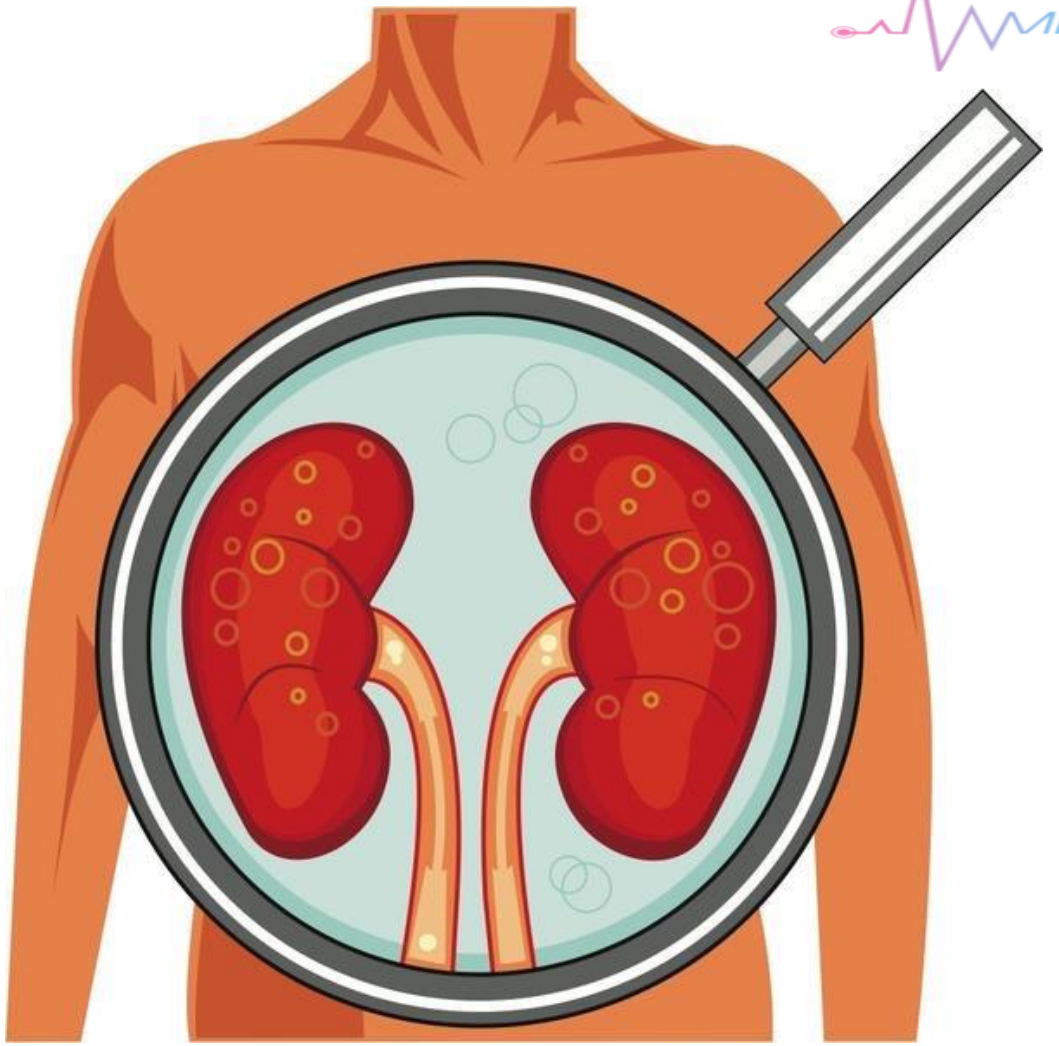
6 & 5 & 4

Diuretics .

Renal block.

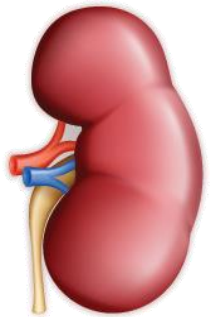


Additional note : Grey color

Important: Red color

For any correction, suggestions or any useful information do not hesitate to contact as: pharmacology434@gmail.com

Diuretics:



- **Definition:** It is a group of drugs that increase renal excretion of sodium and water resulting in increase in urine volume
- **How do diuretics work?**

Most diuretics act by interfering with the normal sodium reabsorption by the renal tubules resulting into sodium and water excretion.

- **How could urine output be increased ?**

1- ↑ Glomerular filtration 2- ↓ Tubular reabsorption

- **What is the Purpose of Using Diuretics?**

1- To maintain urine volume (e.g.: renal failure)
2- To mobilize edema fluid (e.g.: heart failure, liver failure; nephrotic syndrome)
3- To control high blood pressure.

New terms :

- **Diuresis:** is the process of excretion of water in the urine.
- **Natriuresis**: is the process of excretion of sodium in the urine.

- **What is the site of action of Diuretics?**

Target molecules for diuretics are carriers or transporters in luminal membrane of renal tubular cells required for tubular reabsorption of sodium from filtrate back into blood.

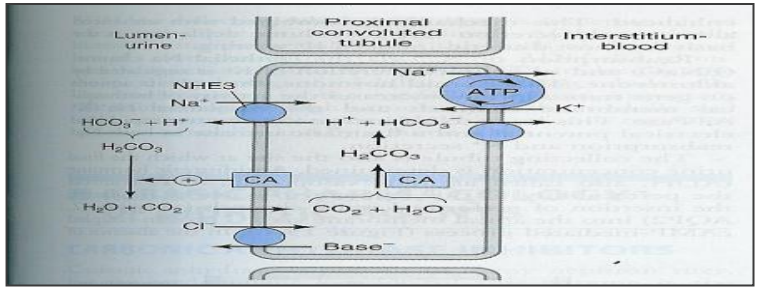
- **What is the clinical uses of Diuretics ?**
- 1- Edema of any origin 2- Congestive heart failure 3- Elimination of toxins 4- Hypertension
- **Classification of Diuretic According to site of Action (Best Classification) :**

Classification of Drug	Mechanism of Action	Examples
Carbonic anhydrase inhibitors	Inhibits carbonic anhydrase (CA) enzyme in proximal convoluted tubules thus interferes with $NaHCO_3$ re-absorption and causes diuresis.	Acetazolamide & dorzolamide
Osmotic diuretics	↑ urine output by osmosis, drawing water out of cells and into the blood stream.	Mannitol
Loop diuretics	• Inhibit Na+ / K+ / 2 Cl- co-transporter in the luminal membrane of the thick ascending loop of Henle (TAL). • Inhibit Ca++ and Mg ++ re-absorption.	Furosemide, bumetanide , ethacrynic Acid
Thiazide diuretics	acts via inhibition of Na/Cl co-transporter on the luminal membrane of distal convoluted tubules.	Chlorothiazide , Metolazone, Chlorthalidone, Hydrochlorothiazide, Indapamide
Potassium sparing diuretics	Act in collecting tubules and ducts by inhibiting Na re-absorption and K & H excretion	Spironolactone, triamterene , amiloride

