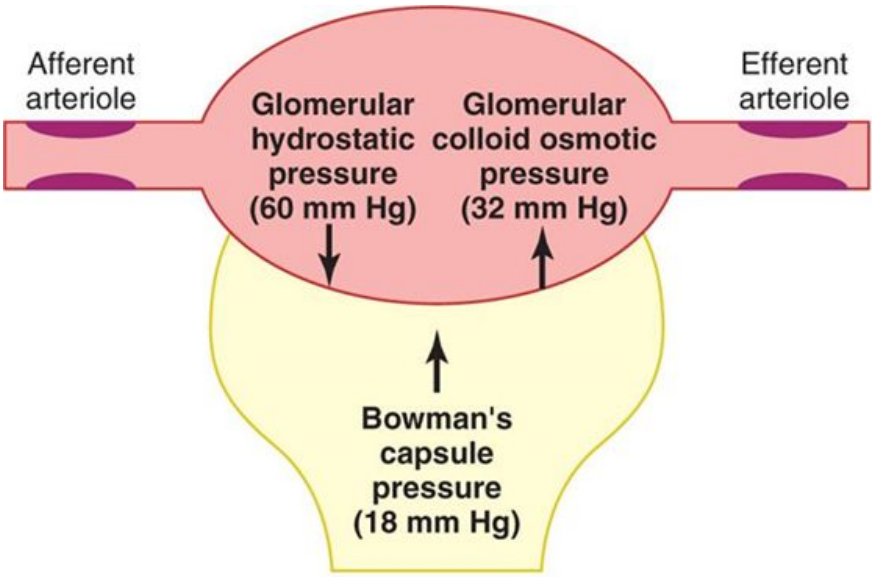
Net Filtration Pressure (NFP):

- The pressure responsible for filtrate formation
- NFP equals the glomerular hydrostatic pressure (HP_g) minus the oncotic pressure of glomerular blood (OP_g) combined with the capsular hydrostatic pressure (HP_c)

$$NFP = HP_g - (OP_g + HP_c)$$
Or
$$NFP = P_{GC} - P_{BS} - O_{GC}$$



Blood hydrostatic pressure (BHP)	60 mmHg out
Colloid osmotic pressure (COP)	–32 mmHg in
Capsular pressure (CP)	–18 mmHg in
Net filtration pressure (NFP)	10 mmHg ou



Net filtration pressure (10 mm Hg) = Glomerular hydrostatic pressure (60 mm Hg) – Bowman's capsule pressure (18 mm Hg) – Glomerular oncotic pressure (32 mm Hg)

Filtration

Hydrostatic Pressure

- glomerular hydrostatic pressure (GHP) push fluid out of vessels
- capsular hydrostatic pressure (CsHP) push fluid back into vessels
- net hydrostatic pressure (NHP):
  - NHP = GHP - CsHP
  - 35 = 50 - 15 mmHg

Colloid Pressure

- blood colloid osmotic pressure (BCOP)
- proteins in blood (hyperosmotic):
  - draw water back into blood ~ 25 mm Hg

Filtration Pressure (FP):

- NFP = NHP - BCOP
- 10 = 35 - 25 mmHg
- importance of blood pressure:
  - 20% drop in blood pressure.
  - 50 mmHg to 40mm Hg
  - **Filtration would stop**

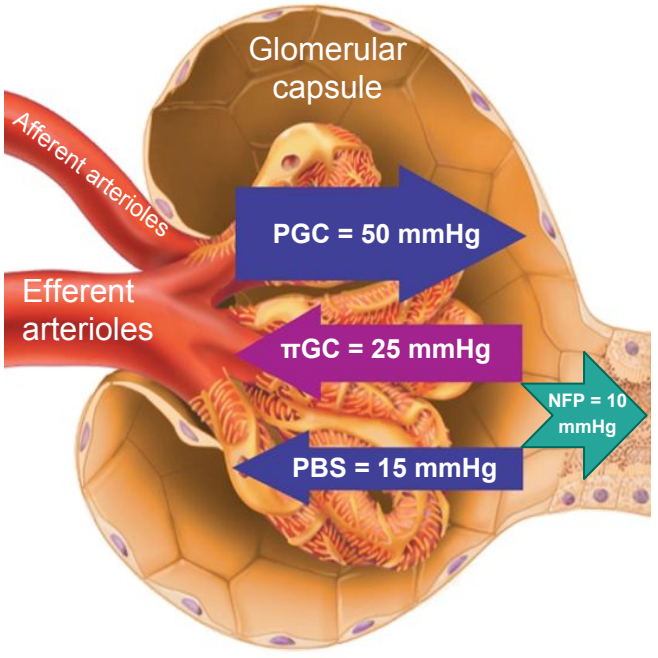
Determinants of GFR;

- **Filtration coefficient (K_f)**

- **Net Filtration Pressure (NFP)**
  - The cumulative pressure responsible for filtrate formation.

= OUTWARD pressures – INWARD pressures
= (PGC + πBS) – (PBS + πGC)
= (50) – (15 + 25) = 10 mm Hg

$$GFR = K_f \times [P_{GC} - (P_{BS} + \pi_{GC})]$$



Changes in GFR result from changes in glomerular blood pressure.

Control of GFR:

GFR = Kf x [(PG-PB)-(pG- pB)]

GFR = Kf x [(60-18)-(32- 0)]

Mentioned in male slides with different numbers

1. Hydrostatic pressure inside the glomerular capillaries (glomerular hydrostatic pressure, PG), which promotes filtration
2. The hydrostatic pressure in bowman's capsule (PB) outside the capillaries, which opposes filtration
3. The colloid osmotic pressure of the glomerular capillary plasma proteins (πg), which opposes filtration
4. The colloid osmotic pressure of the proteins in bowman's capsule (πb), which promotes filtration.

Regulation of GFR:

GFR = Kf X (PG - πG - PB + πB)

-Any factor that affect the parameters in the equation will affect the GFR. However, physiologic regulation of the GFR involves mechanisms that affect mainly the **PG**

PG depends on:

- Arterial BP
- Afferent arteriolar resistance
- Efferent arteriolar resistance

P= hydrostatic
π= osmotic

Kf
πG
PB

} Can get affected in disease conditions causing changes in GFR

Why is it important to have the GFR regulated?

