

Lecture Notes

UJ | SCHOOL OF MED

PHYSIOLOGY

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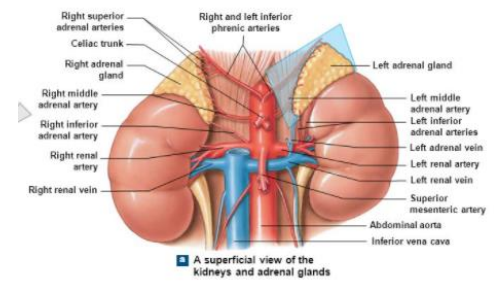


النادي الطلابي
كلية الطب

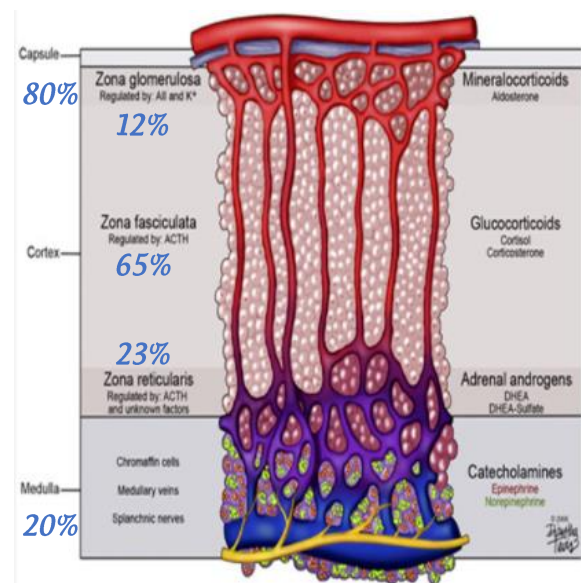


Physiology Lecture 5

- We have **2** adrenal glands located above the kidney.
- Their blood supply is through small arteries coming from the **Aorta** .
- The adrenal gland is made up of 2 distinct organs (they differ in their histological structure , anatomy developments & functions) :
 - i. **The adrenal cortex** , secretes **80%** of the secretions .
 - ii. **The adrenal medulla** , secretes **20%** of the secretions .
- They are considered as small glands as they weigh **6-10 grams** .
- The adrenal cortex is an essential gland because
 - i. It controls **Na, K & H₂O** metabolism.
 - ii. It controls **Carbohydrate , fat & protein metabolism & mobilisation for energy** .
 - iii. It participates in responses to **stresses** of various kinds .



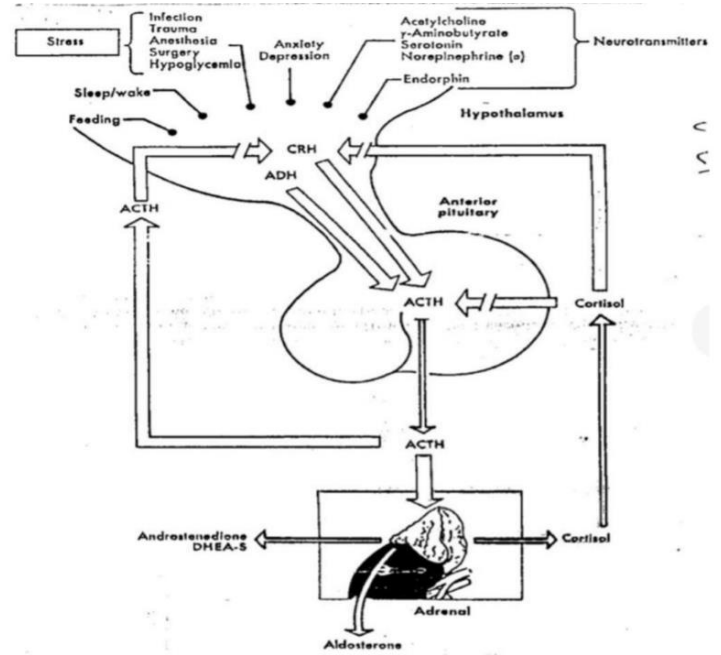
- Adrenal medulla secretes Catecholamines (adrenaline , noradrenaline) . as we mentioned previously , it controls only 20% of the secretion , so it's not that important , why ?!
 - i. Because the sympathetic nervous system produces adrenaline noradrenaline so there is the second source of these hormones.
- Notice the 3 zones found within the adrenal cortex - you need to memorize the names & the percentages.
- Each zone secretes **special hormones with specific functions**.