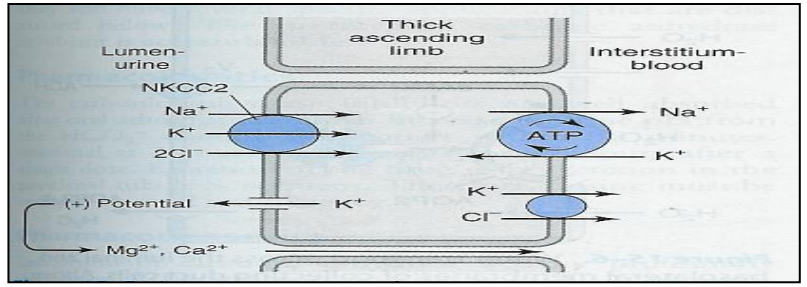
segment	Function	transporter	Diuretics
Proximal convoluted tubules	Re-absorption of 66% Na, K, Ca, Mg, 100% glucose and amino acids; 85% $NaHCO_3$	Na/H transporter, Carbonic anhydrase enzyme	**Carbonic anhydrase inhibitors**
Proximal Straight Tubules	Secretion and re-absorption of organic acids and bases	Acid & base transporter	**NONE**
Thick ascending loop	Active reabsorption 25% Na, K, Cl Secondary reabsorption Ca, Mg	Na/K/2Cl transporter	**Loop diuretics**
Distal convoluted tubules	Active tubular reabsorption of 5%Na, Cl, Ca	Na and Cl cotransporter	**Thiazide diuretics**
Collecting tubules	Na reabsorption K & H secretion	Na channels K & H transporter	**K-sparing diuretics**

Segment of nephron

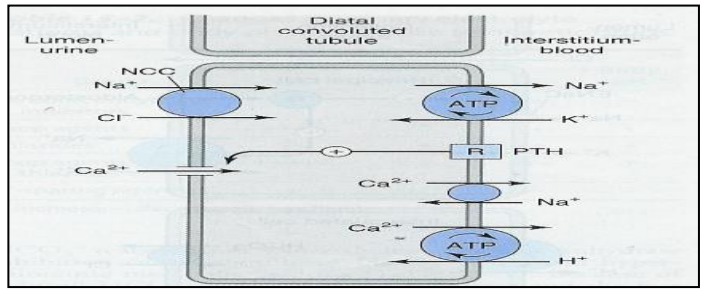
PCT



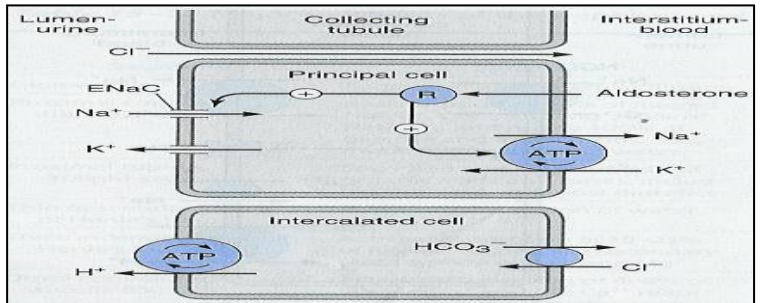
Ascending loop of H

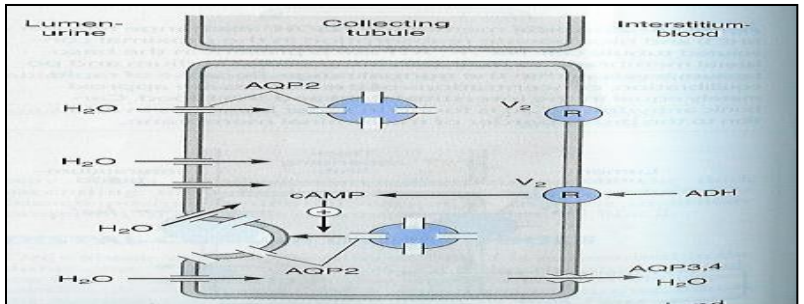


DCT

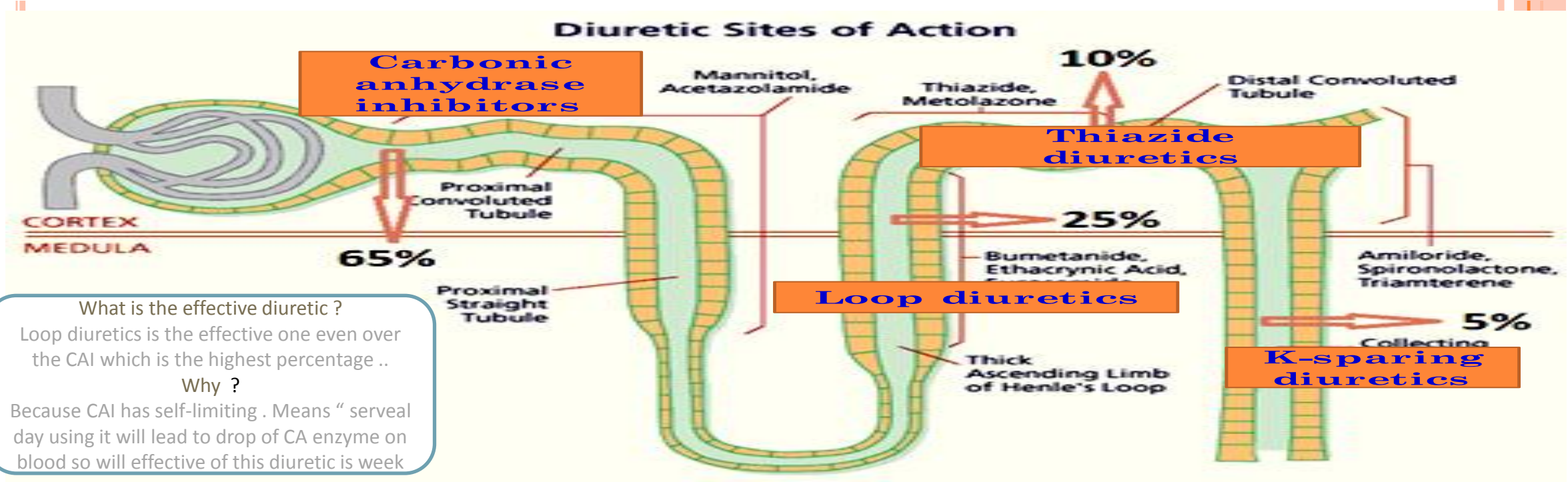


CT





This slide is physiology but we need to take looks at transporter , different Electrolytic diffuse to understand pharmacology



What is the effective diuretic ?

Loop diuretics is the effective one even over the CAI which is the highest percentage ..

Why ?

Because CAI has self-limiting . Means " serveal day using it will lead to drop of CA enzyme on blood so will effective of this diuretic is week

Classification of Diuretics

According to mechanism

1-Target protein:-

a) Transporter: Loop of diuritics and Thiazides.

b) Ion channle: Triamterin and Amiloride.

c) Enzyme: CA inhibitors

d) Receptor: Spironolactone

2-target No protein:- Osmotic diuretics

According to action

1-Directly-acting:- -

K-sparing: a)Aldosteroneantagonists b)Triamterine & amiloride –

K-losing:-

a)CA Inhibitors. b)Thiazides. c)Loop-diuretics.

2-Indirectly-acting:- Osmotic diuretics.

According to efficacy

1-High efficacy:

Loop of diuritics.

2-Moderate efficacy: Thiazide.

3-Low efficacy:-

a)Osmotic:

b)CA inhibitors.

c)K+ sparing

Diuretics that inhibit transport in the Convoluted Proximal Tubule

Osmotic Diuretics

Example - Route

Mannitol – I.V. , NOT given orally because it causes Diarrhea

Indications

- To decrease intracranial pressure in neurological condition
- To decrease intraocular pressure in acute glaucoma
- To maintain high urine flow in acute renal failure during shock

Mechanism of action

They are hydrophilic compounds that are easily filtered through the glomerulus with little re-absorption and thus increase urinary output via **osmosis**

Adverse effects

Extracellular water expansion and dehydration

Hypernatremia due to loss more water than sodium

Can you conceder Osmotic Agents as good Diuretics ?