Glomerular Filtration Rate:

If the GFR is <u>too high:</u>

-Fluid flows through tubules too rapidly to be absorbed, so needed substances cannot be reabsorbed quickly enough and are lost in the urine.

-Urine output rises.

Creates threat of dehydration and electrolyte depletion

If the GFR is <u>too low:</u>

-Fluid flows sluggishly through tubules.

-Tubules reabsorb wastes that should be eliminated (everything is reabsorbed).

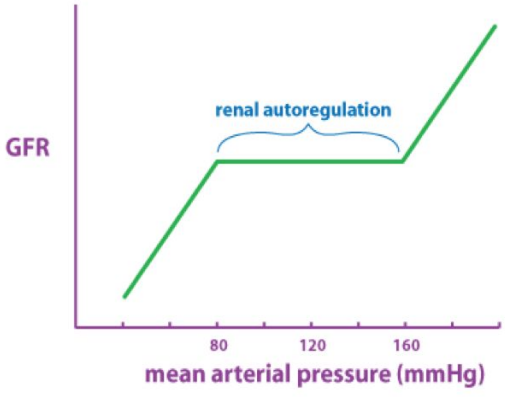
-Azotemia develops (high levels of nitrogen-containing substances in the blood).

GFR controlled by adjusting glomerular blood pressure through the following mechanisms:

- Autoregulation.
- Sympathetic control.
- Hormonal mechanism: renin and angiotensin.

Effect of Arterial blood pressure on GFR:

- ↑↑ABP → ↑↑GFR.
- However, the body maintains **<u>constant GFR</u>** over an **ABP** range of **75-160 mmHg.**
- Why? And how?



Forces controlling GFR: Starling's forces

Mentioned in male slides with different numbers

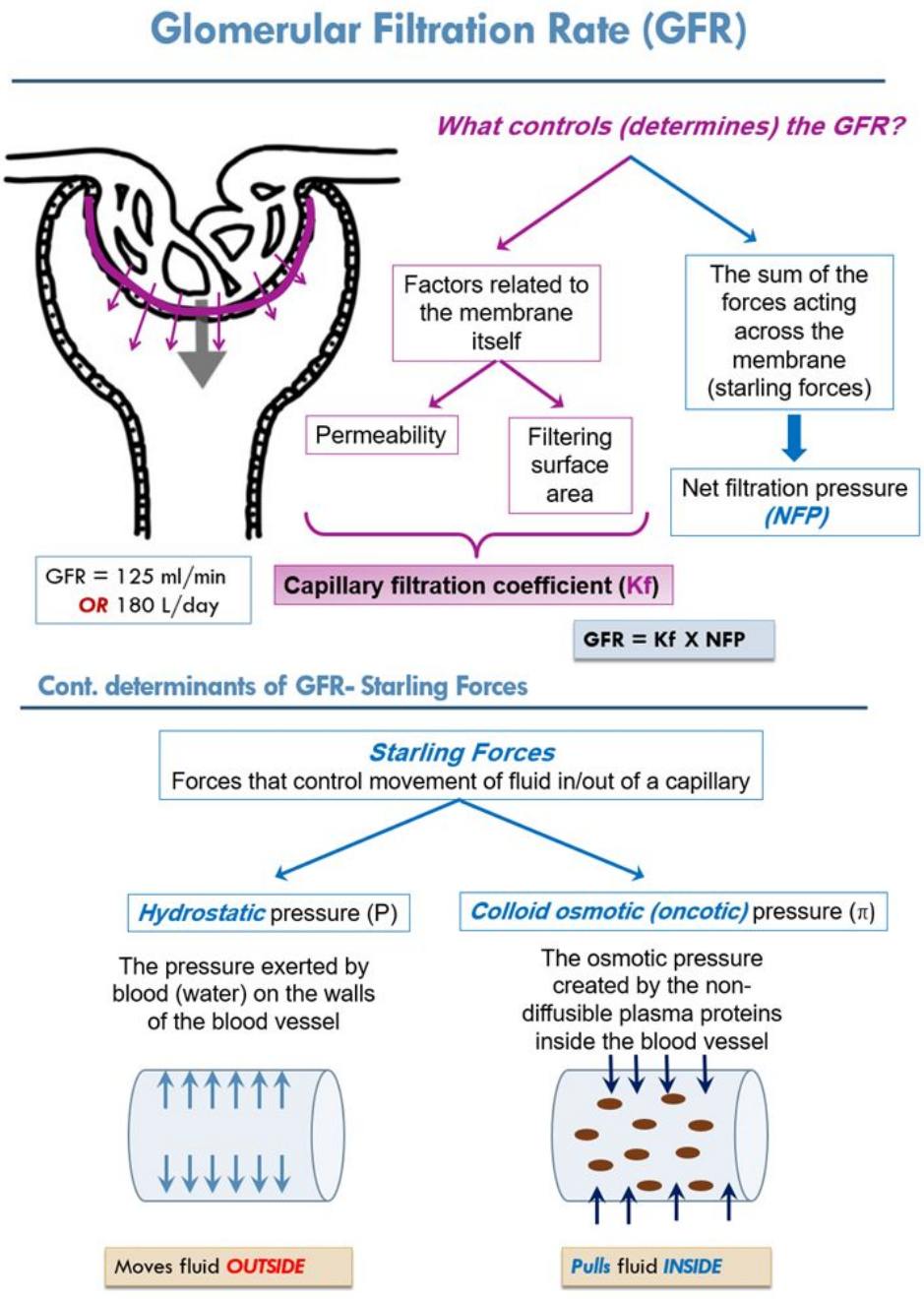
The net filtration pressure is the sum of:

1. glomerular hydrostatic pressure (= 60 mmHg). It promotes filtration.

2. hydrostatic pressure in Bowman's capsule (= 18 mmHg). It opposes filtration.

3. colloid osmotic pressure of glomerular plasma proteins (= 32 mmHg). It opposes filtration.

So, net filtration pressure = 60-18-32= 10 mmHg.



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How changes in Forces determining GFR affect GFR?

•Increased **Bowman's capsule pressure** decreases GFR. It can happen in urinary obstruction e.g. stones , tumors..

•Increased **glomerular capillary colloid osmotic pressure** decreases GFR.

