

# Diuretics



Kidney

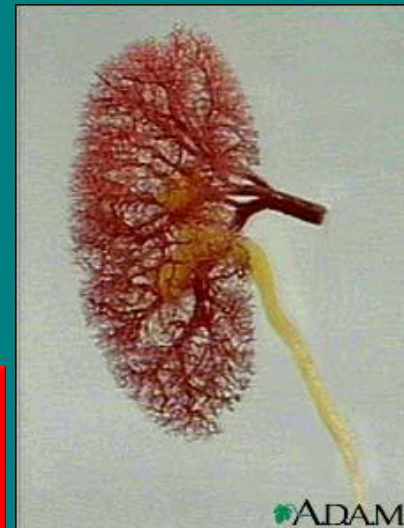
# DIURETICS

## ILOS

Define and classify diuretics

Identify the site of action of each class of diuretics in the nephron

Describe the mechanisms of action of diuretics

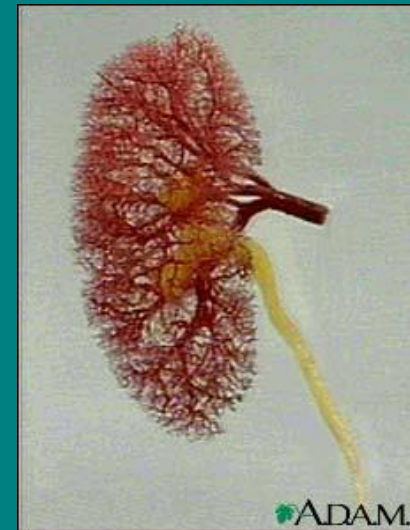


# DIURETICS

## ILOS

Detail on the pharmacodynamic actions and pharmacokinetic aspects of diuretics

List ADRS, therapeutic uses, contraindications and drug- drug interactions of diuretics



