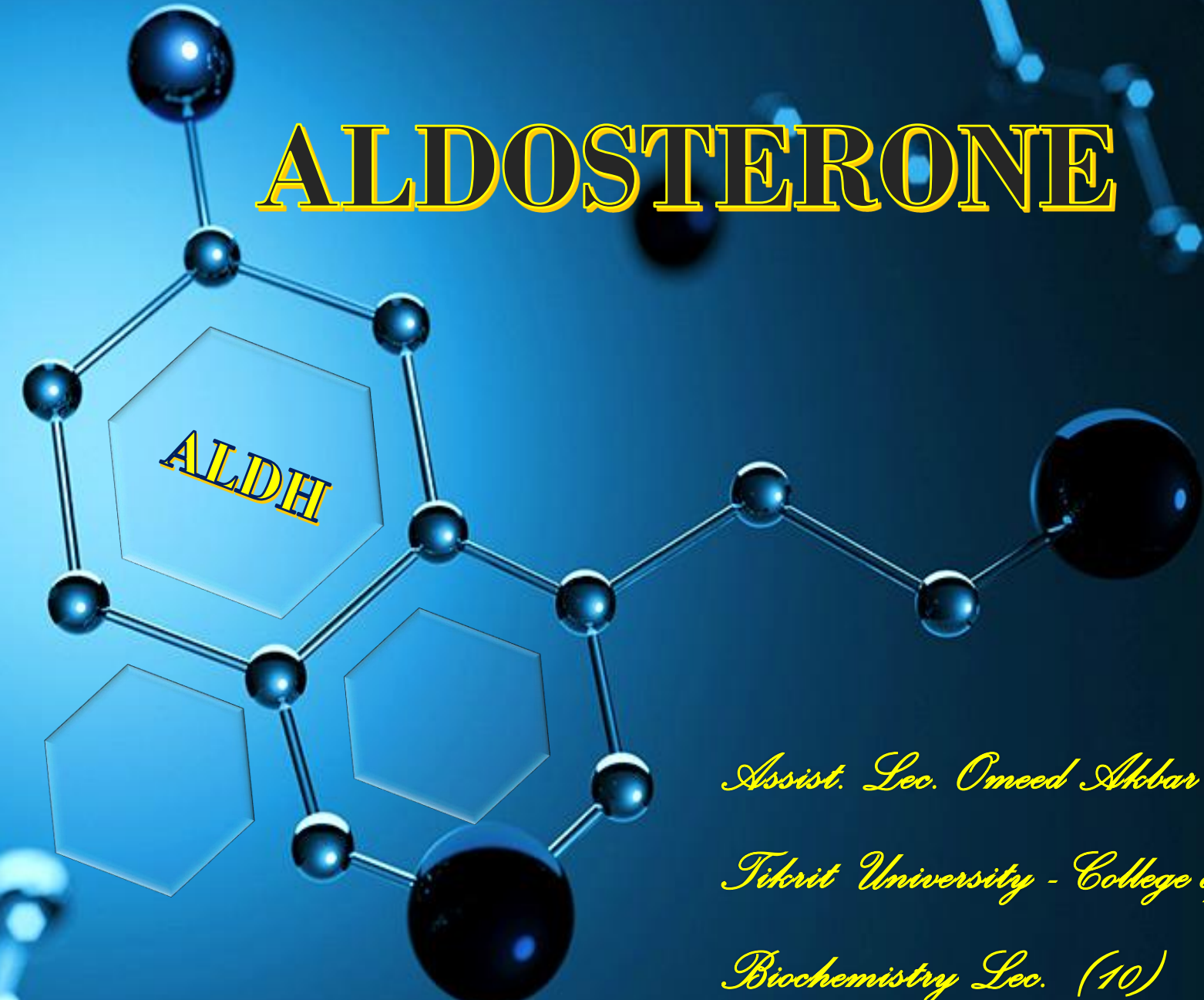


ALDOSTERONE



ALDH

Assist. Lec. Omeed Akbar Ali
Tikrit University - College of Medicine
Biochemistry Lec. (10)

Scopes:

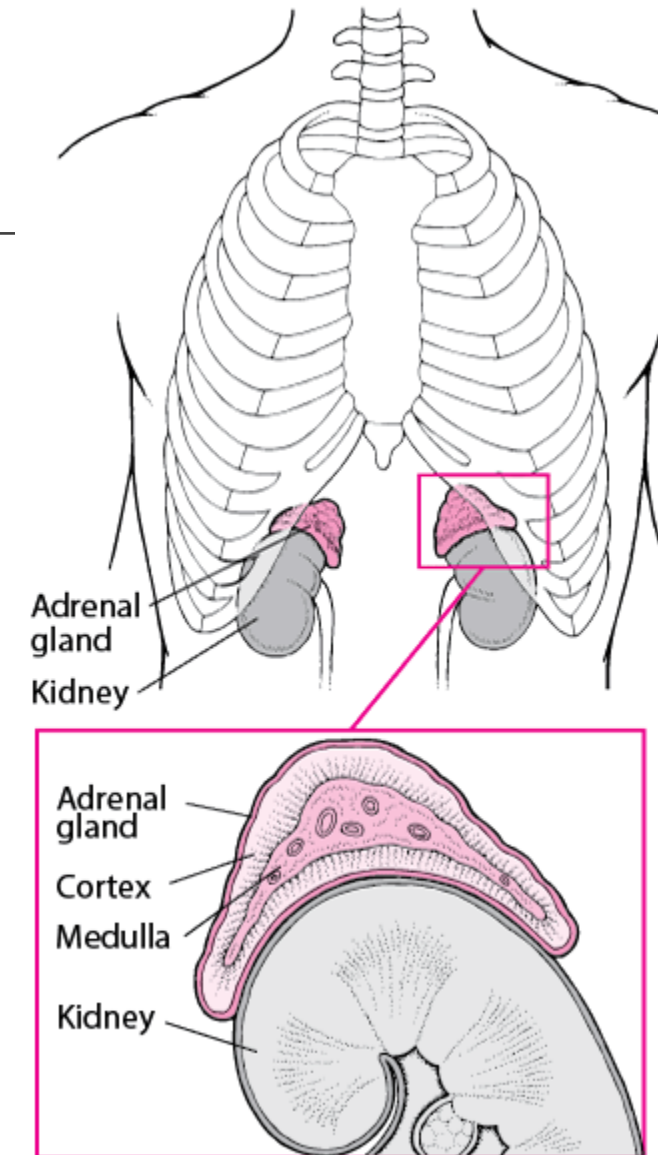
- - To describe adrenal hormones
- - To clarify circadian release pattern of adrenal hormones
- - To clarify glucocorticoid receptors and signaling pathways
- - To describe physiological effects of adrenal hormones
- - To describe the permissive effects of adrenal hormones
- - To describe the pathologies related to adrenal hormone defects