No , we only use it in emergency condition for two reason , first it will eliminate more water , second it has to be used I.V. !

Osmotic Diuretics

Site of action : in proximal tubules & descending loop of Henle

Mannitol

Mechanism of action	1. ↑ urine output by osmosis, drawing water out of cells and into the blood stream. 2. Expand the extracellular fluid volume, decrease blood viscosity and ↑renal blood flow. 3. ↑water excretion with relatively less effect on Na+ (water diuresis).
Pharmacokinetics	✓ Poorly absorbed ✓ If given orally → osmotic diarrhea ✓ Given intravenously. ✓ Not metabolized. ✓ Excreted by glomerular filtration within 30-60 min without being re-absorbed or secreted.
Therapeutic Uses:	➢ Acute renal failure due to shock or trauma → to maintain urine flow/ preserve kidney function. ➢ Acute drug poisoning → To eliminate drugs that are reabsorbed from the renal tubules e.g. salicylates, barbiturates. ➢ To ↓ intraocular & intracranial pressure before ophthalmic or brain procedures (cerebraledema).
Side effect	➢ Headache, nausea, vomiting ➢ Extracellular volume expansion, complicates heart failure & pulmonary oedema. ➢ **Excessive use**→ dehydration & hypernatraemia (Adequate water replacement is required).

Diuretics that inhibit transport in the Convoluted Proximal Tubule

Carbonic Anhydrase Inhibitors

Example - Route

Acetazolamide – Oral
Dorsolamide – Ocular
Brinzolamide – Ocular

Dorzolamide

- Used topically for treatment of open angle glaucoma.
- No diuretic or systemic side effects.

Mechanism of action

Inhibits **carbonic anhydrase (CA) enzyme** in proximal convoluted tubules thus interferes with **NaHCO3 re-absorption** and causes diuresis

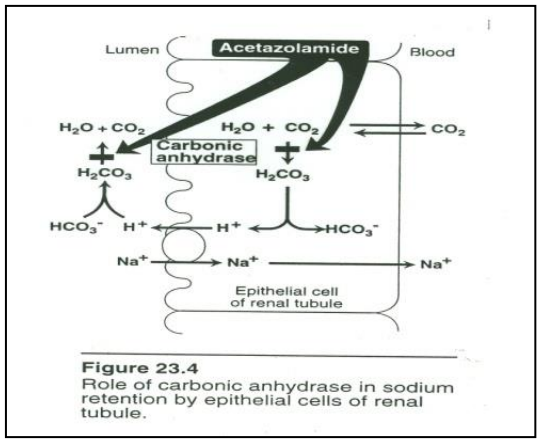


Figure 23.4
Role of carbonic anhydrase in sodium retention by epithelial cells of renal tubule.

Why do CA inhibitors have weak diuretic properties?

Diuretic properties decreases after several days as the blood bicarbonate falls.

Adverse effects

- Sedation
- Hypersensitivity reaction
- Metabolic acidosis
- Hyperchloremia
- Drowsiness
- Renal stone
- Hyponatremia
- Hypokalemia

Diuretics that inhibit transport in the Convoluted Proximal Tubule

Carbonic Anhydrase Inhibitors

pharmacokinetics	•Given orally once a day. •Onset of action is rapid (30m). •Duration of action (12h). •Excreted by active secretion in proximal convoluted tubules. •Produces alkaline urine.
Pharmacological actions	• ↑urine volume. • ↑ urinary excretion of sodium, potassium, bicarbonate (alkaline urine). •Metabolic acidosis. • ↑ urinary phosphate excretion. •Promotes K+ excretion by the load of Na+ delivered to the distal tubules.
Indications	•Open angle glaucoma: carbonic anhydrase inhibitors cause IOP ↑ by reducing aqueous humor formation in ciliary body of eye. •As prophylactic therapy, in acute mountain sickness ↓ CSF of brain: given nightly 5 days before the ascent ↓ weakness, breathlessness, dizziness, nausea, cerebral & pulmonary oedema. •Epilepsy (decrease cerebrospinal fluid, CSF). •Urinary alkalinization to enhance renal excretion of acidic substances (cystenie in cystinuria). •Hyperphosphatemia. •Metabolic alkalosis. IOP: intraocular pressure. CSF: cerebrospinal fluid.

Loop Diuretics

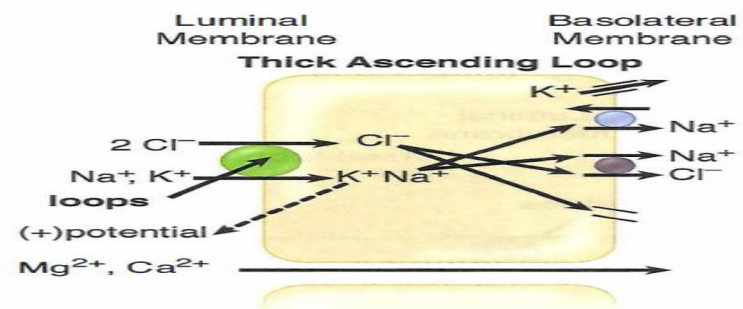
Basic Concept

Water follows sodium
Block re-absorption of Na → diuresis

Review of normal physiology related to loop diuretics

Na,K,2Cl transporter:

- **Located in the thick ascending limb of loop of Henle** Is impermeable to water



- **It has two important functions:**

1) Reabsorb Na → Reabsorb water (water follows Na)
2) Enables the reabsorption of Mg++, & Ca++

- **What is the mechanism of the reabsorbtion of calcium & magnesium?**

1) Na,K,2Cl transporter normally transports Na, **K**, &2Cl into the cell
2) K concentration in the cell
3) K must find a way to leave the cell
4) K leaves the cell by going to the **luminal membrane** or basolateral membrane via facilitated diffusion
5) When K leaves the cell & goes into the luminal membrane, it maintains a positive charge in the lumen (because K is positive)
6) When Mg++ & Ca++ want to enter the lumen of the thick ascending limb of the loop of Henle, they find it filled with positively charged potassium
7) Mg & Ca are repelled & pushed through the spaces between the cells (paracellular route) to re-renter the body

- **Inhibition of Na,K,2Cl will inhibit the recycling of potassium & will wash it out → the positive charge in the lumen is now lost → Mg & Ca will not be repelled → loss of Mg & Ca in urine → hypocalcemia & hypomagnesemia**