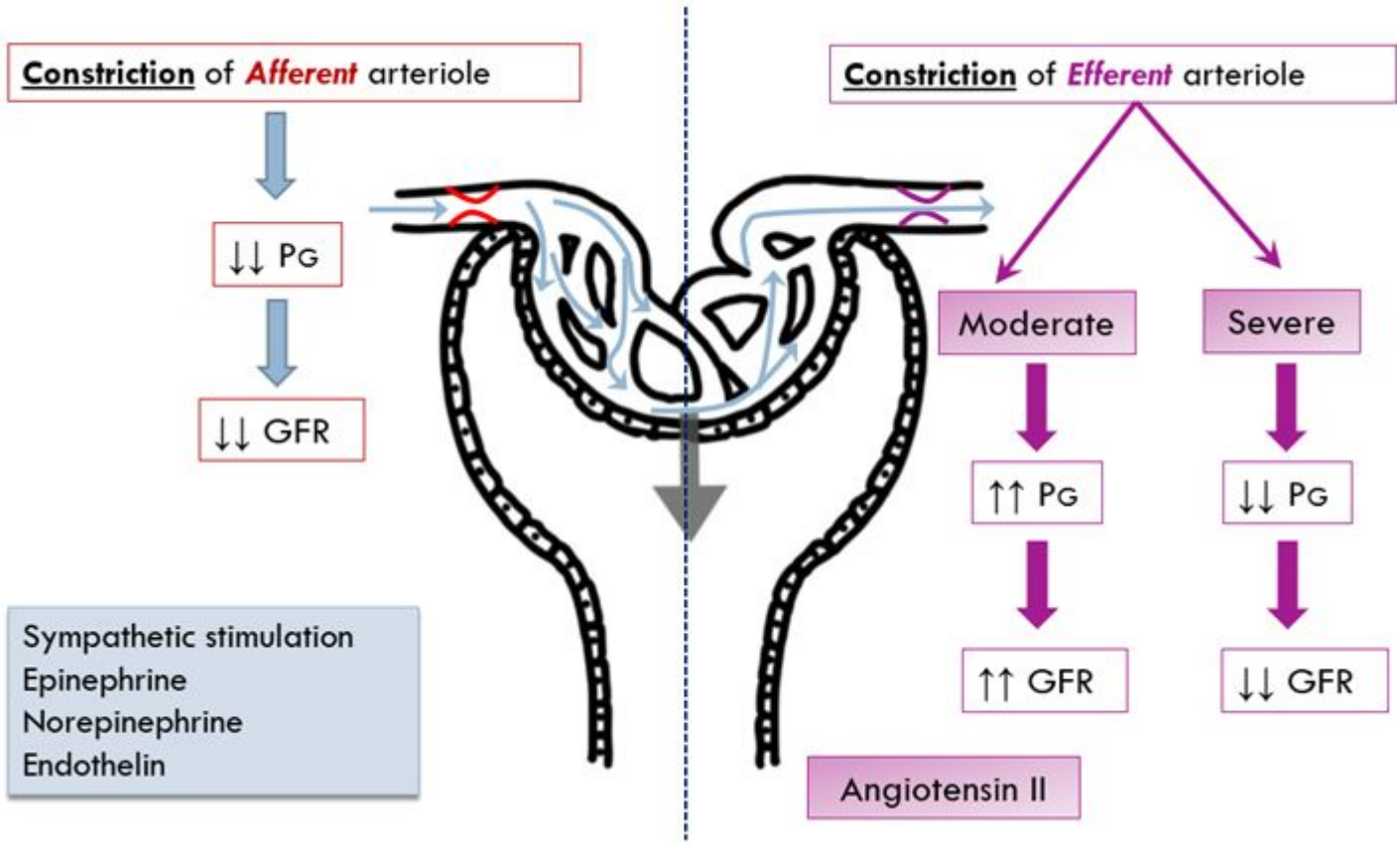
Increased **glomerular capillary hydrostatic pressure** increases GFR. This pressure is affected by:

1-ABP

2-Afferent arteriolar resistance

3-Efferent arteriolar resistance

Physiologic Regulation of GFR:



Constriction/dilation of afferent/efferent arterioles & GFR:

As vasodilation and vasoconstriction of the afferent and efferent arterioles alter the blood flow through the glomerular capillaries, there are corresponding alterations in the glomerular filtration rate (GFR).

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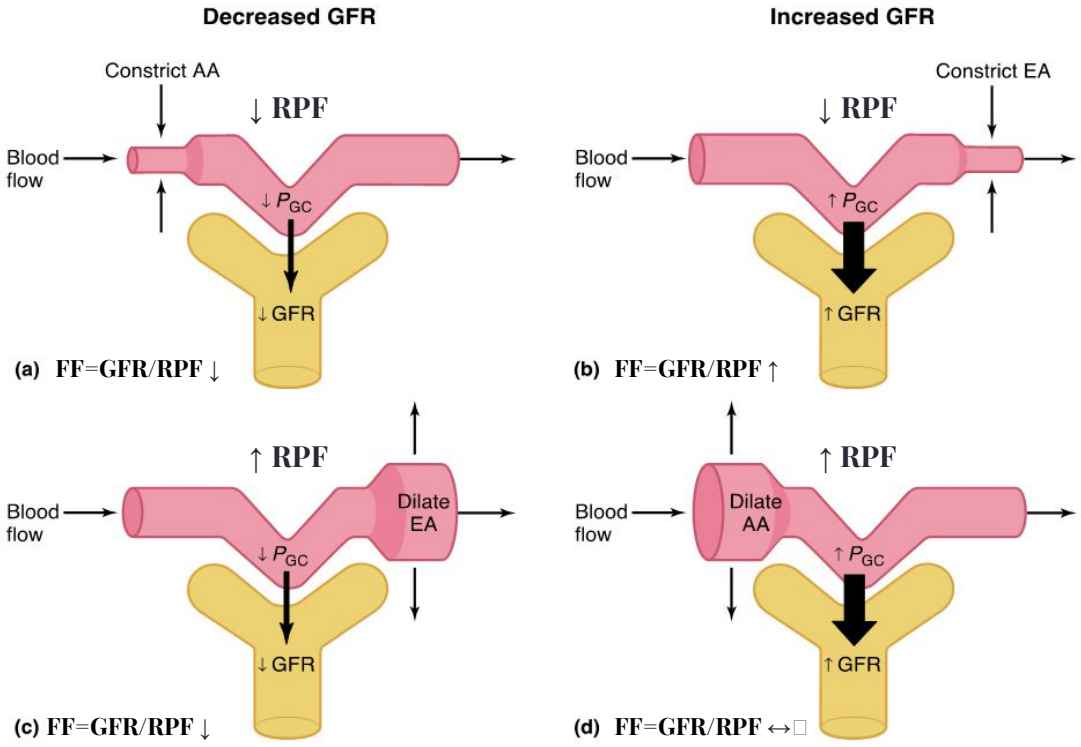
Important