Overview

- INTRODUCTION
- HORMONES OF ADRENAL CORTEX
- MINERALOCORTICIDS
 - - Aldosterone
- RENIN-ANGIOTENSIN SYSTEM
- REGULATION OF ALDOSTERONE SECRETION
- ACTIONS OF ALDOSTERONE

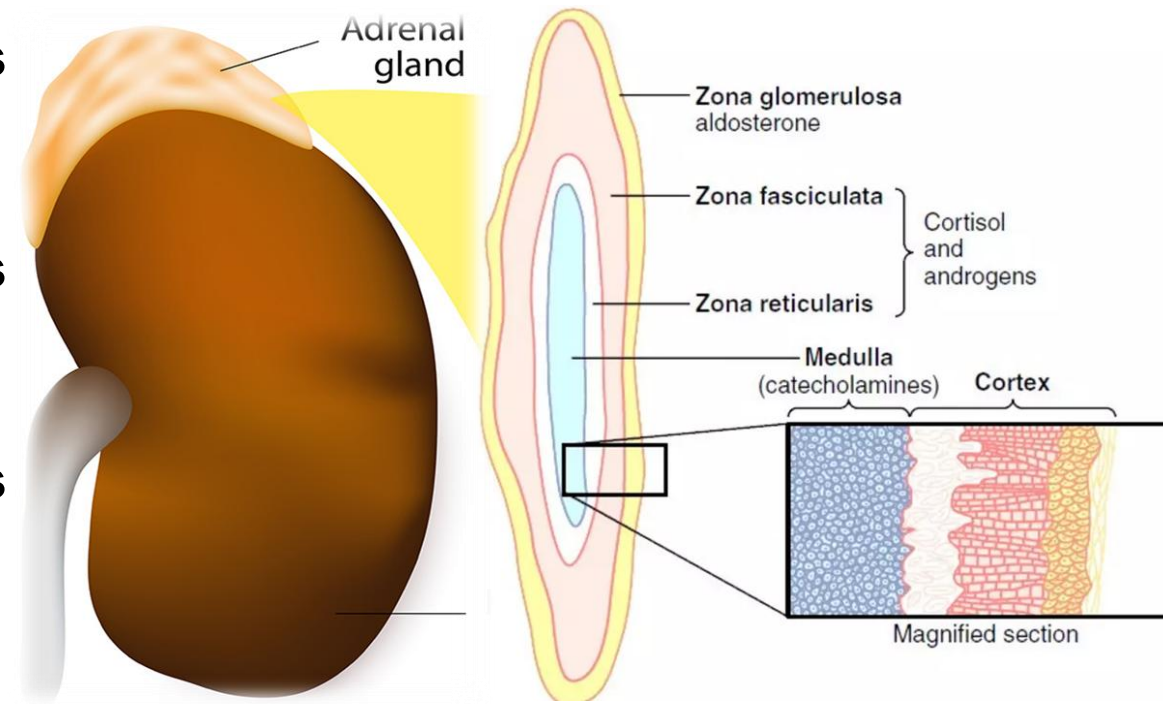
Adrenal Gland Hormones

- ❖ - The adrenal glands have two parts: the **cortex** and the **medulla**
- ✓ - The **cortex** is the outer part of the gland.
 - It produces the hormones **aldosterone** and **cortisol**.
- ✓ - The **medulla**, meanwhile, is the inner part of the gland.
 - It produces the hormones **adrenaline (epinephrine)** and **noradrenaline**.
 - **Each layer produces steroid hormones from the precursor cholesterol.**
However, the specific steroid hormone produced differs in each layer **because of zonal specific enzymes.**



Adrenal Cortex

- ❖ The adrenal cortex takes part in steroidogenesis, It has 3 distinct functional and histological zones:
- ✓ The zona glomerulosa (outermost layer) **produces mineralocorticoids**
- ✓ The zona fasciculata (middle layer) **produces glucocorticoids**
- ✓ The zona reticularis (innermost layer) **produces androgen precursors**



MINERALOCORTICOIDS

- **Mineralocorticoids** are the corticosteroids that act on the minerals (electrolytes), particularly promote sodium retention and Potassium excretion from kidneys to maintain Na balance.