# DIURETICS

Drugs used to increase renal flow rate

Water diuresis

*Is water a clinically-useful diuretic?*



# DIURETICS

The main indications

Edema of any origin

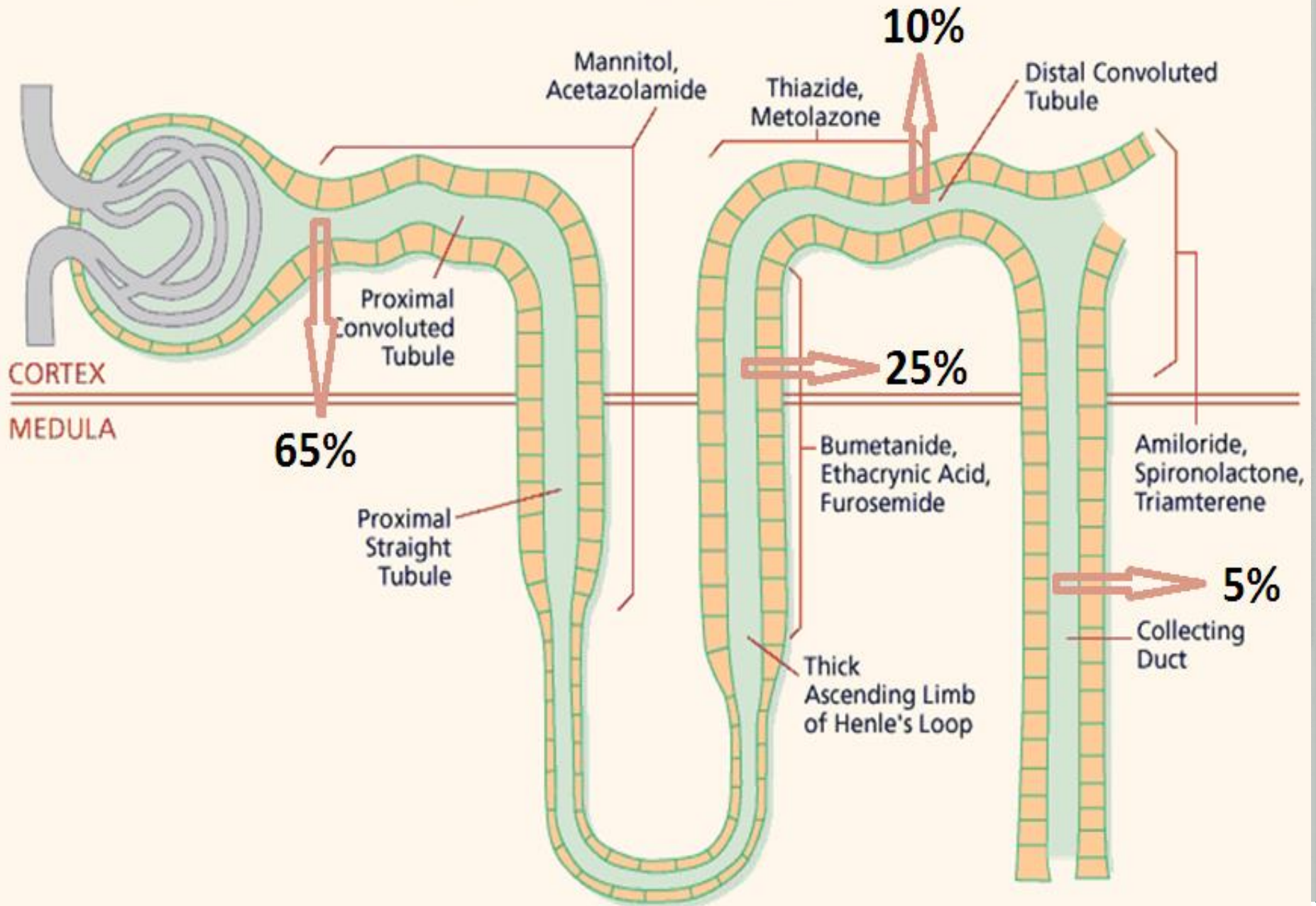
Congestive heart failure

Hypertension

Elimination of toxins



# Diuretic Sites of Action

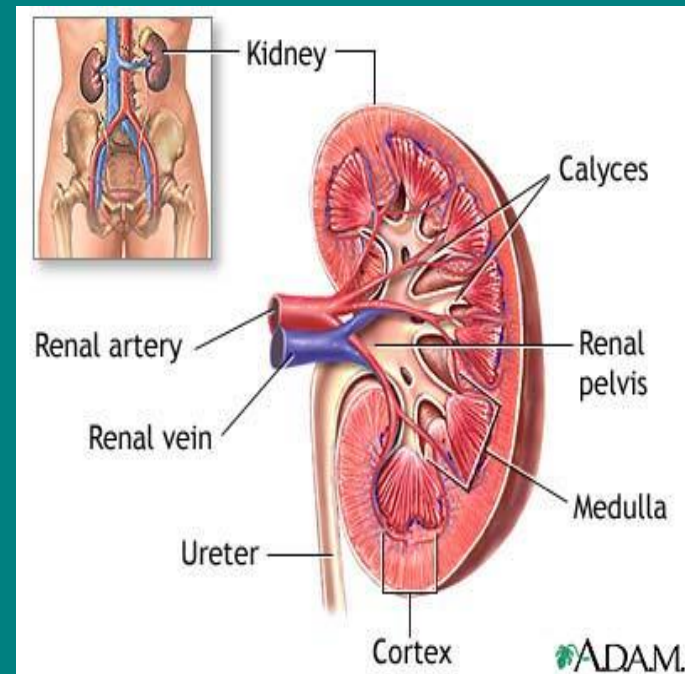




# DIURETICS I

**CARBONIC  
ANHYDRASE  
INHIBITORS**

**OSMOTIC  
DIURETICS**

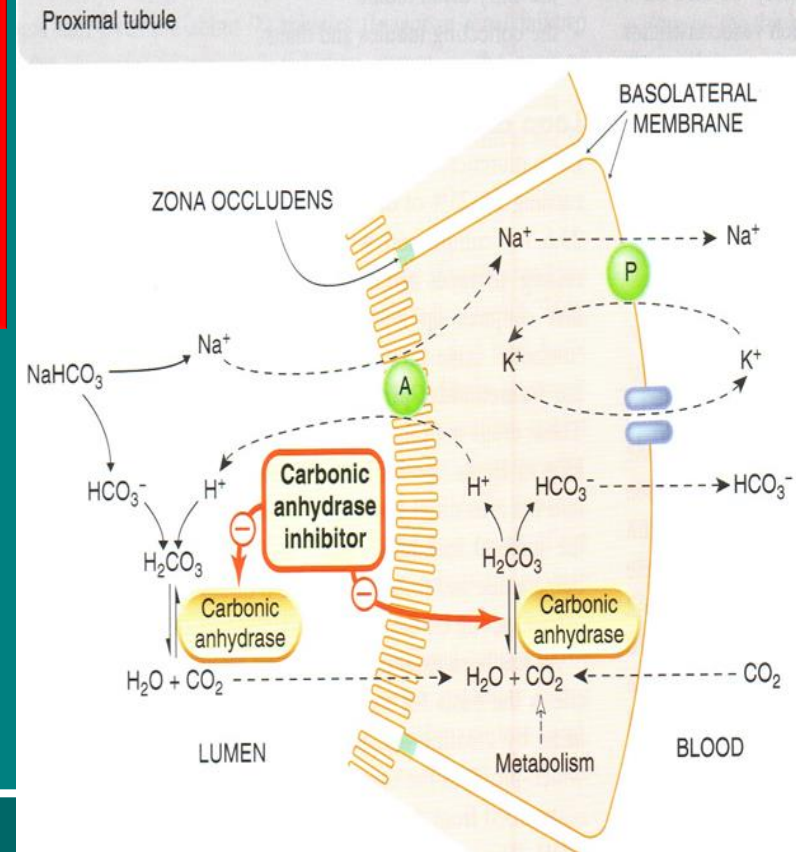


# DIURETICS I

## CARBONIC ANHYDRASE INHIBITORS

● Carbonic anhydrase accelerates the attainment of equilibrium in the reaction  
