**Page 86: Figure 12.15:**

-There are two adrenal glands, one above every kidney. Note that they are located one on each side, left & right.

-Also, note the blood supply; they receive the blood directly from the aorta which means they are essential to life.

**Pages 84 & 86:**

Read the notes under the figure in booklet ☺

***Further explanation of some notes:***

**Note (2):** Regulate the growth and secretion of the adrenal CORTEX –NOT adrenal gland –.

**Note (3):** the main target hormone for ACTH is cortisol.

**Note (4)**: ACTH secretion begins before the development of the adrenal cortex, which means that the ACTH is very important for the survival of the fetus.

**Note (5):** What makes ACTH regulation complex? The fact that it is affected & regulated by many neurotransmitters, many hormones, & “stress” as well.

**Note (6):** CRH (Corticotropin–Releasing Hormone); recall that this hormone is among the hypothalamus hormones that control the pituitary hormone secretion. CRH & ADH work together to stimulate the release of corticotropin. There are some similarities between those two hormones, which the doctor will be talking about later.

**Page 88:**

Read the text shown on this page.

**Fig 11-6 page 89+90:**

***\*Each adrenal gland consists of:***

1- Adrenal cortex (representing 80% of it)

2- Adrenal medulla (representing 20% of it)

***\*The adrenal cortex consists of three zones:***

**1-Zona glomorulosa (12%):**

This zone produces hormones which are collectively known as “mineral corticoids”. Those hormones are mainly represented by --the strongest & most secreted one- "Aldosterone". They mainly affect the metabolism of minerals in the body.

**2-Zona fasciculata (65%):**

This zone produces hormones which are collectively known as "Glucocorticoids". These hormones are represented by "cortisol" –the strongest of them-, & a little amount of “androgens” is also produced.

**3-Zona reticularis (23%):**

This zone mainly produces “androgens” & a small amount of cortisol.

Cells in this zone (reticularis) don’t differentiate fully until a person reaches the age of 6 to 8 years old.

\*The cells in the “glomerulosa” zone in an adult migrate down till they reach the “reticularis” zone, changing their histology & function as they migrate to become “the more mature” cells of the “reticularis” zone.

**Page 92:**

**Cortisol & Aldosterone are one of the main hormones produced by the adrenal cortex as we have seen before.**

**Refer to diagram A:**

-As you can see, both hormones play roles in glucocorticoid activity. Notice that cortisol hormone here has a higher potency (strength of effect) than aldosterone.

**Refer to diagram B:**

-As you can see here as well, both hormones play roles in mineralocorticoid activity. Notice that aldosterone hormone here plays a bigger role & has a higher potency; yet, cortisol still has a role.

**Refer to diagram C:**

-The secretion rate of cortisol is much higher than that of aldosterone.

**Refer to diagrams D & E:**

- Diagram D shows that cortisol contributes much more (plays a bigger role) to the glucocorticoid activity.

-Diagram E shows that aldosterone –as mentioned before- contributes more than cortisol to the mineralocorticoid activity.

-Notice that cortisol contributes more to the mineralocoticoid activity than aldosterone does to the glucocorticoid activity (aldosterone plays a very minor role in the glucocorticoid activity). This can be due to the higher secretion rate of cortisol.

**Page 93:**

Notice that the change of secretion of cortisol during the day is parallel to the change of the secretion of ACTH. This represents a sleep-wake rhythm as well.

**Page 95:**

-All hormones shown on the figure are produced from cholesterol –steroid hormones-. The synthesis of these hormones require a lot of enzymes. The synthesis of these hormones mainly happens in the fasciculata and some synthesis happens in the reticularis. They are produced & released directly; they are not stored nor kept in the adrenal glands. Therefore, any need for these hormones requires new synthesis.

-Note that if cortisol synthesis was blocked, the corticosterone concentration would increase.

**Page 94:**

Memorize the table.

**Page 98:**

-Although cortisol affects all organs in the body, its main functions are:

1. Glucose production from many non-carbohydrate sources.
2. Increased mobilization of glycerol & fatty acids.
3. Stress response –increased vascular tone.
4. The main function (most important & effective): modulation of CNS function.

-Cortisol receptors are present on almost all cells of the body.