❖- **Mineralocorticoids are:**

1. Aldosterone
2. 11-deoxycorticosterone

ALDOSTERONE

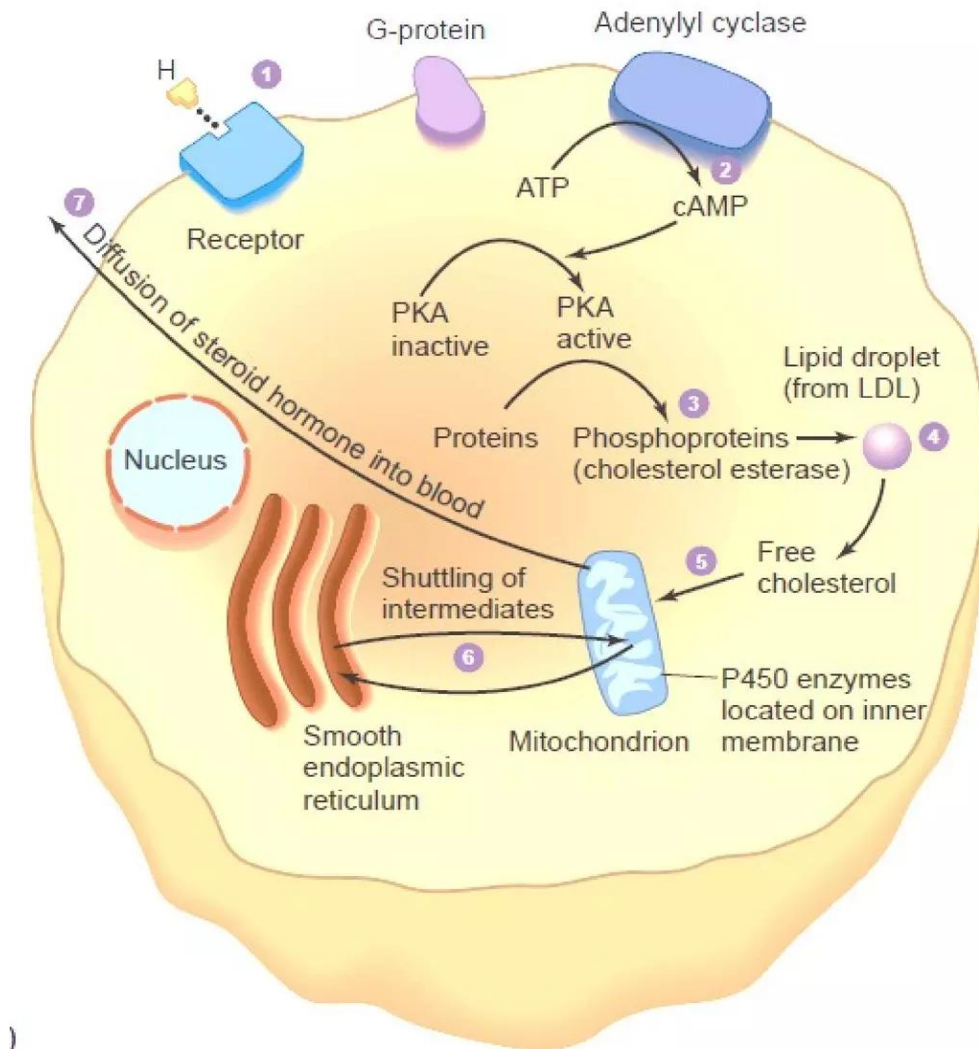
What is Aldosterone Hormones?

It is a steroid hormone synthesized in the **zona glomerulosa** of the adrenal cortex responsible for electrolyte (**sodium, chloride, and potassium**) and fluid balance in the body. Therefore, Aldosterone is known a **mineralocorticoid** hormone.

Chemistry and half-life

- Mineralocorticoids are C₂₁ steroids having 21 carbon Atoms.
- Half__ life of mineralocorticoids is **20 minutes**.
- Approximately **80 %** of the cholesterol used for steroid synthesis is provided by low density lipoproteins (LDL) in the circulating plasma.

- **The LDLs**, which have high concentrations of Cholesterol
- It diffuse from the plasma into the interstitial fluid.
- Attach to specific receptors contained in structures called Coated pits on the adrenocortical cell membranes.
- The coated Pits are then internalized by endocytosis, forming vesicles.
- That Eventually fuse with cell lysosomes and release cholesterol that can be used to synthesize adrenal steroid hormones.