$$\text{CO}_2 + \text{H}_2\text{O} \leftrightarrow \text{H}_2\text{CO}_3$$

**Acetazolamide** is a potent specific inhibitor of carbonic anhydrase, enzyme inhibition is non competitive





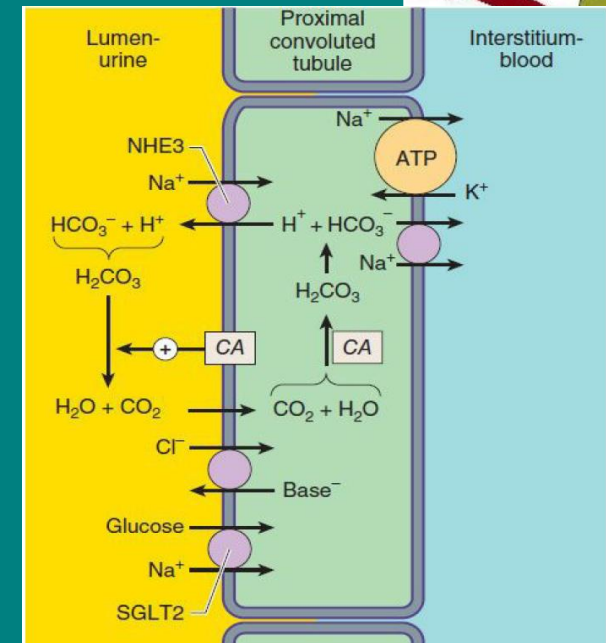
# CARBONIC ANHYDRASE INHIBITORS

● It ↓ reabsorption of bicarbonate in the proximal tubule & prevent the acidification of urine in the distal tubule

● Promotes  $K^+$  excretion by ↑ the load of  $Na^+$  delivered to the distal tubules

● With repeated dosage the diuretic action is lost → loss of  $HCO_3^-$  & development of acidosis

● **Self-limiting action** of acetazolamide restrict its use to mild oedema .