Loop Diuretics

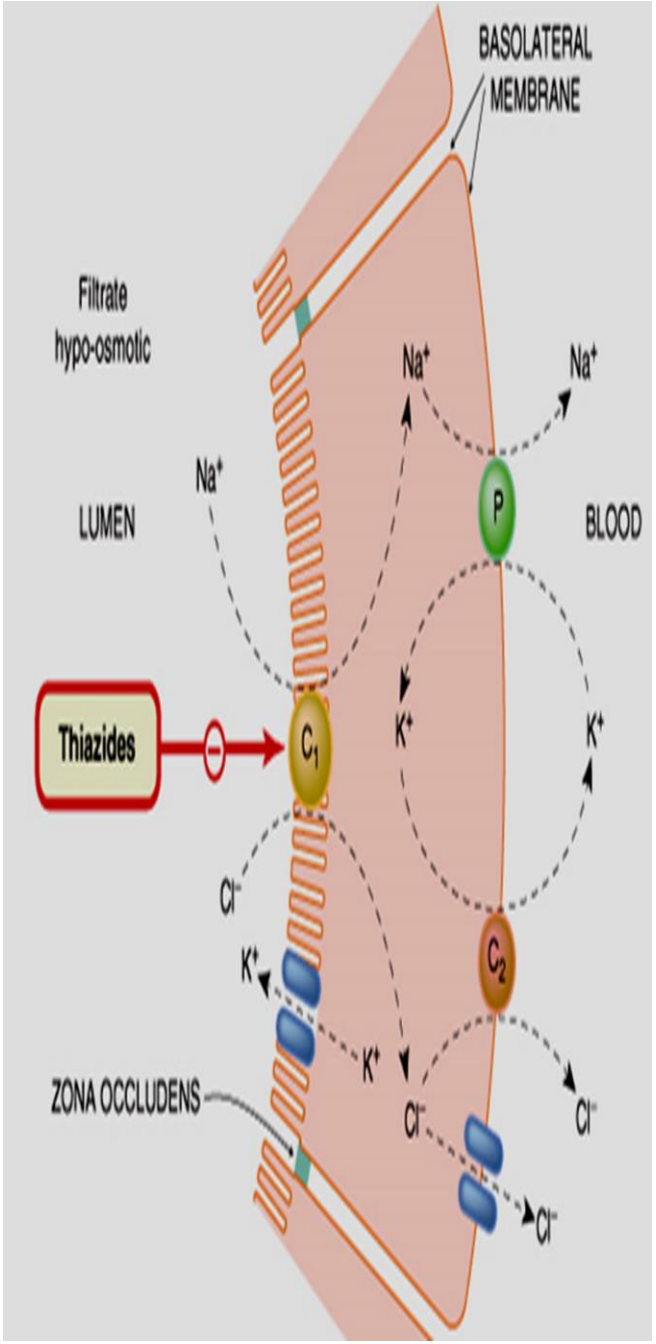
Include Furo**semide**, Tor**semide**, Bumeta**nide**, Ethacrynic ac**id**

Pharmacokinetics	Given orally or I. V. Have fast onset of action (suitable for emergency) Have short duration of action. Excreted by active tubular secretion of weak acids into urine Interfere with uric acid secretion (hyperuricemia).
Mechanism of action	• Loops inhibit Na,K,2Cl transporter in the TAL of loop of Henle • Loops also release vasodilators (prostaglandins PGE2) which cause vasodilation, particularly in the pulmonary circulation • Loops are the most potent diuretics because most of the Na is reabsorbed by this transporter, & because there is little compensation 1) Compensation means that other parts of the nephron would work harder to reabsorb Na • High natriuresis as 25-30% Na^{+} is reabsorbed. & inhibit Ca^{++} and Mg^{++} re-absorption.
Adverse effects	• **Hypocalcemia & hypomagnesemia** 1) Due to decreased positive potential in TAL of loop of Henle • Hypokalemia which leads to alkalosis 1) Hypokalemia is due to decreased reabsorbtion of K because of inhibition of Na,K,2Cl transporter 2) Metabolic alkalosis secondary to hypokalemia (transcellular shifting) • **Sulfonamide hypersensitivity** 1) Furosemide contains sulfa which may elicit a hypersensitivity reaction • **Hyperuricemia → Be careful with gouty arthritis** 1) Loops (& thiazides) are actively secreted by the peritubular capillaries 2) Uric acid is also actively secreted by the PTC 3) Competetion → hyperuricemia → gout • **Volume depletion (hypotension)** 1) Patients might pee to death 2) This may be manifested as postural hypertension • **Ototoxicity** (*risk increased if combined with aminoglycosides*)
Clinical uses	• **Acute pulmonary edema** Because loops cause diuresis Because loops secrete prostaglandins which are vasodilators → ↑ renal blood flow. • **Heart failure (**Diuresis → decrease preload → work done by heart) • **Hypertention (**Mainly because loops secrete PGs which cause vasodilation) • **Edemas** • **Pts. with hypercalcemia** • **Pts. with hyperkalemia** • **Acute renal failure (**Because they increase urine volume → increase renal blood flow)

Thiazide Diuretics

(Chlorothiazide t½ 2h,**Chlorthalidonet**½26h , Metolazone t½ 5h , Hydrochlorothiazide t½ 3h , Indapamide t½ 16h)

Mechanism of action	acts via inhibition of Na/Cl co-transporter on the luminal membrane of distal convoluted tubules. Efficacy: Moderate natriuresis (loss of Na+ in the urine) as 5-10% of filtered load of sodium is reabsorbed
Pharmacokinetics	Given orally, slow of onset , long duration of action. are secreted by active tubular secretory system of the kidney may interfere with uric acid secretion and cause hyperuricemia
Pharmacological effects	Increase urinary NaCl excretion Increase urinary K excretion (Hypokalemia) Increase urinary magnesium excretion Decrease urinary calcium excretion Increase calcium re-absorption (hypercalcemia)
Clinical uses	1-Hypertension Drug of Choice (Hydrochlorthiazide, Indapamide) 2-Refractory Edema together with the Loop diuretics(Metolazone) (to reduce extracellular volume) 3-Calcium nephrolithiasis due to hypercalciuria (to increase calcium re-absorption and decrease renal calcium stones) 4-Nephrogenic diabetes insipidus (decrease blood volume and GFR) 5-Treatment of mild heart failure (to reduce extracellular volume).
Adverse effects	No ototoxicity, more hyponatremia than loop diuretics, Hypokalemia Hypomagnesaemia , Hyperlipidemia , Hyperglycemia , Metabolic Alkalosis, volume depletion, Hyperuricaemia (gout), Hypercalcemia



Potassium-sparing diuretics (STAys (

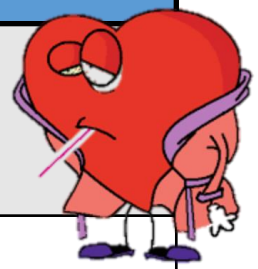
Site of action : collecting tubules and ducts

	A- (Steroids( ) Aldosterone antagonists(	B- (Nonsteroids( )Na^+ channels inhibitors(
	Spironolactone	***Triamterene & Amiloride***
Mechanism of action)K-sparing effect) by	produces its diuretic effect by antagonizing cytoplasmic aldosterone receptors .	by Inhibition of Na influx through Na channels in the luminal membrane
Pharmacodynamics	1. ***↑urinary Na^+ excretion*** 2. ***↓urinary K^+ excretion ⑨hyperkalemia*** 3. ***↓urinary H^+ excretion ⑨acidosis***	
Uses	In hypertension (as thiazide diuretic(prevent hypokalemia (combined with thiazide or loop diuretics to correct for hypokalemia.(Drug of choice for patients with hepatic cirrhosis*(by spironolactone as aldosterone antagonist(Secondary hyperaldosteronism (CHF, hepatic cirrhosis, nephrotic syndrome(	
Adverse Effects	***Hyperkalaemia.*** ***Metabolic acidosis.*** ***Gynaecomastia) تثدي Spironolactone(*** ***GIT upset and peptic ulcer***	
Contraindications	Hyperkalaemia: as in chronic renal failure, K+ supplementation, ®blockers or ACE inhibitors.	

*It is a chronic degenerative disease in which normal **liver** cells are damaged and are then replaced by scar tissue.