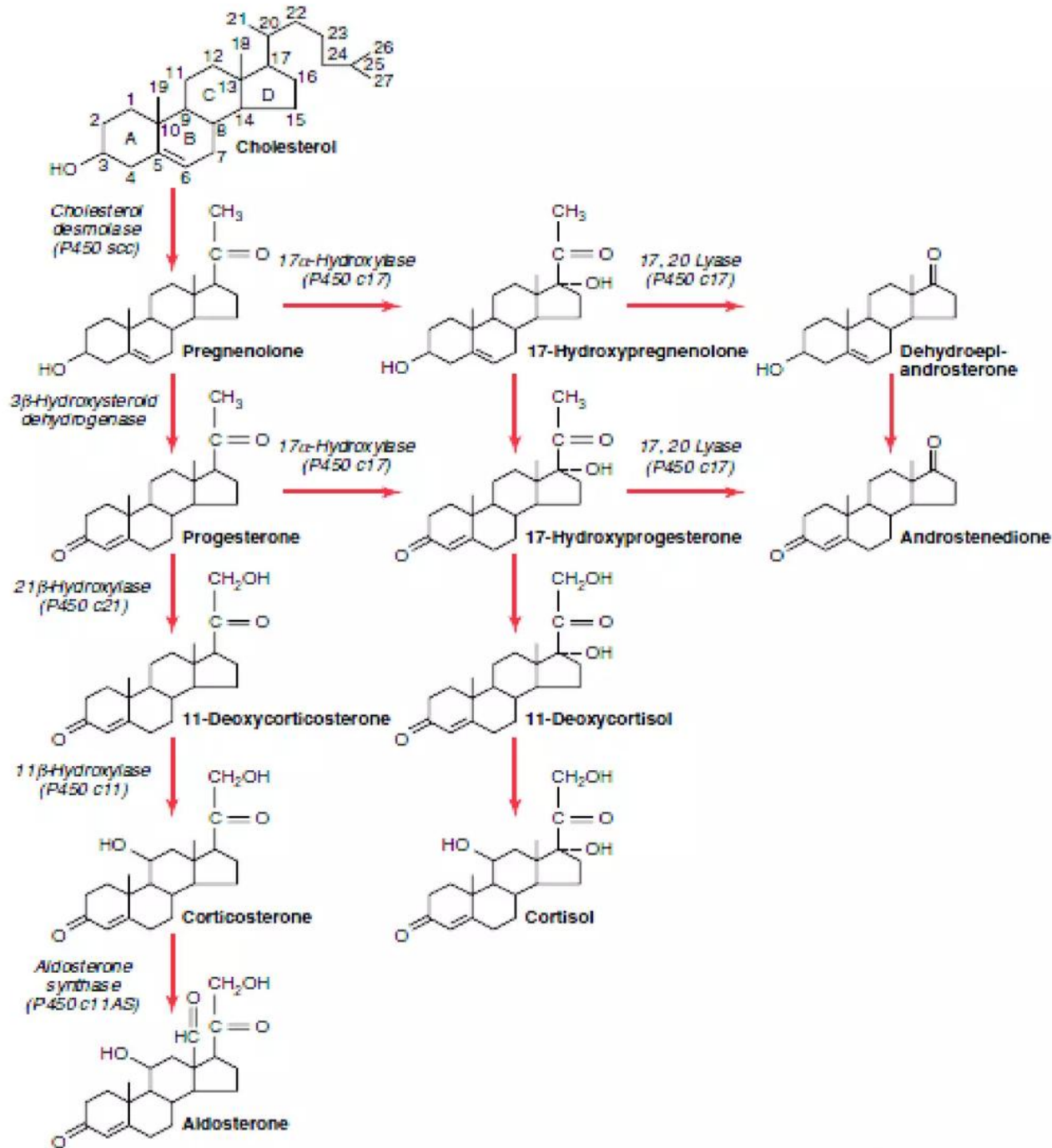
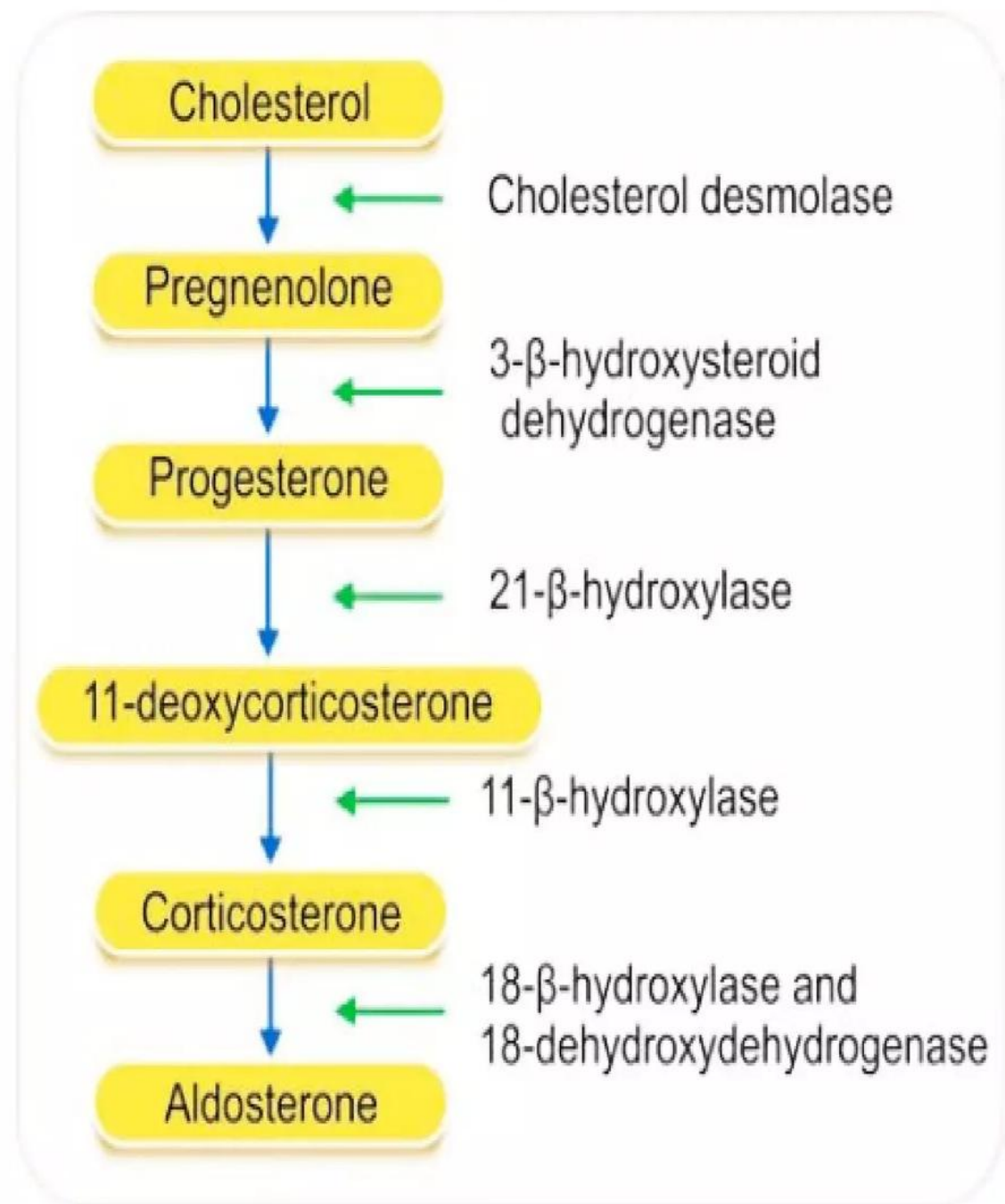


Figure 77-2 Pathways for synthesis of steroid hormones by the adrenal cortex. The enzymes are shown in italics.