Factors affecting Renal blood flow and GFR

- Sympathetic stimulation of renal arterioles decrease GFR & RBF.
- Norepinephrine decreases GFR & RBF.
- Angiotensin II decreases RBF. It constricts efferent arteriole more than afferent .
- High protein diet increases GFR.
- Hyperglycemia increases GFR & RBF.
- Fever increases GFR & RBF.
- Aging decreases RBF & GFR

Glomerular Filtration Rate Formula: $GFR = \frac{[sub]_{urine} \times \text{urine flow rate}}{[sub]_{plasma}}$

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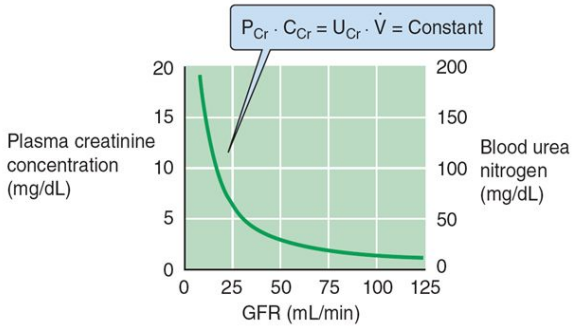
Substances Used to Measure GFR:

Important

Inulin - fructose polymer - precise (meets all criteria)

- freely filtered
- not reabsorbed
- not secreted
- not synthesized by kidney
- not degraded by kidney
- does not alter renal function



↓ GFR by 50% will ↑ $[Cr]_{plasma}$ to ***twice*** normal if Cr production by the body remains constant.

Creatinine - endogenous released by skeletal muscle

- Not as accurate as inulin as a small quantity is **secreted** into the proximal tubule ↠ **Amount excreted > amount filtered**

Regulation of GFR & RBF:

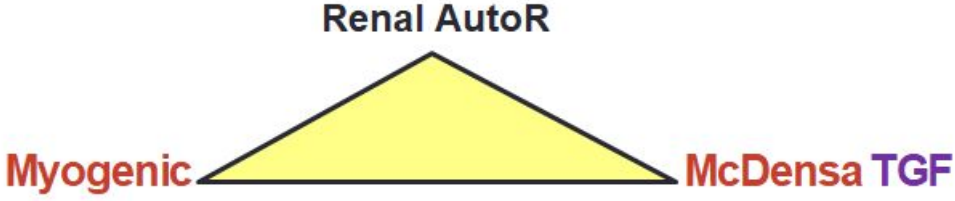
- **Intrinsic controls (renal autoregulation):** Act locally - maintain GFR, BP 80-180 mmHg.
- **Extrinsic controls (Sympathetic)**

1-Neuroendocrine mechanisms - maintain BP.

2-Can negatively affect kidney function

3-Take precedence over intrinsic controls if systemic **BP < 80 or > 180 mmHg**

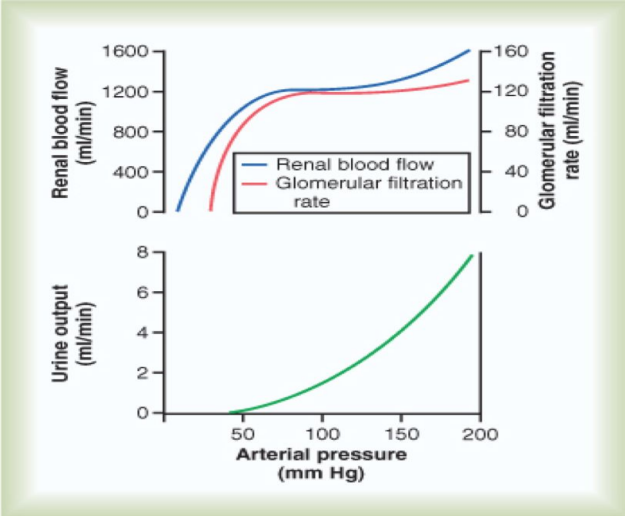
- **Hormonal mechanism**



How autoregulation takes place?

1- Autoregulation of GFR:

- GFR remains constant over a large range of values of BP
- 75-160 mmHg (80-180 mmHg)

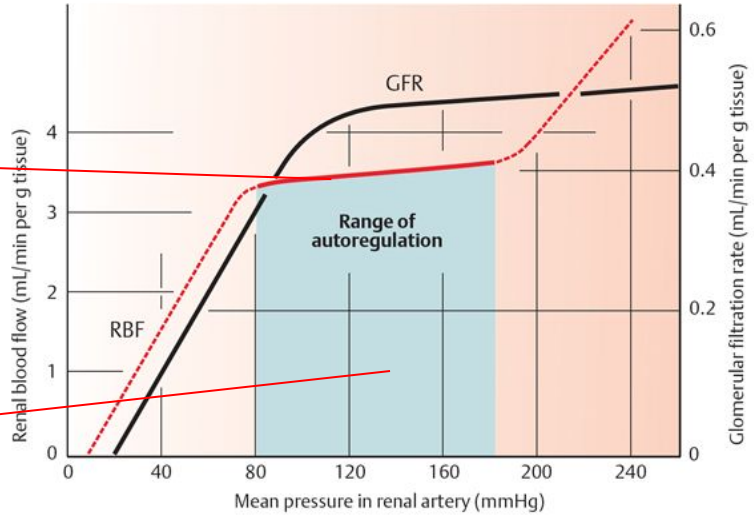


- Refer to feedback mechanisms intrinsic to the kidney that keep the renal blood flow and GFR relatively constant despite fluctuations in ABP.
- These mechanisms operate over an ABP ranging between 75-160 mmHg.
- **Achieved by 2 major mechanisms**:
  1. Tubulo-glomerular feedback mechanism.
  2. Myogenic auto-regulation.