Therapeutic applications of diuretics

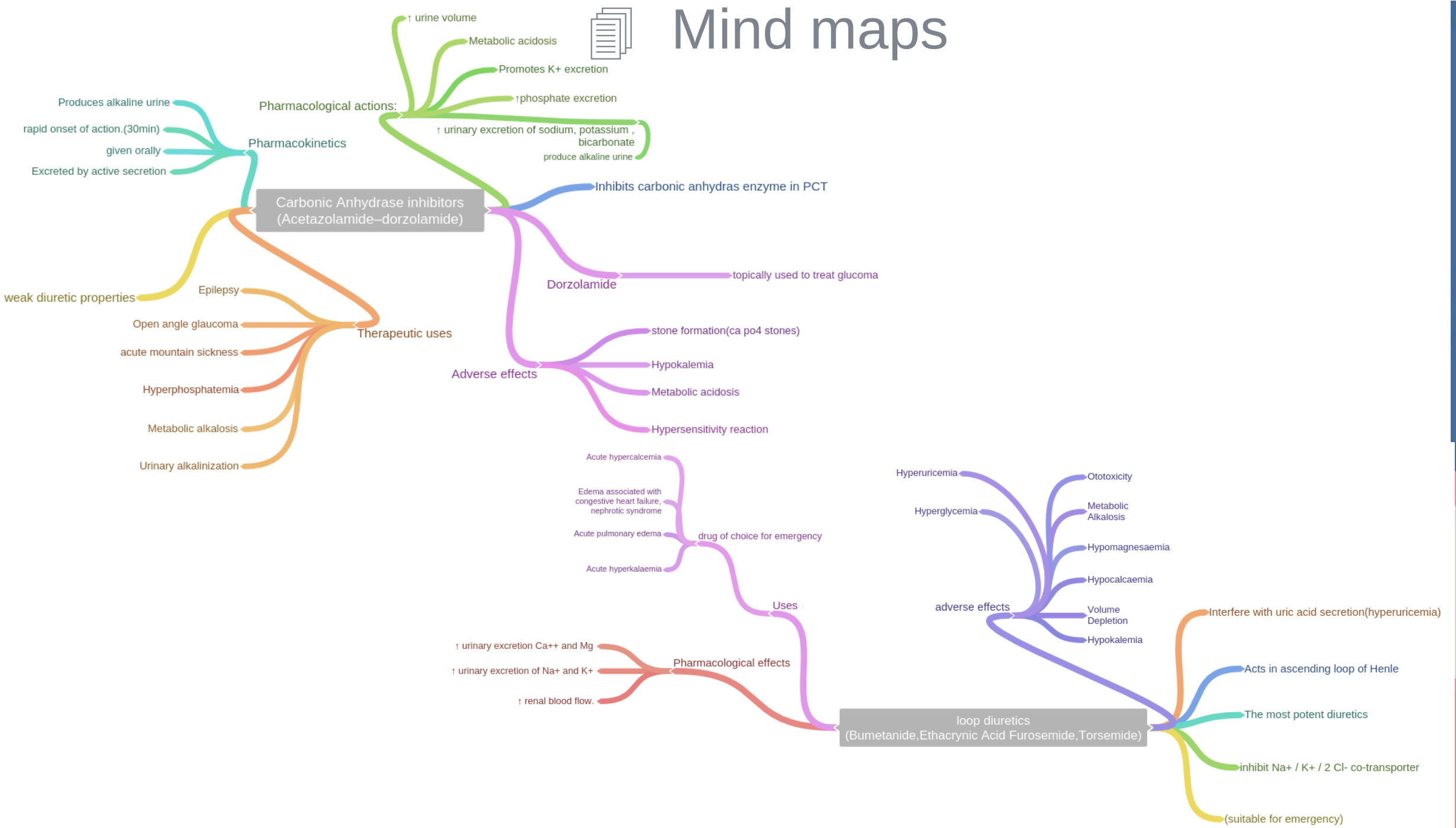
Medical condition	Thiazides Diuretic	Loop Diuretics	Notes
.1Treatment of hypertension :	*used alone or in combination with beta- blockers at low-dose (fewer side effects (*	*Used in presence of renal failure.* ***)to increase blood flow(***	
.2Edema States	Used in mild edema with normal renal function .	Used in cases with impaired renal function .	
.3Congestive Heart failure	*Used in only mild cases with well-preserved renal function*	*Much more preferred in severe cases especially when GF is lowered .*	*In life-threatening acute pulmonary edema , Furosemide (loop duretic) is given IV .*
.4Renal failure	Used if : GFR ≥ 40-50 ml/ min	Used if : GFR < 40	
.5Diabetes inspidus	*Reduces urine volume*		*Large volume(>10 L/day) of dilute urine in diabetes inspidus .*
.6Hepatic cirrhosis with ascites			Spironolactone (K-sparing diuretic) is the drug of choice .