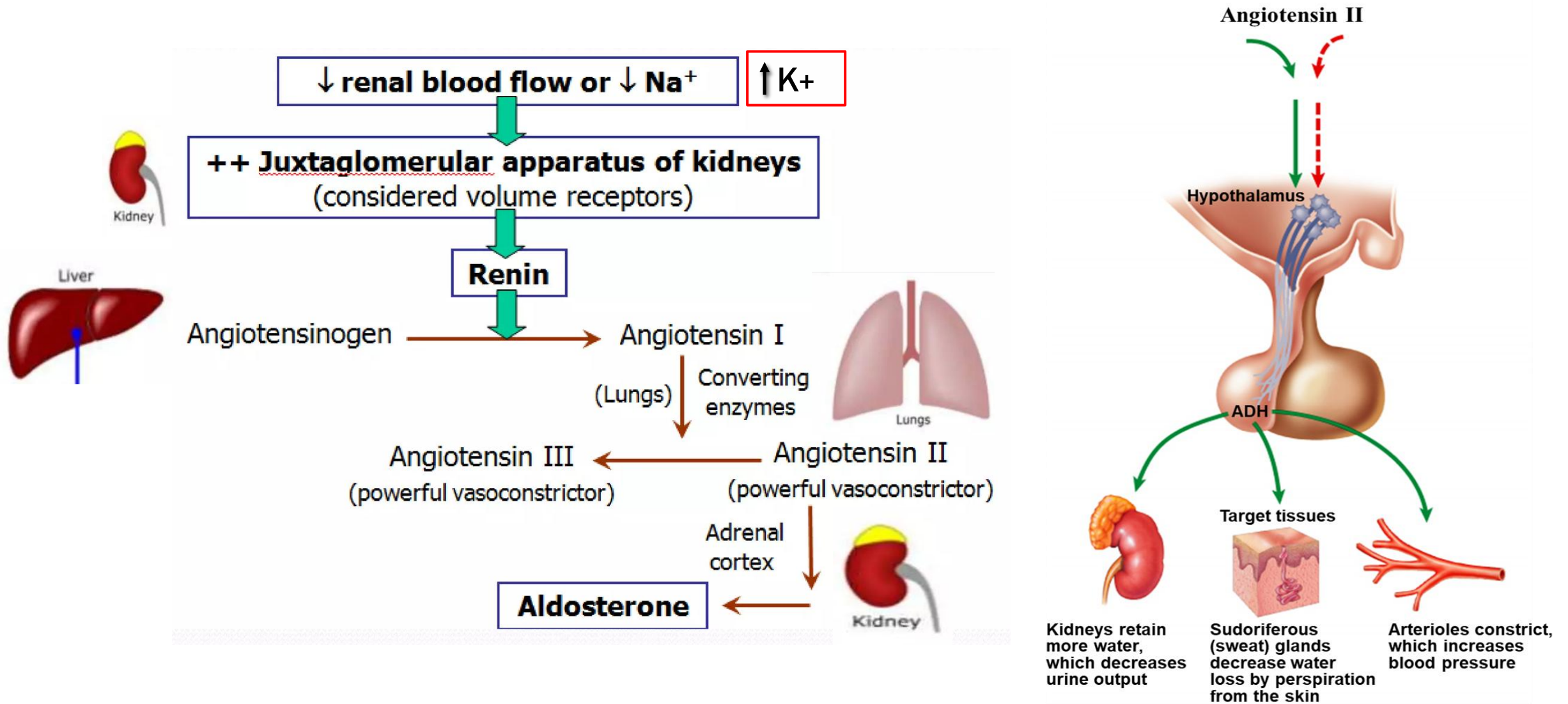


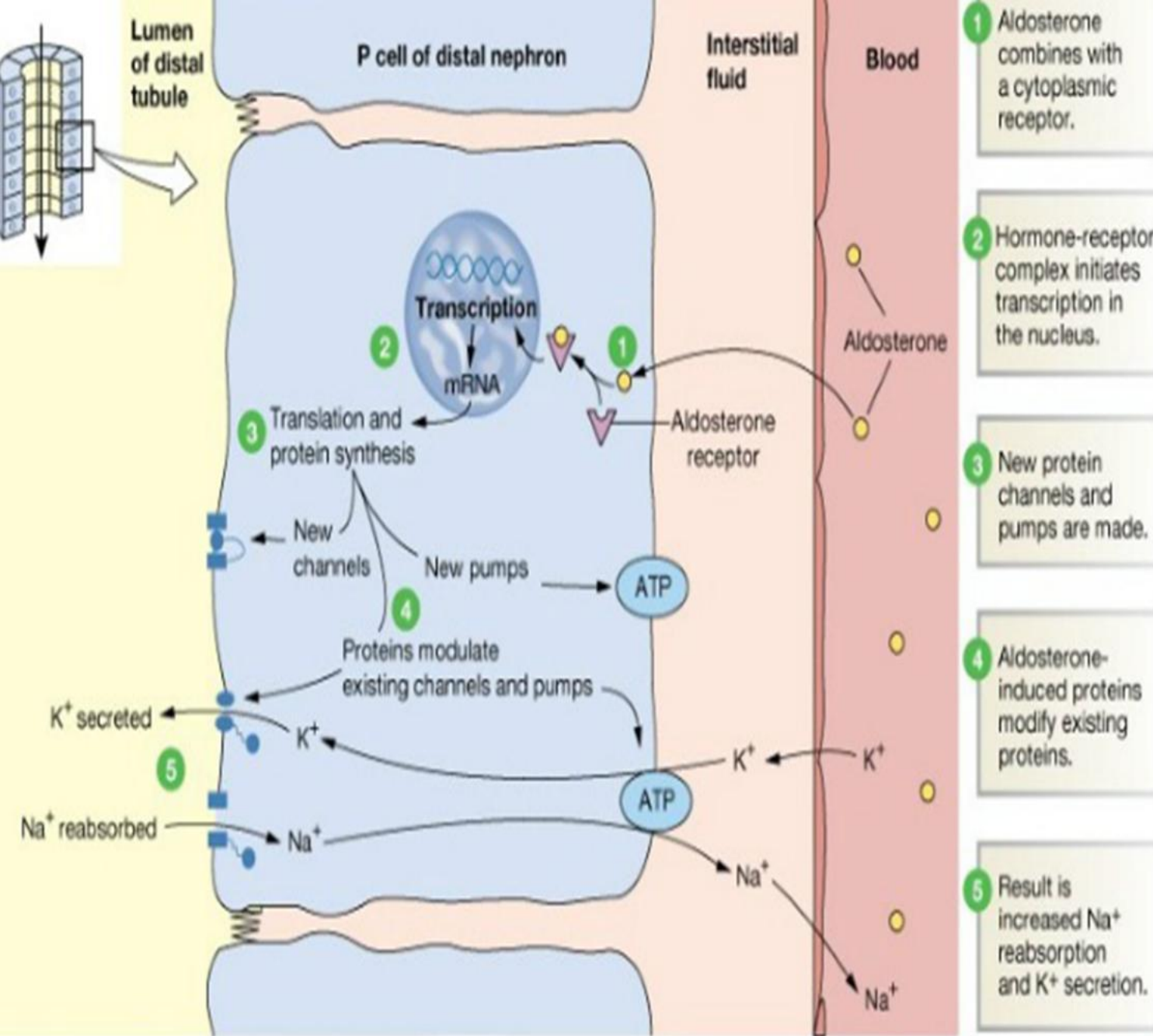
Regulator of Aldosterone Synthesis

❖ **The 2 primary regulators of aldosterone are :**

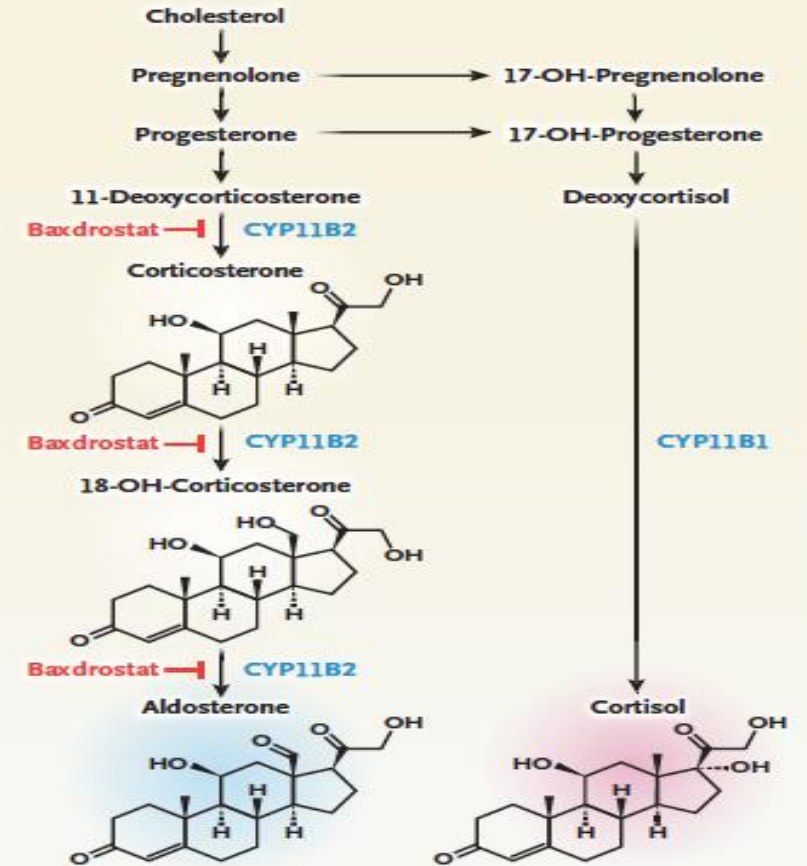
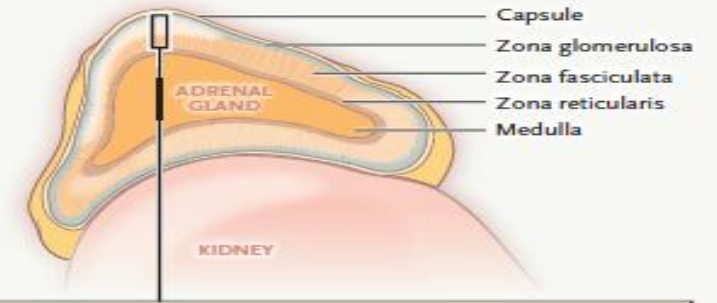
- (1) The renin-angiotensin-aldosterone system (RAAS)
- (2) Potassium levels

Renin-angiotensin-aldosterone System





Aldosterone Synthesis



TRANSPORT

- In the plasma, **40%** aldosterone circulates in free form and **60%** in bound form.
- Aldosterone is weakly bound to the specific aldosterone-binding globulin to transcortin and to albumin.

