Aldosterone

Dr Taha Sadig Ahmed

Physiology Department , College of Medicine , King Saud University , Riyadh

- The mineralocorticoid, aldosterone, is an adrenal corticosteroid, synthesized in Zona Glomerulosa
- It is vital for maintaining →
- (1) sodium reabsorption
- (2) potassium secretion
- (3) And , by conserving sodium , it maintains ECF volume.

Regulation of Aldosterone

- (1) The main stimului for aldosterone secretion are decreased ECF sodium & decreased ECF volume (hypovolemia) , which acts via the Renin-Angiotensin mechanism .
- (2) Increased ECF potassium also stimulates aldosterone secretion
- (3) ACTH also stimulates aldosterone synthesis.
- However the ACTH stimulation is more transient than the other stimuli and is diminished within several days.
- Therefore , even in absence of ACTH ,hypovolemia & sodium depletion still activates renin-angiotensin system to stimulate aldosterone synthesis.

- Q : if aldosterone secretion is not fully dependant on ACTH , what is the role of ACTH ?
- A: it is believed that ACTH provides a tonic control of aldosterone synthesis , and also helps to increase aldosterone secretion in the transient situations of stress .
- Aldosterone levels fluctuate diurnally → highest concentration being at 8 am , lowest at 11 pm , in parallel to cortisol rhythms .
- On the other hand , overhydration and Atrial Natriuretic Peptide (ANP) inhibit aldosterone synthesis

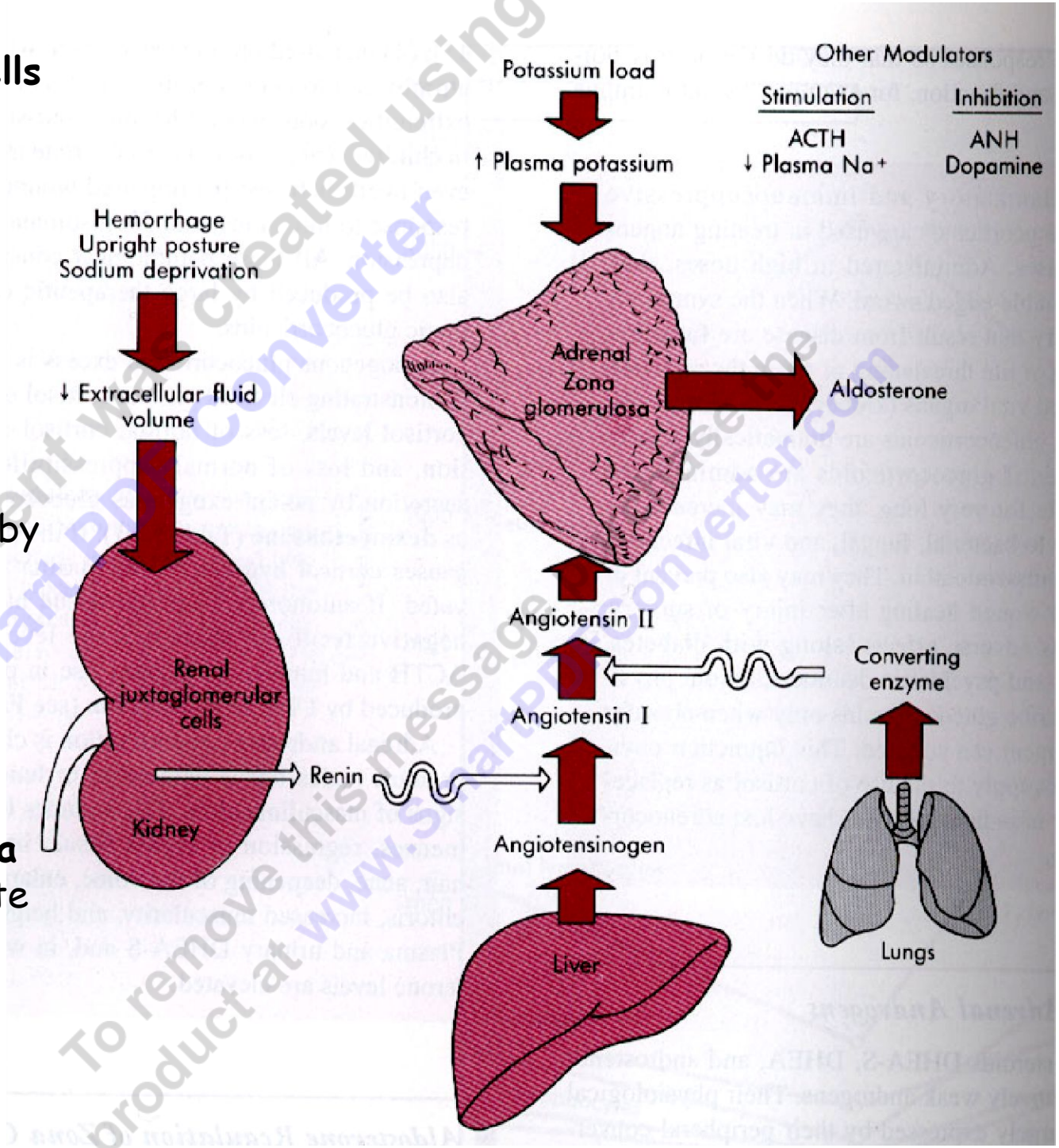
✓The **juxtaglomerular cells** of the kidney respond to hypovolemia by secreting **renin.**