# CARBONIC ANHYDRASE INHIBITORS

## PHARMACOKINETICS

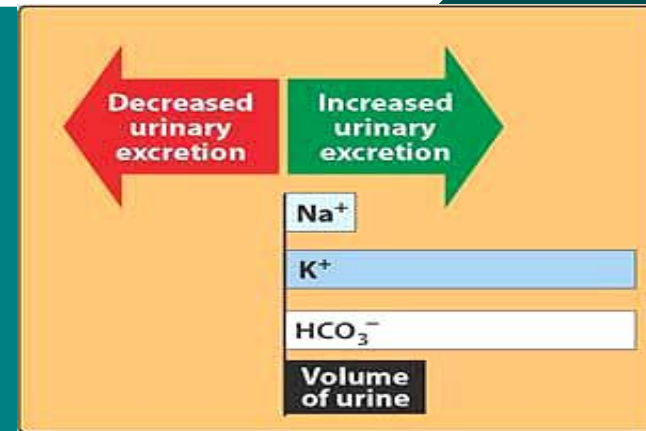
## ACETAZOLAMIDE

Given orally once a day

Onset of action is rapid (30 min)

$t_{1/2}$  6-9h

Excreted by active secretion in proximal convoluted tubules



# CARBONIC ANHYDRASE INHIBITORS

## DORZOLAMIDE

Is a carbonic anhydrase inhibitor

Used topically for treatment of increased intraocular pressure in open-angle glaucoma

No diuretic or systemic side effects  
(Why?).



# CARBONIC ANHYDRASE INHIBITORS

ADRS

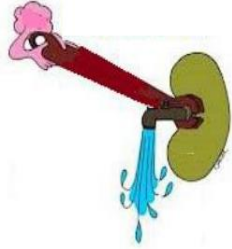
Drowsiness

Numbness

Tingling sensation of the face & extremities

↓ Disturbance of vision

↓ Contraindicated in patients with liver cirrhosis (alkaline urine ↓ excretion of  $\text{NH}_4$  → hyperammonemia & hepatic encephalopathy)



# CARBONIC ANHYDRASE INHIBITORS

## CLINICAL INDICATIONS

**1-Glaucoma:-** aqueous humour contains a high concentration of bicarbonates. ↓ of carbonic anhydrase ↓ rate of aqueous humour formation → ↓ intraocular pressure (tolerance does not develop to this effect)

**2-Urine alkalinization:-** uric acid, cysteine & methotrexate are relatively insoluble in acid urine. Renal excretion can be ↑ by ↑ urinary bicarbonate excretion. Effect is short lived & require bicarbonate infusion.

# CARBONIC ANHYDRASE INHIBITORS

## CLINICAL INDICATIONS

**3-↓Formation of CSF:-** ↓of carbonic anhydrase in the chorioid plexus  
→↓formation of CSF. Useful in management of benign intracranial hypertension.

4-Useful for correcting a **metabolic alkalosis**, especially an alkalosis caused by diuretic-induced increases in  $H^+$  excretion & metabolic alkalosis of heart failure.



# CARBONIC ANHYDRASE INHIBITORS

## CLINICAL INDICATIONS

↓ **5-Mountain sickness prophylaxis:-**  
given nightly 5 days before the ascent  
↓ weakness, breathlessness, dizziness,  
nausea, cerebral & pulmonary oedema