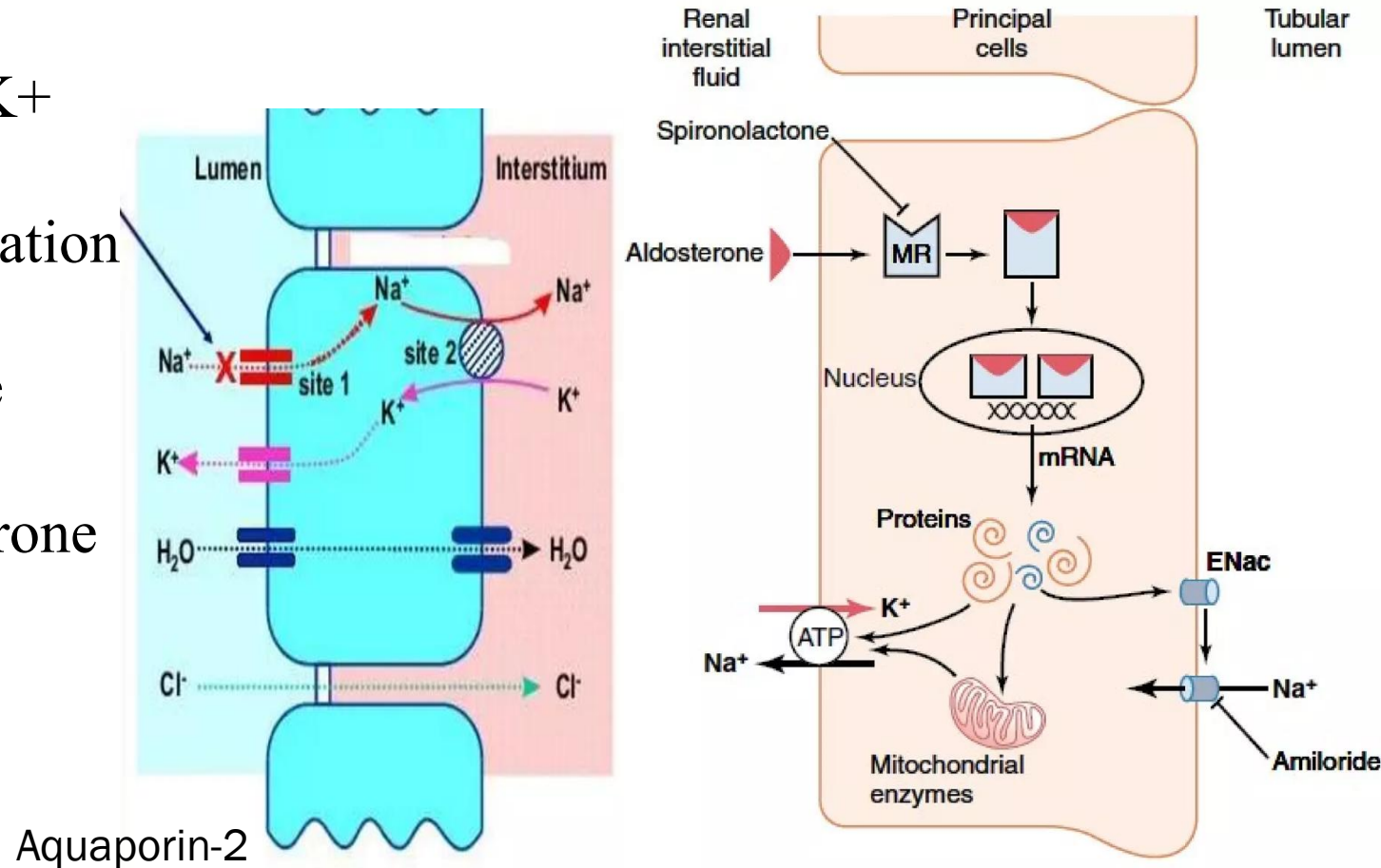
ACTIONS OF ALDOSTERONE

1. Conservation of Na^+ & excretion of K^+

2. Water excretion & ECF Volume Regulation

3. Relationship with Acid – Base balance

4. Secondary effects of excess of aldosterone



1. Effects on Renaltubules

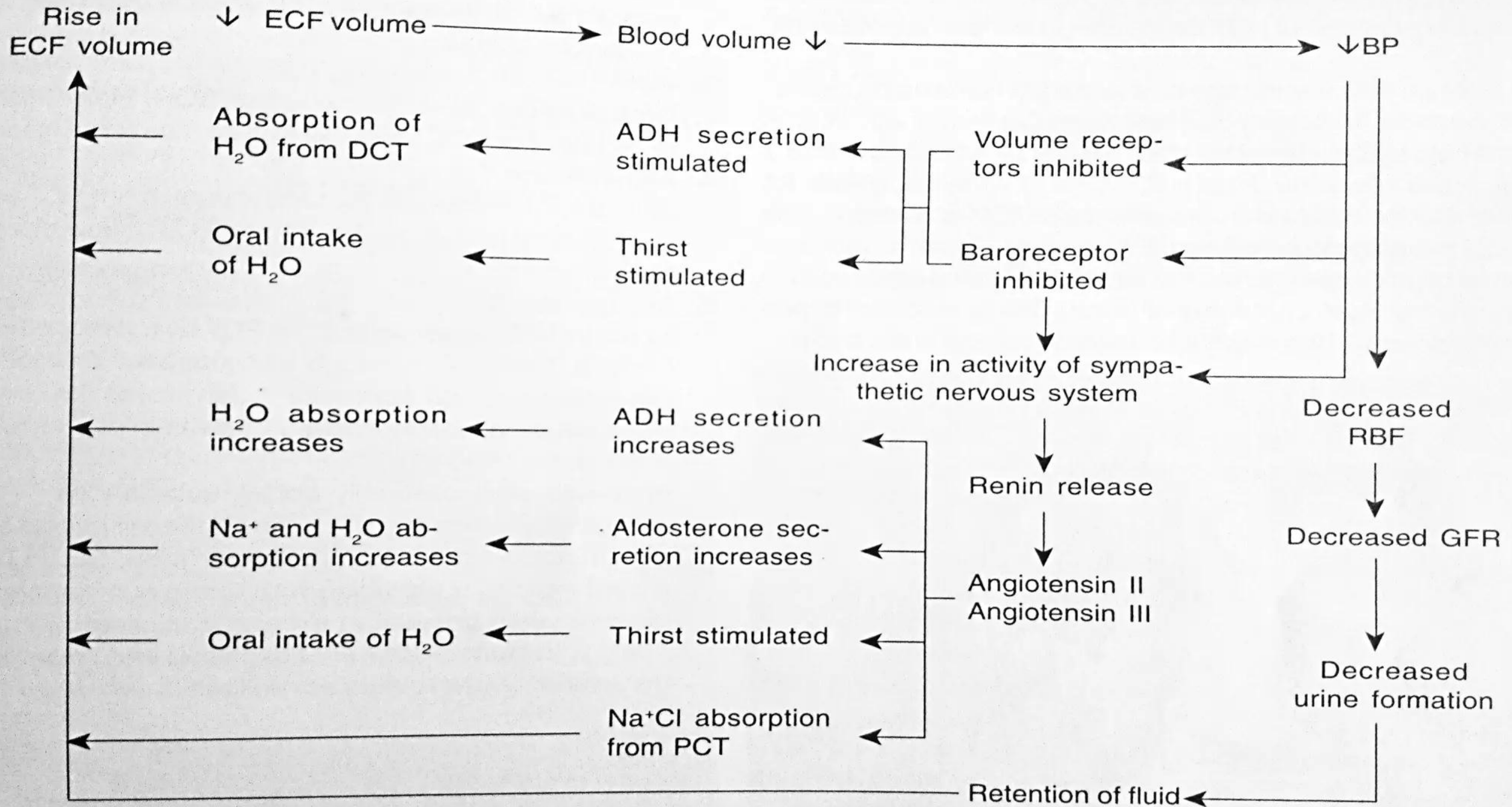
Aldosterone acts on late distal tubules and collecting ducts of kidney and causes following effects:

- I. **Sodium reabsorption** from the tubular fluid into the Renal tubular epithelial cells.
- II. **Potassium excretion.** In the kidney, the active reabsorption of Na^+ occurs in exchange of K^+ and H^+ . Thus, Aldosterone not only causes reabsorption of Na^+ , but Excretion of K^+ as well by renal tubular epithelial cells.
- III. **H^+ excretion.** Aldosterone also enhances the tubular Secretion of H^+ as Na^+ is reabsorbed.
- IV. **Ammonium and Magnesium excretion** is also increased by aldosterone.

- **It increases** Na^+ reabsorption from GIT, salivary gland and sweat glands.
- It may also lead to $\uparrow$ ses in K^+ and $\downarrow$ ses the Na^+ in muscle & brain cells
- Stimulation of K^+ excretion is greatly depends on dietary Na^+ proved by Animal studies
- Excess aldosterone leads to :
 - • $\uparrow$ sed plasma Na^+/K^+ Conc. Ratio due to $\uparrow$ ses K^+ excretion
 - • Decline in urine Na^+/K^+ Conc. Ratio due to $\downarrow$ ses Na^+ and $\uparrow$ ses K^+ excretion
- Removal of adrenal cortex results in :
 - • Na^+ & Water loss, but Na^+ loss excess then water
 - • Result decreased in ECFV produces hypotension, dehydration, circulatory collapse, finally death.
 - • Retention of K^+ produces hyperkalemia, dehydration and circulatory collapse.