✓Renin acts on **angiotensinogen (**which is secreted by the liver) to form **angiotensin I**

✓Then angiotensin converting enzyme , ***ACE*** (which which is secreted by the lungs) acts on angiotensin I

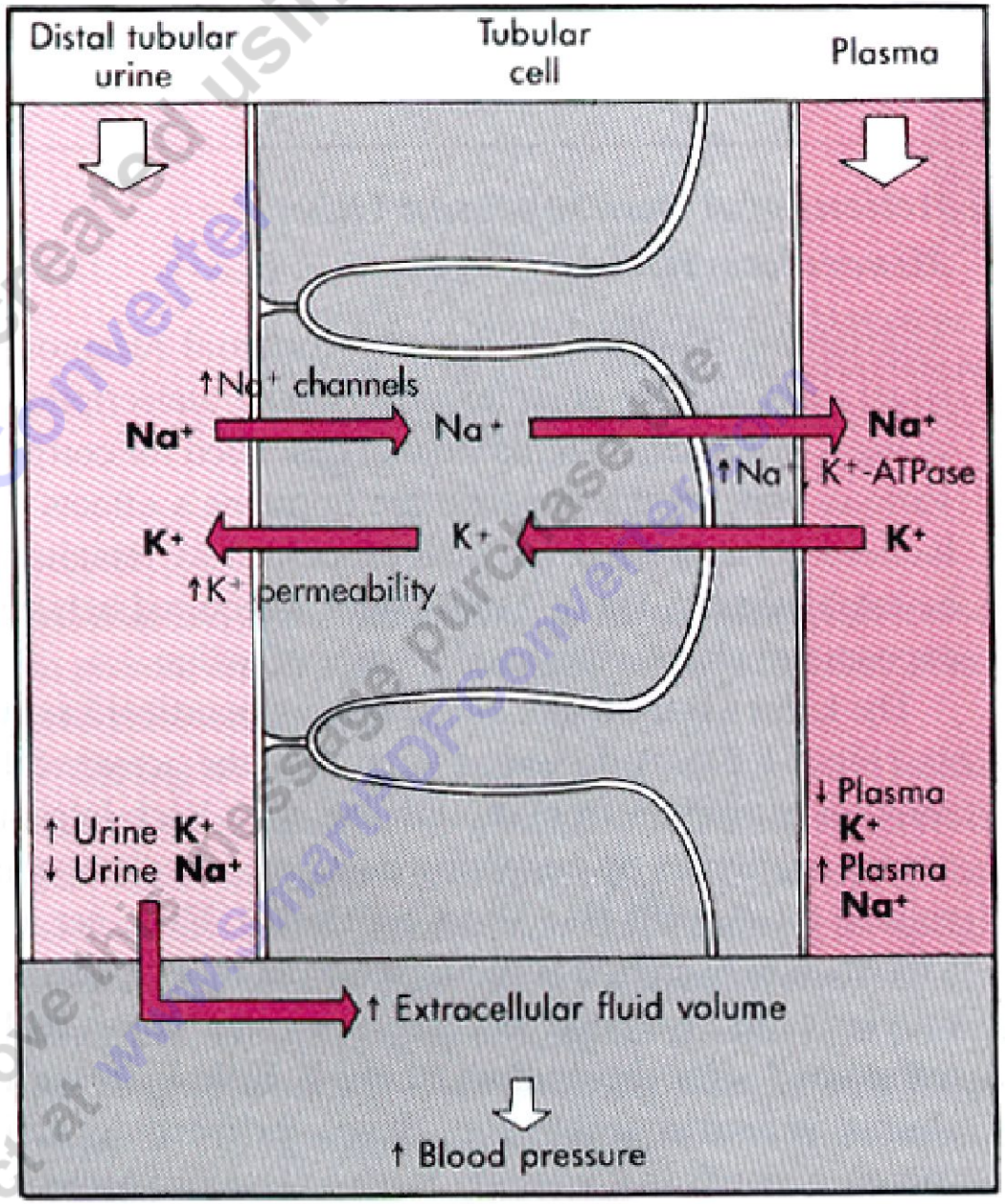
✓It cleaves it to **angiotensin II** .