-Cortisol does not cause the glycogenesis directly but it facilitates the action of glucagon (This is an example of permissive interaction).

-Note that cortisolis critical for survival of fasting human beings and animals, as when the glycogen in the liver is depleted, cotisol produces glucose from non-carbohydrate sources, therefore making sure that the organs and cells are still supplied with glucose.

-Cortisol binds weakly with aldosterone receptors.

**Page 96:**

Read the text.

Synthetic hormones are stronger than the natural hormones.

**Page 102:**

Recall that Aldosterone is also produced by cholesterol. Recall also that it is the major mineral corticoid hormone.

20% of aldosterone circulates bound to the corticosteroid-binding protein (CBG), and 40% circulates bound to albumin.

The main function of aldosterone is to maintain normal body fluid volume, by altering sodium concentrations as well as water’s absorption.

-Mineralocortioid hormones:

1. Aldosterone
2. Resox cortiosterone
3. Corticosterone
4. Fluoro cortisol
5. Cortisol
6. Cortisone

**Page 103:**

-Recall that the main target hormone for ACTH is cortisol.

-The main stimulus for the release of aldosterone from adrenal cortex is the Angiotensin װ. When extracellular fluid volume decreases, renin is produced by the kidneys. Renin is an enzyme protein. There is a plasma protein produced by the liver called Angiotensinogen. Angiotensinogen is converted to angiotensin I under the effect of Renin. Angiotensin I converted to Angiotensin II under the effect of converting enzyme (from the vascular endothelial cells in the lungs). It is said that 40% of this converting enzyme is produced in the lungs while 60% come from elsewhere. To inhibit the production of angiotensin II, we inhibit the activity of the converting enzyme, by drugs called “Angiotensin Converting Enzyme Inhibitors". These drugs are therefore used as Anti-hypertention(ACI). They are considered to be safe drugs as they do not relatively have any strong side effects.

-Note that there aren’t any natural inhibitors to the enzyme. All inhibitors to the converting enzyme are synthetic.

Going back, the main stimulus to the secretion of aldosterone hormone is the presence of angiotensin II. A second stimulus is the increase in the plasma potassium concentration (which consequently means a decrease in the sodium concentration). A third stimulus is ACTH.

**Page 106:**

-The effect of Angiotensin II on sodium reabsorption (a direct effect):

1. Affecting the tubular basal membrane of the tubular cells & luminal membrane to reabsorb Na+ by two ways:
2. Against with K+
3. Along with HCO3-
4. By having a direct effect on the reabsorption of water. How?

**Answer on Fig 26.7 page 108:**

Constriction of the afferent arteriole will cause the fluid volume in the peritubular capillaries to decrease & thus decreasing their hydrostatic pressure. This will cause the concentration of the plasma proteins in the peritubular capillaries to increase, causing an increase in their oncotic pressure. Increasing the oncotic pressure, as well as decreasing the hydrostatic pressure of the peritubular capillaries will both cause an increase in the reabsorption of water along with Na+ into the peritubular capillaries.

**Page 105:**

-This shows that there is also Angiotensin III, which is a potent stimulator of aldosterone secretion.

- By the effect of aminopeptides, angiotensin II will be converted to angiotensin III.

**Page 104:**

Notice that aldosterone does not only affect the renal tubules to increase the reabsorption of Na+ & water BUT also affects:

1. Salivary glands
2. Intestine
3. Sweat glands

**Page 111:**

* Recall that androgens are produced by the fasciculata & reticularis.
* There are two weak androgens:

1. Dehydroepiandrosterone
2. Androstenedione

Those two are mainly produced by the reticularis & a little amount is produced by the fasiculata. These are converted to potent androgens (Testosterone). Then the estrogens are produced by (Estradiol & Estrone).

**Page 112:**

**The function on Androgens in:**

* **Females**: presence of pubic, axillary hair, & libido.
* **Males**: functions the same as testosterone.
* When there is block in synthesis of these 2 weak androgens in the adrenal cortex, cortisol concentration increases.
* The adrenal cortex androgens are not important in males in all stages of their lives as there is a potent androgen produced by testes. EXCEPT in the ABNORMAL case of which a child shows early puberty during childhood.
* In females, they are very important in all stages of their lives especially during menopause in which they remain the only source of androgens and estrogens as the ovaries stop producing them.