Intrinsic Autoregulation:

RBF remains ~ constant as BP changes between **80** and **180** mmHg.

Autoregulation, is achieved by changes in resistance, mainly through the **a**fferent arterioles.



< **80 mmHg** (75 mmHg), filtration decreases, and ceases altogether when MAP = **50 mmHg**
- Autoregulation is **independent** of nerves or hormones
- occurs in denervated and in isolated perfused kidneys.

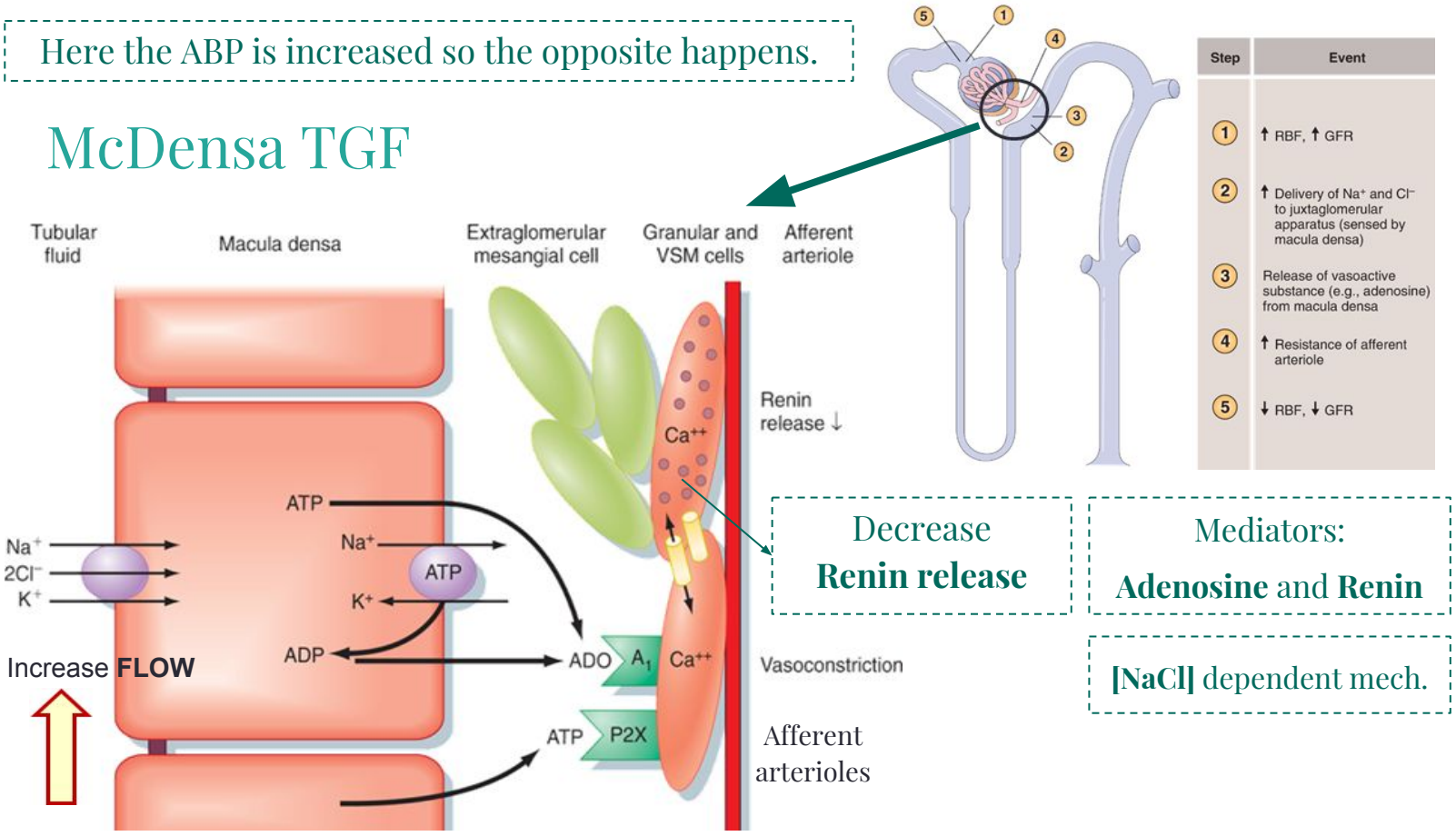
A- Tubuloglomerular Feedback:

mechanism:

- ↓ABP → ↓delivery of NaCl to the macula densa cells, which are capable of sensing this change , this will cause two effects:
  1. decrease in resistance of the afferent arterioles (i.e. vasodilatation) → ↑glomerular hydrostatic pressure to normal levels.
  2. increase in renin release from JG cells → Ang II → constrict efferent arteriole → ↑glomerular hydrostatic pressure & GFR to normal.

Here the ABP is increased so the opposite happens.