✓ Then Angiotensin II acts , via increased intracellular cAMP in **Zona Glomerulosa** , to stimulate **aldosterone** synthesis.



Action of Aldosterone
Aldosterone binds to the mineralocorticoid receptor in renal tubular cells → affects <u>transcriptional changes</u> typical of steroid hormone action.

(1) Sodium reabsorption from tubular urine into the tubular cells is stimulated.
(2) At the same time, potassium secretion from the tubular cell into urine is increased.
Na^+/K^+-ATPase, and Na^+ channels work together to increase volume and pressure, and decrease K^+.



ANP & Aldosterone

- ANP (Atrial Natriuretic Peptide) inhibits aldosterone synthesis .
- In response to volume expansion, artrial myocytes secrete ANP which binds to receptors in the *zona glomerulosa* to inhibit aldosterone synthesis.
- ANP acts via increased intracellular cGMP which opposes cAMP and inhibits aldosterone synthesis.
- ANP also reduces aldosterone indirectly by inhibiting renin release.

- Aldosterone stimulates the Active Reabsorption of sodium from the tubular urine back into the nearby capillaries in the distal tubule.
- Water is passively reabsorbed with sodium which maintains sodium concentrations at a constant level.
- Hence extracellular fluid volume expands in a virtually isotonic fashion
- Aldosterone facilitates Potassium Excretion loss from ECF) tubular urine
- Increased ECF potassium stimulates aldosterone synthesis → thus providing a feedback control mechanism to control potassium levels.
- Conversely, potassium depletion lowers aldosterone secretion.

Hypoaldosteonism

(Aldosterone Deficiency)

- Occurs in **Addison's disease**
- Q : what happens to plasma Sodium & Potassium levels ?

Hyperaldosteonism

(Aldosterone Excess)

- Overproduction of aldosterone in conditions such as Conn's syndrome → sodium & water retention → hypertension .
- Conditions of low cardiac output are also known to stimulate synthesis of aldosterone (secondary hyperaldosteronism)
- Both conditions result in sodium & water retention → sustained hypertension .
- The treatment of patients with severe congestive heart failure with spironolactone (mineralocorticoid antagonist) produced significant reduction in mortality and morbidity, despite the very modest diuretic effect of the drug.
- The demonstration of local synthesis of aldosterone by cardiac and vascular cells

Thank You