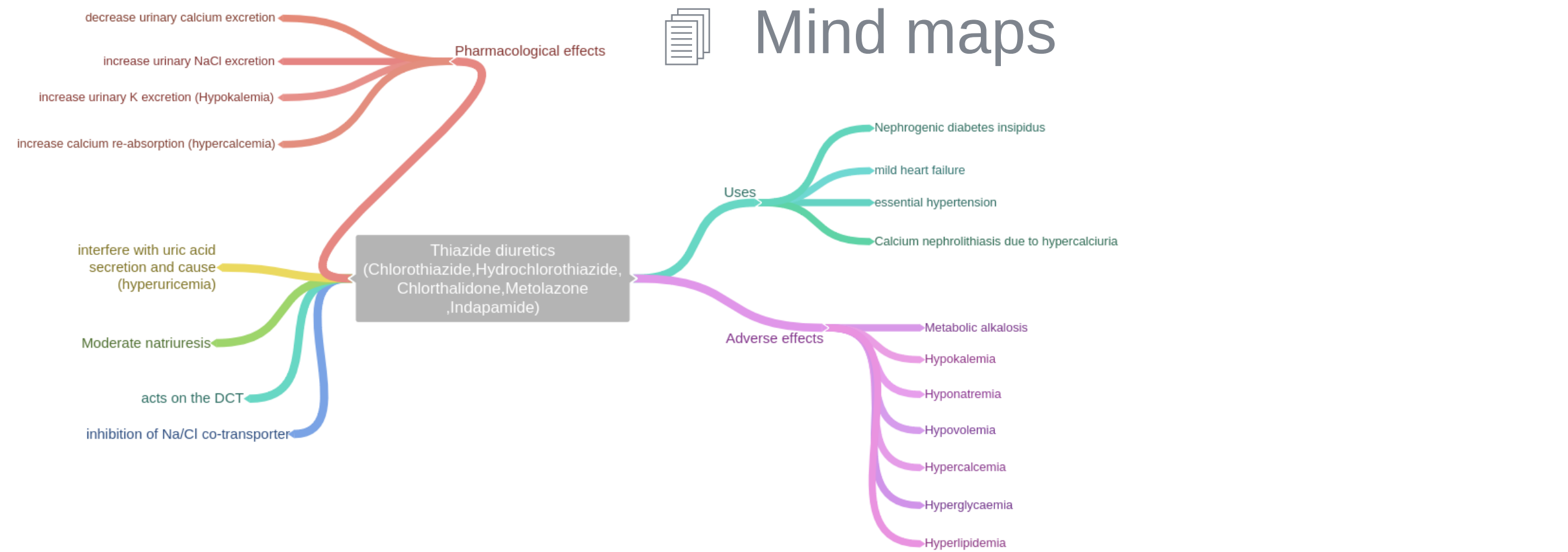
Summary For All Diuretics

Side effects	Uses	Effects	Mechanism of action	Diuretics
• Metabolic acidosis , Urinary alkalosis, • Hypokalemia	• Glaucoma, epilepsy • Mountain sickness • Alkalosis • Phosphatemia	□ Urinary Na HCO3, K • Urinary alkalosis • Metabolic acidosis	• Inhibition of NaHCO3 reabsorption in PCT	**CA inhibitors** **Acetohexamide** **Dorzolamide**
• Extracellular water expansion • Dehydration • Hypernatremia	• Cerebral edema, glaucoma • Acute renal failure, drug toxicities	□Urine excretion □ Little Na	• Osmotic effect in PCT	**Osmotic diuretic** **Mannitol**
• Hypokalemia, • hypovolemia, hyponatremia, hypomagnesemia, hypocalcemia • Precipitate gout, alkalosis	• Acute pulmonary edema (Drug of choice(• Heart failure • Hyperkalemia, Hypercalcemia	□Urinary Na, K, Ca, Mg	• Na/K/2Cl transporter in TAL the most effective	**Loop diuretics** **Furosemide**
• Hypokalemia, hyponatremia, hypovolemia, hypomagnesemia, hypercalcemia • Alkalosis, precipitate gout • Hyperlipidemia, hyperglycemia	• Commonly used • Hypertension, mild heart failure, nephrolithiasis, diabetes inspidus	□Urinary Na, K, Mg • BUT↓ urinary Ca (hypercalcemia(• Metabolic alkalosis	• Na and Cl cotransporter in DCT	**Thiazide diuretics** **hydrochlorothiazide**
• Gynaecomastia • Hyperkalaemia, Metabolic acidosis. • GIT upset and peptic ulcer	• Hepatic cirrhosis •)Drug of choice(	• ↑Urinary Na • ↓K, H secretion • Metabolic acidosis	• competitive antagonist of aldosterone in CCT	**K-sparing diuretic** **Spironolactone.**

Mind maps

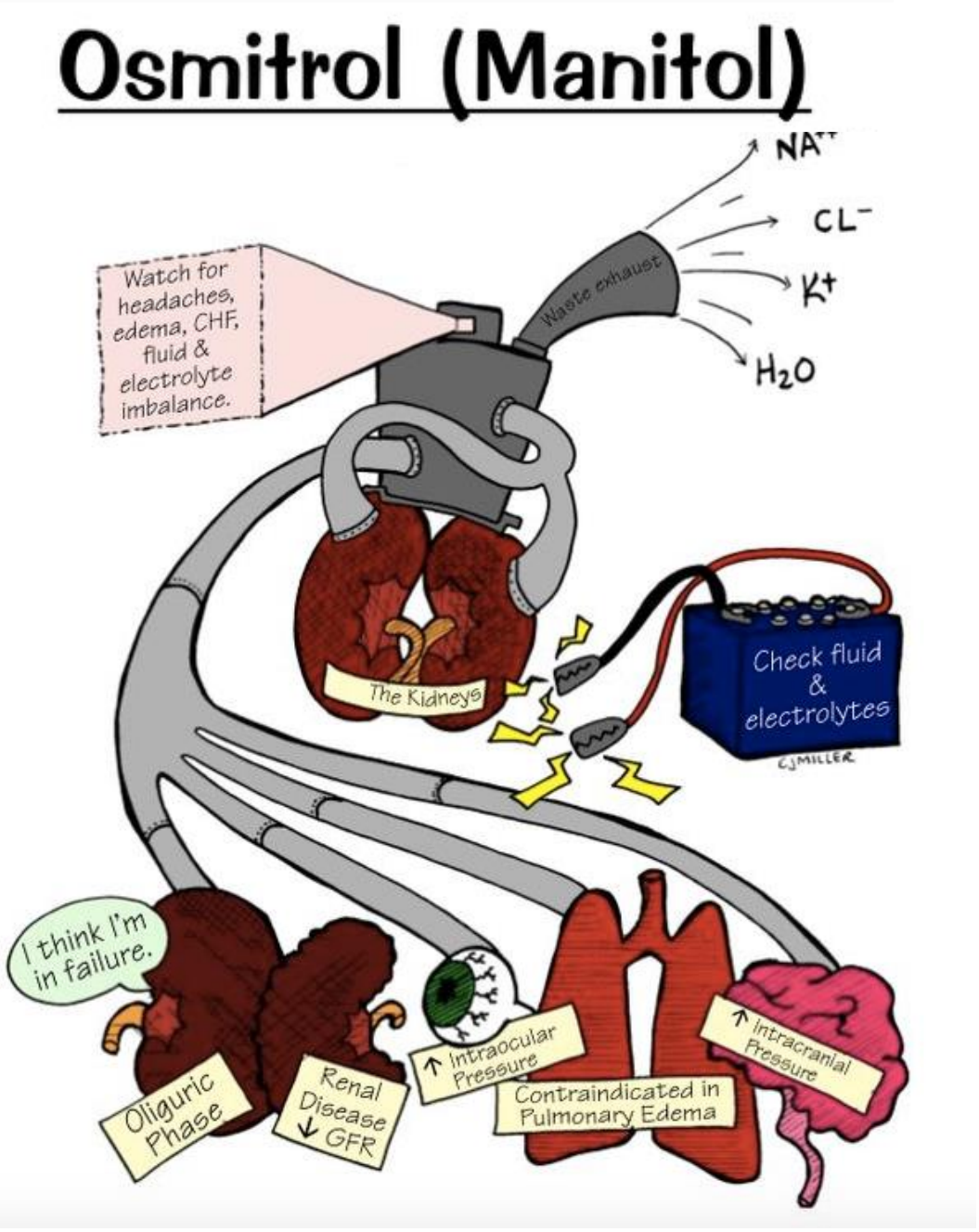

Carbonic Anhydrase inhibitors (Acetazolamide–dorzolamide)
Pharmacokinetics
Produces alkaline urine
rapid onset of action.(30min)
given orally
Excreted by active secretion
Pharmacological actions:
↑ urine volume
Metabolic acidosis
Promotes K+ excretion
↑phosphate excretion
↑ urinary excretion of sodium, potassium , bicarbonate
produce alkaline urine
Inhibits carbonic anhydras enzyme in PCT
Dorzolamide
topically used to treat glucoma
Therapeutic uses
weak diuretic properties
Epilepsy
Open angle glaucoma
acute mountain sickness
Hyperphosphatemia
Metabolic alkalosis
Urinary alkalinization
Adverse effects
stone formation(ca po4 stones)
Hypokalemia
Metabolic acidosis
Hypersensitivity reaction
loop diuretics (Bumetanide,Ethacrynic Acid Furosemide,Torsemide)
Uses
drug of choice for emergency
Acute hypercalcemia
Edema associated with congestive heart failure, nephrotic syndrome
Acute pulmonary edema
Acute hyperkalaemia
Pharmacological effects
↑ urinary excretion Ca++ and Mg
↑ urinary excretion of Na+ and K+
↑ renal blood flow.
adverse effects
Hyperuricemia
Hyperglycemia
Ototoxicity
Metabolic Alkalosis
Hypomagnesaemia
Hypocalcaemia
Volume Depletion
Hypokalemia
Interfere with uric acid secretion(hyperuricemia)
Acts in ascending loop of Henle
The most potent diuretics
inhibit Na+ / K+ / 2 Cl- co-transporter
(suitable for emergency)