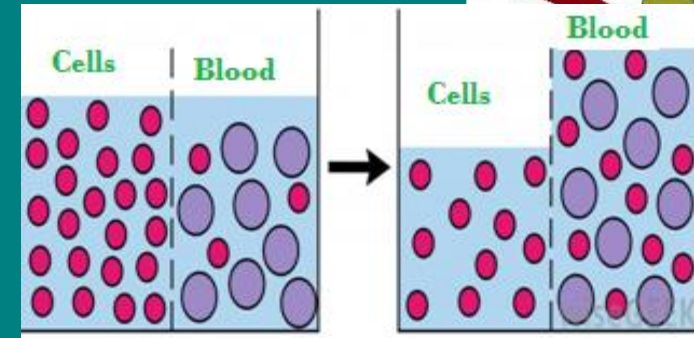
↓ **6-Adjunct for treatment of epilepsy:-** glial cells contain carbonic anhydrase. Nerves are highly responsive to rise in pH.  $\uparrow 7.4 \rightarrow 7.8$  causes convulsions  
↓ of neuronal carbonic anhydrase  $\rightarrow$  ↓ pH in the vicinity of neurons  $\rightarrow$  ↓ convulsions.



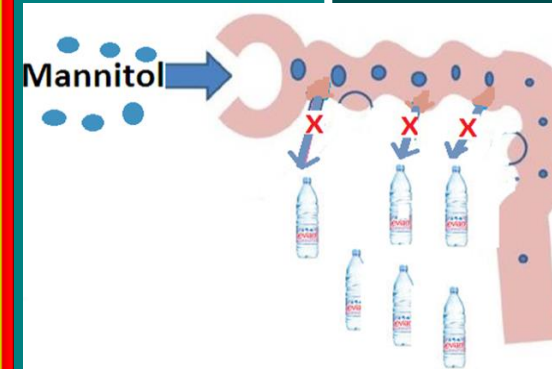
# OSMOTIC DIURETICS (AQUARETICS)

## MANNITOL

Mannitol increases urine output by osmosis, drawing water out of cells and into the bloodstream



IV administration of any solute filtered by glomeruli may produce osmotic diuresis when the amount delivered to tubules exceeds their absorptive capacity



The dissolved compound exert an osmotic pressure  $\rightarrow$   $\downarrow$  water &  $\text{Na}^+$  reabsorption

Expand the extracellular fluid volume, decrease blood viscosity, and inhibit renin release,  $\uparrow$  renal blood flow

# MANNITOL

## PHARMACOKINETICS

↓ Mannitol, IV, not absorbed from the GIT,  
↑ water excretion with relatively less effect on  
Na<sup>+</sup>

↓ If given orally → osmotic diarrhea

↓ Little metabolized

Mainly excreted unchanged in urine

Excreted by glomerular filtration

↓ t<sub>1/2</sub> 0.25-1.7h, prolonged in renal failure to 36h

# MANNITOL

## CLINICAL USES

1-To eliminate drugs that are reabsorbed from the renal tubules in acute poisoning e.g. salicylates, bromides, barbiturates

2-To prevent acute renal necrosis after severe injury , haemorrhage, hypovolaemia,  $\rightarrow \downarrow$  GFR, absorption of water & salts is complete , distal part dries up  $\rightarrow$  irreversible damage

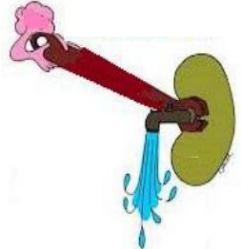
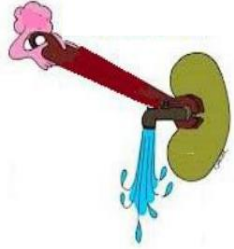


# MANNITOL

## CLINICAL USES

3-To ↓ intracranial & intraocular pressure before ophthalmic or brain procedures

4-To maintain urine volume & to prevent anuria resulting from large pigmentation load to the kidney e.g. haemolysis, rhabdomyolysis



# MANITOL

## ADRS

↓ Headache, nausea, vomiting → hyponatremia

↓ Extracellular volume expansion, complicates heart failure & pulmonary oedema

↓ Excessive use → dehydration & hypernatraemia, (Adequate water replacement is required).



# MANNITOL

## CONTRAINDICATIONS

Chronic heart failure

Anuric patients or patients not responding to a test dose of mannitol