McDensa TGF



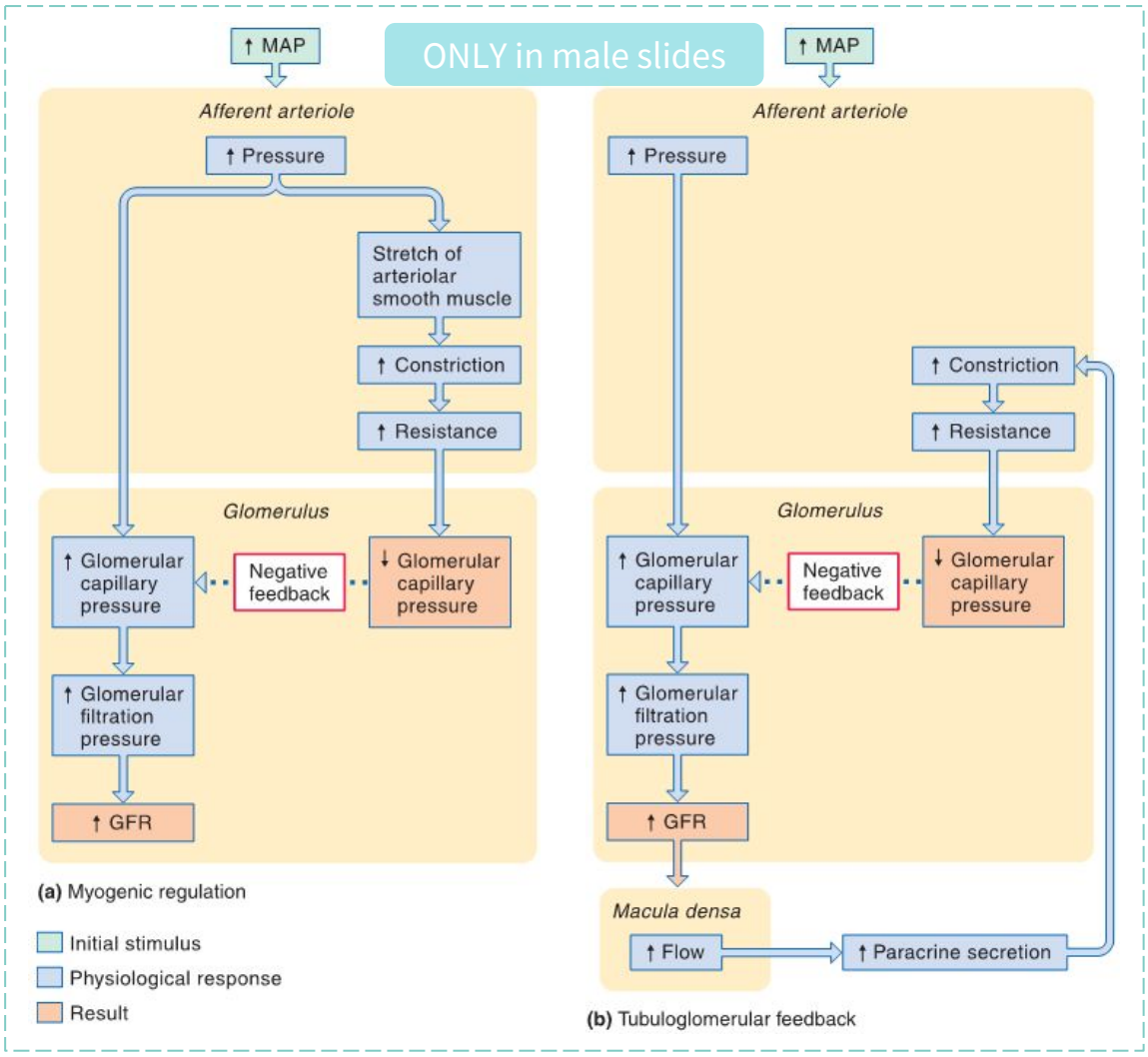
Decrease **Renin release**

Mediators: **Adenosine** and **Renin**

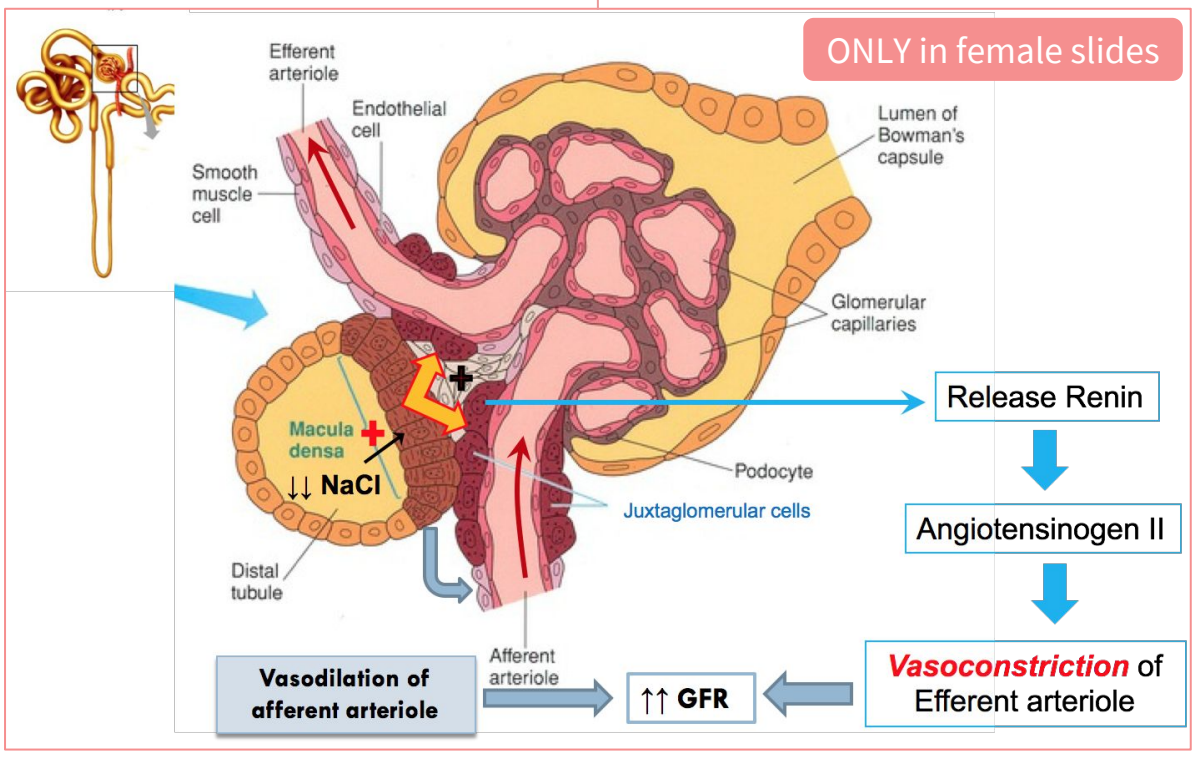
[NaCl] dependent mech.