Mind maps

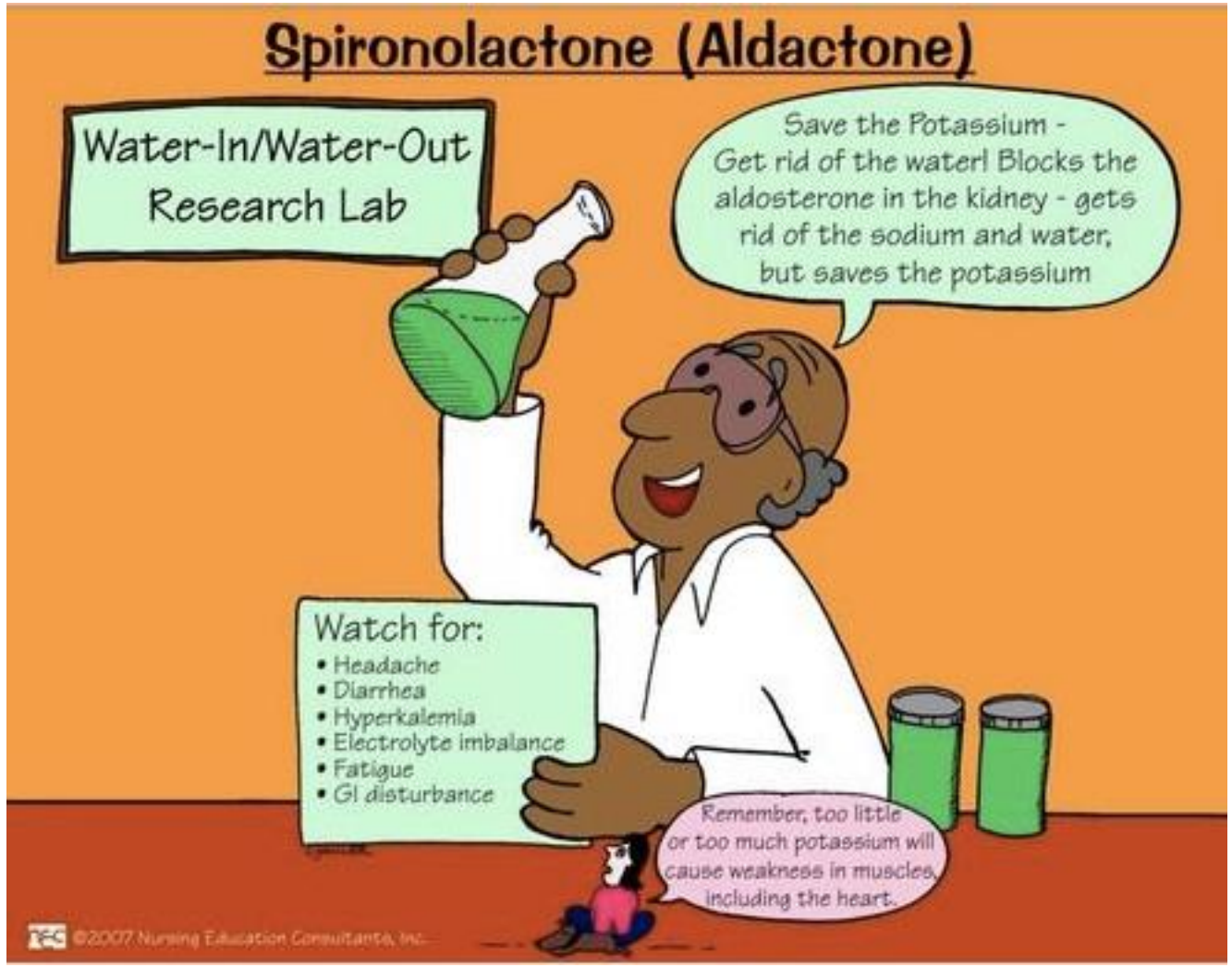

Thiazide diuretics (Chlorothiazide,Hydrochlorothiazide, Chlorthalidone,Metolazone ,Indapamide)
Pharmacological effects
decrease urinary calcium excretion
increase urinary NaCl excretion
increase urinary K excretion (Hypokalemia)
increase calcium re-absorption (hypercalcemia)
interfere with uric acid secretion and cause (hyperuricemia)
Moderate natriuresis
acts on the DCT
inhibition of Na/Cl co-transporter
Uses
Nephrogenic diabetes insipidus
mild heart failure
essential hypertension
Calcium nephrolithiasis due to hypercalciuria
Adverse effects
Metabolic alkalosis
Hypokalemia
Hyponatremia
Hypovolemia
Hypercalcemia
Hyperglycaemia
Hyperlipidemia

Osmotic diuretics(Mannitol)
MOA
drawing water out of cells and into the blood stream.
Therapeutic Uses
before ophthalmic or brain procedures
Acute renal failure
acute drug poisoning
pharmacokinetic
enhances water diuresis with no affect on Na
excreted by filtration(without being secreted or reabsorbed)
Given intravenously
if given orally>osmotic diarrhea
Not metabolized
acts by osmotic effect on PCT & descending henle
Adverse Effects
Excessive use> dehydration & hypernatraemia
Headache, nausea, vomiting
complicates heart failure & pulmonary oedema

Osmotic Diuretics



Potassium-sparing diuretics



MCQs

1)A 35-year-old woman presents to your office for a regular check-up. She has no complaints. On examination, her blood pressure is slightly elevated at 145/85. She is physically fit and follows a healthy diet. You decide to start her on antihypertensive therapy and prescribe hydrochlorothiazide.How does this agent work?

A) Inhibits reabsorption of sodium chloride in the early distal convoluted tubule

B)Decreases net excretion of chloride, sodium, and potassium

C) Increases excretion of calcium

D) Interferes with potassium secretion

E) Inhibits reabsorption of sodium chloride in the thick ascending limb of the loop of Henle

2) A 45-year-old man with a history of medication-controlled hypertension presents to your office with complaints of a painful, swollen big toe on the left foot. You suspect gout and check his uric acid levels, which are elevated. From looking at the list of the medications the patient is taking, you realize that one of the medications may be the cause of hi current symptoms.Which medication might that be ?

A) Acetazolamide

B) Amiloride

C) Spironolactone

D) Hydrochlorothiazide

E)Mannitol

3) An 87-year-old woman who is taking multiple medications for her ''heart disease'' is prescribed gentamicin for diverticulitis. After a few days of taking the antibiotic, she complains of dizziness and tinnitus "ototoxicity". What ''heart medication'' might she be on?

A) Spironolactone

B) Hydrochlorothiazide

C) Mannitol

D) Ethacrynic acid

E) Urea

4) A 54-year-old man develops congestive heart failure (CHF) after suffering his second myocardial infarction. His physician puts him on a regimen of several medications, including furosemide. On follow-up, the patient is found to have hypokalemia, likely secondary to furosemide use. The addition of which medication would likely resolve the problem of hypokalemia, while helping to treat the underlying condition,CHF?

A) Allopurinol

B) Hydrochlorothiazide

C) Spironolactone

D) Acetazolamide

E)Ethacrynic acid

5) A 45-year-old woman with a long history of alcohol abuse is being treated for cirrhosis associated ascites. Her internist decided to give her amiloride, a diuretic helpful in edema caused by cirrhosis. What common side effect should be monitored in this patient?

A)Hypernatremia

B) Hypocalcemia

C) Hyperphosphatemia

D) Hypermagnesemia

E) Hyperkalemia

Answers:
1-a
2-d
3-d
4-c
5-e

MCQs

6) A 57-year-old man develops progressive vision loss with a sensation of pressure behind his eyes. His ophthalmologist diagnoses the patient with glaucoma. To prevent further progression of the disease and to alleviate current symptoms,What is the drug of choice of diuretics can be use?