2. Water excretion & ECF Volume Regulation

- Aldosterone has no direct effects on GFR, renal plasma flow or renin production.
- By stimulating Na^+ reabsorption it causes water retention.
- The result expansion of ECFV then leads to $\uparrow$ ses in GFR, RPF & $\downarrow$ ses renin production.
- High circulating aldosterone level is common finding in cirrhosis of liver, nephrosis, CHF, etc.



3. Relationship with Acid – Base balance

*Metabolic alkalosis**

↑ acid loss

- Prolonged vomiting/ loss of gastric fluid
- Conns, Cushings, Bartter's syndrome

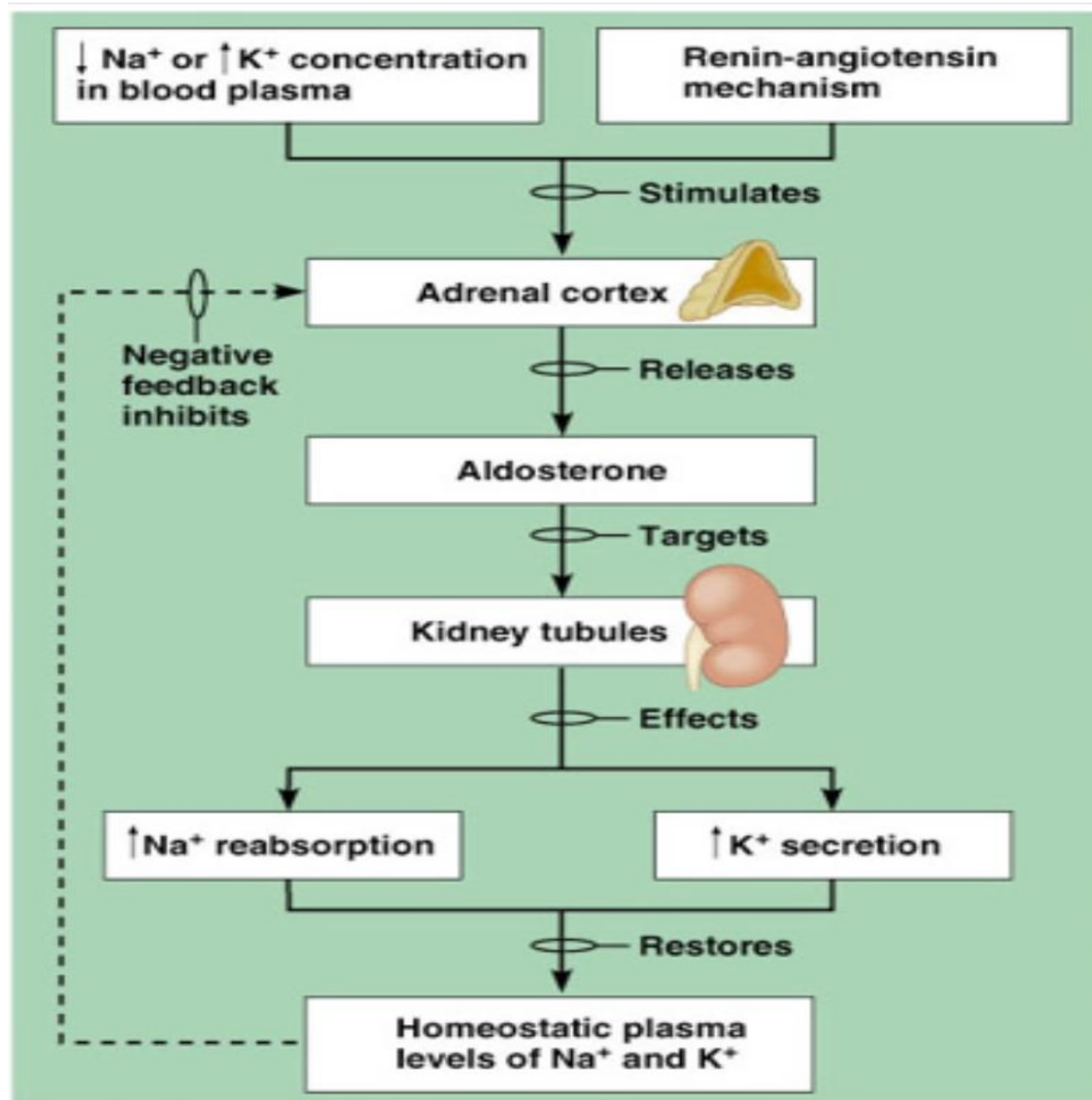
↑ Base administration, retention or concentration

- Given Excess bicarbonate
- Loss of Na^+ K^+ Cl^- (eg diuretics)
- Renal compensation/retention of bicarbonate
- Potassium deficiency

4. Secondary effects of excess of aldosterone

- Increased secretion of K^+ in DCT increases its excretion in urine causing marked hypokalemia
- Characterized by – muscular weakness, $\uparrow$ ses H^+ secretion – acidic urine etc
- Affects on BP –
- Increase in ECF volume and the blood volume finally leads to increase in blood pressure.

Negative Feedback



Aldosterone: Role in diseases

Complete failure to secrete aldosterone leads to death (dehydration, low blood volume).

Hyperaldosterone states: Contribute to hypertension associated with increased blood volume.

Over production of aldosterone

primary causes, ie. Conn's syndrome

- adenoma, nodular hyperplasia of zona glomerulosa

secondary

- cirrhosis, ascites, nephrotic syndrome

symptoms, signs

- headache, hypokalemia causing muscle weakness, hypernatremia, hypervolemia, nocturnal polyuria, hand cramping

A decorative arrangement of autumn leaves in shades of red, orange, and yellow, scattered across the left and bottom portions of the slide. Some leaves are large and detailed, while others are small and scattered. There are also soft, glowing light effects around some of the leaves.

Thanks For Listening ..