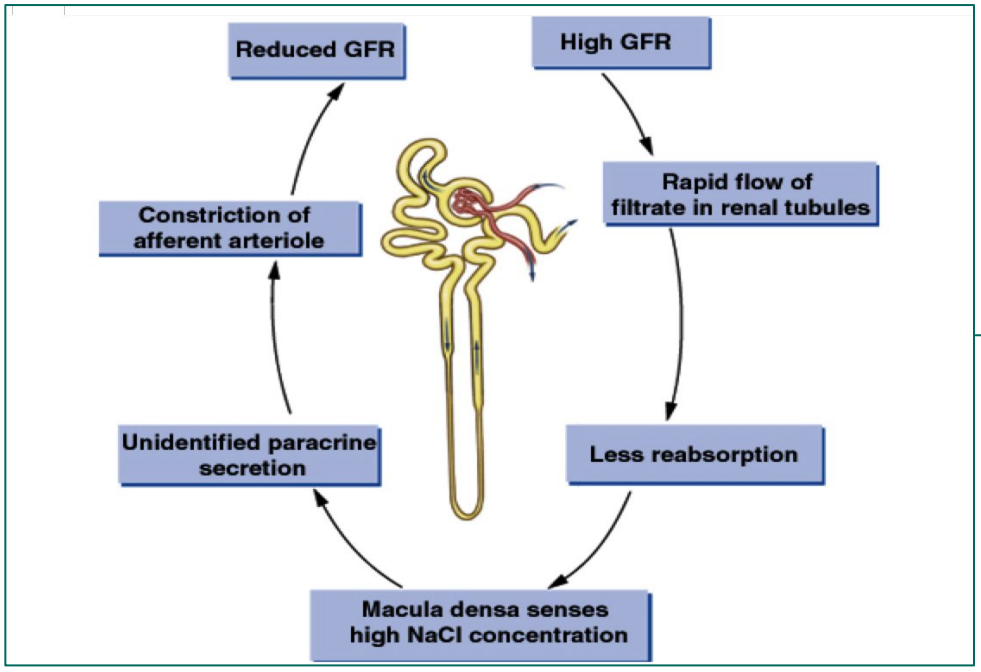
B- Myogenic Mechanism:

- It is the intrinsic capability of blood vessels to constrict when blood pressure is increased. The constriction prevents excess increase in renal blood flow and GFR when blood pressure rises.
- When blood pressure decreases the myogenic mechanism reduces vascular resistance and the vessel dilates.



(Tubulo-glomerular Feedback)





Example of autoregulation

2-Extrinsic controls: **Sympathetic Control of GFR**

When the sympathetic system is :

at rest:

-Renal blood vessels are maximally dilated

-Autoregulation mechanisms prevail

Under stress:

-**Norepinephrine** is released by the sympathetic nervous system

-**Epinephrine** is released by the adrenal medulla

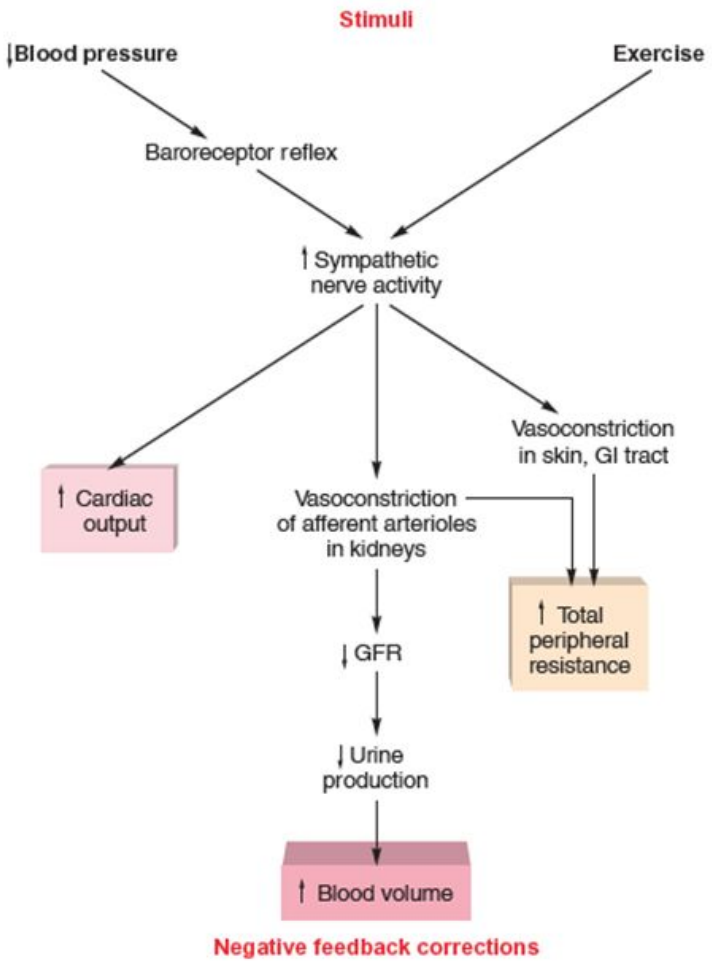
-Afferent arterioles constrict and filtration is inhibited

-Note: during fight or flight blood is shunted away from kidneys

- The sympathetic nervous system also stimulates the renin-angiotensin mechanism. This induces vasoconstriction of efferent arteriole.

- Stimulates vasoconstriction of afferent arterioles:
  - Preserves blood volume to muscles and heart.

- Cardiovascular shock:
  - Decrease glomerular capillary hydrostatic pressure.
  - Decrease urine output.



Summary of neurohumoral control of GFR and RBF:

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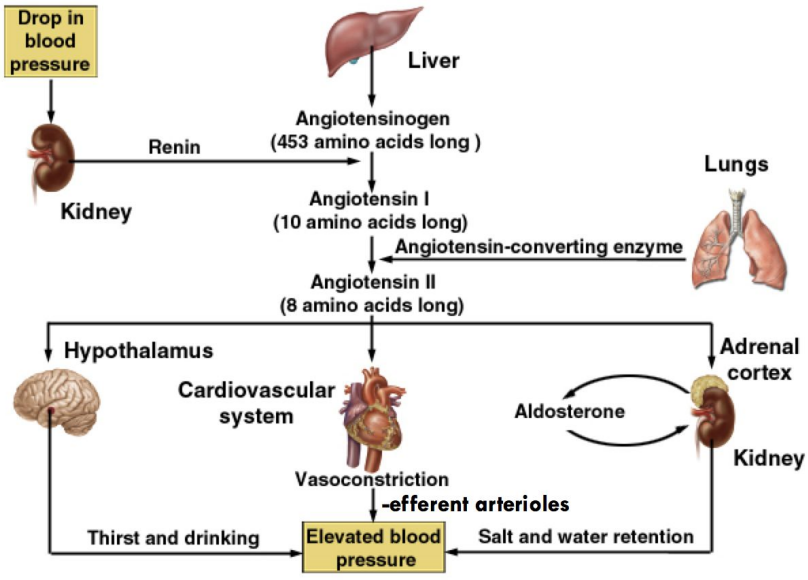
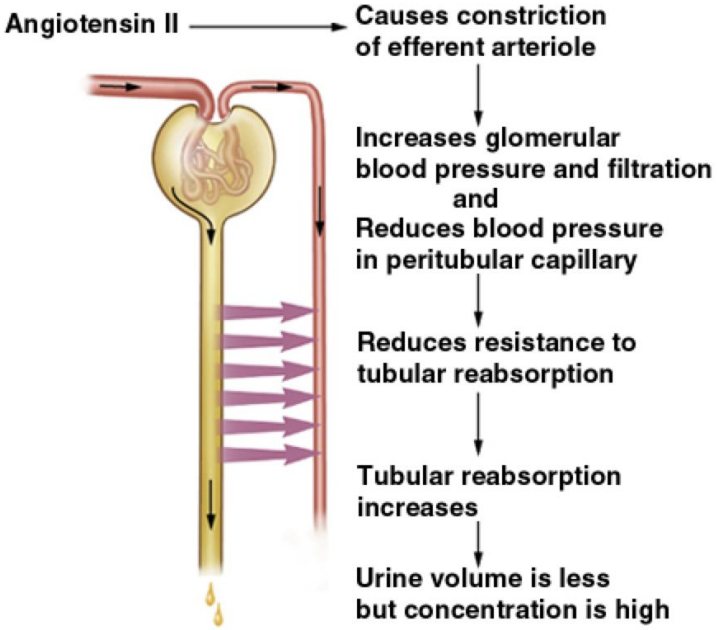
Important

Hormone or autacoid	Effect on GFR	Effect on RBF
↑ Sympathetic activity/Catecholamines ↑↑ R_A + ↑ R_E = ↓ GFR + ↓↓ RBF	↓	↓
↑ Angiotensin II ↑ R_E = ↑ GFR + ↓ RBF	↑	↓
↑ Nitric oxide ↓↓ R_A + ↓ R_E = ↑ GFR + ↑↑ RBF	↑	↑
↑ Endothelin ↑↑ R_A + ↑ R_E = ↓ GFR + ↓↓ RBF	↓	↓
↑ Prostaglandins D,E,I ↓↓ R_A + ↓ R_E = ↑ GFR + ↑↑ RBF	↑	↑

3-Hormonal Control of GFR:





-How does a high protein diet affect, if any, GFR?

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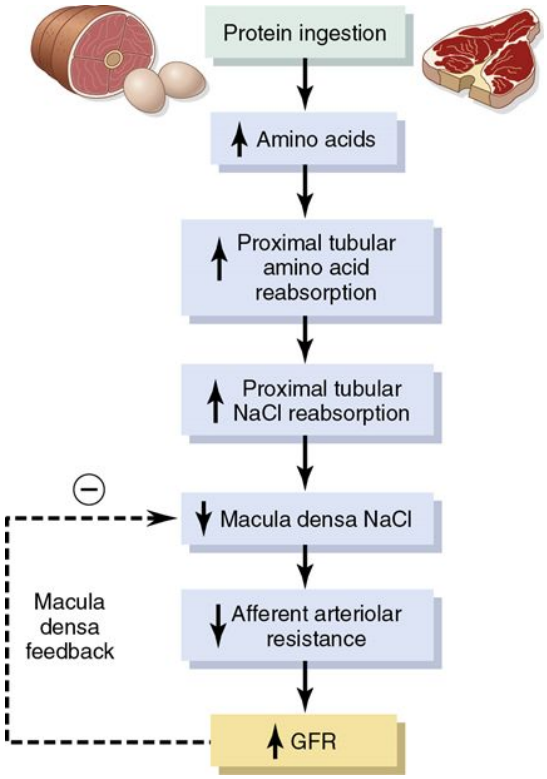
-Possible role of macula densa feedback in increasing GFR after a high protein meal.



Quiz

1- The juxtaglomerular apparatus is a part of :
A. The efferent arteriole
B. The distal convoluted tubule
C. The Afferent arteriole
D. Both C and B

2- When the sympathetic nervous system is stimulated:
A. Renin angiotensin mechanisms dilate Afferent arterioles
B. Renal blood flow is elevated
C. Norepinephrine is released from adrenal medulla
D. Afferent arterioles are constricted to decrease GFR

3- Increased glomerular filtration leads to:
A. Fluid flows through tubules too rapidly to be absorbed
B. Fluid flows through tubules slowly to be absorbed
C. None of the above
D. Both A and B

4- Autoregulation can only response when systemic pressure is:
A. Between 100 - 200 mmHg
B. Between 80- 180 mmHg
C. Between 120-60 mmHg
D. None of the above

5-If an increase in ABP, which one of these mechanism will occur?
A. a decrease in resistance of the afferent arterioles
B. Secrete angiotensin II
C. decrease in renin release
D. constrict efferent arteriole

6- When a patient is treated with an aldosterone antagonist, there is likely to be a fall in:
A. Urine volume
B. Plasma potassium concentration
C. Blood viscosity
D. Blood volume

1- D 2- D 3- A 4- B 5- C 6-D

Thank you for checking our work

Male Team:

أنس السويداء
أنس السيف
خالد شويل
ريان الموسى
سعد الهداب
سلطان الناصر
سعود العطوي
سيف المشاري
عبدالجبار اليماني
عبدالرحمن آل دحيم
هشام الموسى

فهد الفايز
خالد المطلق
نواف الهلال
هشام الشايع
خالد العقيلي
عبدالله الزيد
حسين علامي
سلطان الفهيد
خالد المطيري
فهد النهابي
عمر اليابس

Female Team:

آلاء الصويّغ
رناد المقرن
رهف الشنيبر
روان مشعل
ريم القرني
نورة بنت حسن

مها النهدي
ريناد الغريبي
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