A) Furosemide B) Acetazolamide
C) Amiloride D) Spironolactone E) hydrochlorothiazide

7) A 50-year- old women develops high amount of ADH in the blood, and she diagnosed with nephrogenic diabetes insipidus. Which of the following drug can be used for this condition ?

A) Mannitol B) Furosemide
C) Dorzolamide D) Metolazone
E) Ethacrynic acid

8) which of the following drug can be used as a treatment of Hypertension?

A) Amiloride B) Ethacrynic Acid
C)Acetazolamide D)dorzolamide

9) a patient came to you with hepatic cirrhosis, edema due to nephrotic syndrome , which drug of the following is the best drug to treat his condition?

A) Spironolactone B) Hydrochlorothiazide
C)Bumetanide D)Furosemide

10) a patient is complaining of Hypertension , GIT upset and ulcer , and edema which of the following drugs is the best choice to treat him?

A) Indapamide B) Amiloride
C) Ethacrynic Acid D)Acetazolamide

11) a patient is going to have a brain procedure , which one of the following drugs is best to be given before the procedure?

A) Mannitol B) Amiloride
C) Ethacrynic Acid D) dorzolamide

12)which of the following drugs is contraindicated in patient with pulmonary edema and heart failure?

A) Mannitol B) Spironolactone
C) dorzolamide D) Acetazolamide

Answers:
6-b
7-d
8-a
9-a
10-a
11-a
12-a

SAQs

1) GIVE ONE type of diuretics can be used in acute mountain sickness?
Acetazolamide

2) Which group of diuretics can cause Renal stones as an adverse effect ?
Carbonic anhydrase inhibitors

3) Patient with open -angle glaucoma came to mohammed's clinic asking for medication, He has decided to treat him with a diuretic that doesn't have systemic side effect, What is the best drug that mohammad use ?
Dorzolamide (used topically)

4) Patient in the ER with acute pulmonary edema, the doctor give a diuretic drug that has fast onset of action with short duration i.v , What is the drug that the doctor used ?
Loop diuretics (Furosemide)

5) Gouty patient with CHF , after doing some investigations you find that his blood calcium level is high , Give only ONE drug that is highly contraindicated in this case ?
Thiazide diuretics (Chlorothiazide,Hydrochlorothiazide,Metolazone,Chlorthalidone,Indapamide)

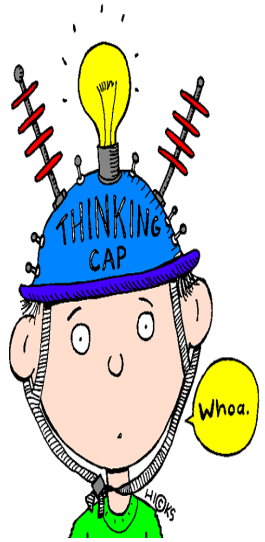
6) Give ONE drugs from the diuretics that can cause Ototoxicity?
Loop diuretics

7) Patient with hepatic cirrhosis developed Ascites because of excess aldosterone level , What is the drug of choice in this type of edema?
Spironolactone (Aldosterone antagonist)

8) Which of type of diuretics can cause diarrhea once it is take orally ?
Mannitol

9) Patient with acute pulmonary edema , the consultant decided to treat with diuretics, he asked the intern about what is the best drug can be used and what is the drug that is contraindicated, What the best answer for this question?
USE → Furosemide
Contraindicated → Mannitol

10)Patient with Calcium stones treated with thiazide diuretics, Give Five results of electrolyte blood test can be seen as a side effect?
Hyponatremia
hypokalemia
hypercalcemia
metabolic alkalosis
hyperuricemia



SAQs

11) what kind of renal stone does the Carbonic anhydrase inhibitors form?
calcium phosphate stones

12) which group of drugs can produce hypersensitivity reaction?
Carbonic anhydrase inhibitors (**Acetazolamide – dorzolamide(**

13) Why do CA inhibitors have weak diuretic properties ?
Diuretic properties decreases after several days as the blood bicarbonate falls.

14)what is the mechanism of action of Potassium-sparing diuretics?
1. Na+ channels inhibitors
2. aldosterone antagonist

15) give an example of Potassium-sparing diuretics which blocks the sodium channels?
Amiloride

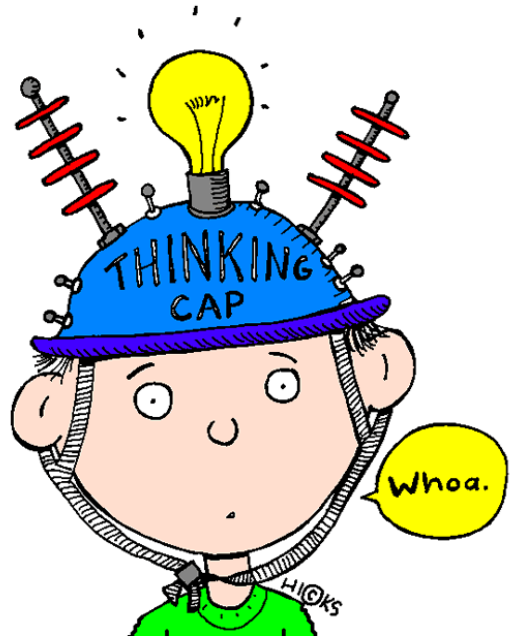
16) Drugs that work on collecting tubules and ducts?
Potassium-sparing diuretics

17) A drug which is used to prevent Hypokalemia?
Potassium-sparing diuretics

18) Give the name of the drug that when its given orally the patient will complain of Diarrhea?
Mannitol

19) Where does Mannitol acts?
in proximal tubules + descending loop of Henle

20) why patients before Opthalmic or brain procedure should be given Mannitol?
to decrease intraocular & intracranial pressure



GOOD LUCK!

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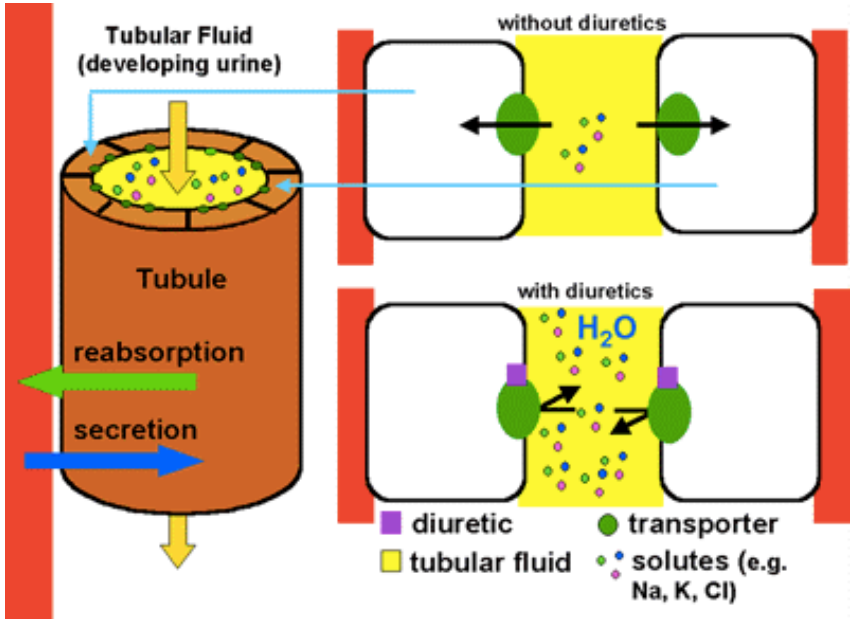

For any correction, suggestions or any useful information do not hesitate to contact as: pharmacology434@gmail.com