Zona Glomerulosa	Zona Fasciculata	Zona Reticularis
<p>Produces hormones collectively called mineralocorticoids . these hormones control the mineral metabolism .</p> <p>represented by the aldosterone hormone as the most potent .</p>	<p>Produces hormones collectively called glucocorticoids, they affect the glucose Metabolism represented by the cortisol as the most potent .</p> <p>And little secretion of androgens .</p>	<p>Produce androgens (male hormones), estrogens and small amounts of cortisol.</p>

Adrenocorticotrophic Hormone

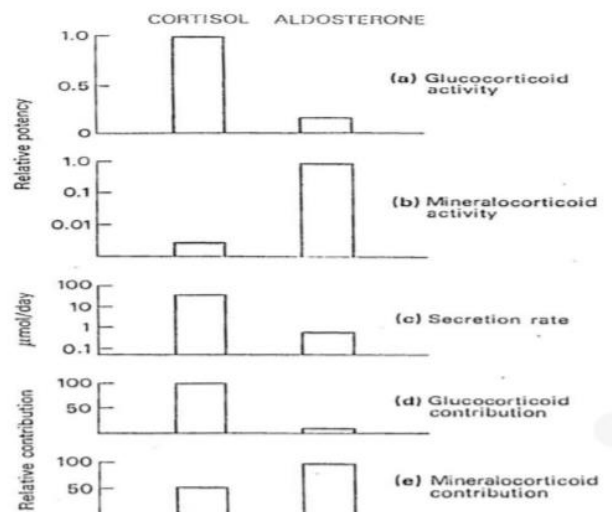
- **ACTH (adrenocorticotrophic hormone)** is an anterior pituitary gland hormone .
- ACTH controls the **growth** of the adrenal cortex as well as the **synthesis and secretion** of its hormones .
- The most important target in adrenal gland's hormones is **Cortisol** .
- **Fetus ACTH** synthesis and secretion begins early just **before** the development of the adrenal cortex .
- Although the mechanisms for each form of control aren't completely known , but **CRH** is the most important **mediator** meaning that **CRH** from the hypothalamus is the most important stimulus for ACTH .



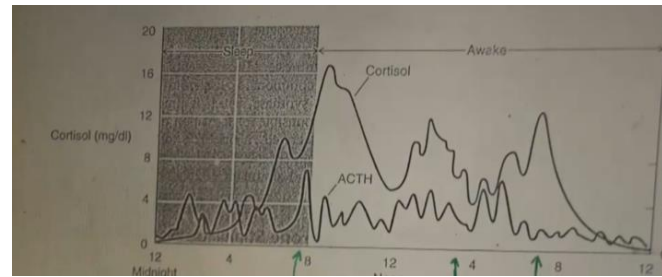
- **EXTRA** : ACTH is affected by CRH from the hypothalamus. So CRH affects ACTH & then ACTH affects the synthesis & secretion of hormones especially cortisol.
- ADH also exhibits corticotropin-releasin effect (**same pattern** of stimulation of the ACTH) .
- The **regulation of ACTH secretion** is the most complicated among all pituitary gland hormones and is affected by all these hormones (CRH & ADH) and conditions.
- ACTH secretion responds **most strikingly to stressful stimuli**, a response that is **critical to survival** .
- Extra-adrenal actions of ACTH are also present, ex: lipolytic & MSH-like action.

- The zona reticularis does not differentiate fully until between **6 - 8 years of age**.
- In the adult gland, the cells of the glomerulosa migrate down through the zona fasciculata to the zona Reticularis, changing their secretory pattern, shape, and function as they migrate. **The functional significance of this migration is not yet clear.**
- the most important hormones regarding the secretions of the adrenal cortex are 2 hormones
 - Cortisol (glucose metabolism) .**
 - Aldosterone (mineral metabolism) .**

- Notice the differences between the cortisol & aldosterone in the figure & memorize them :) !



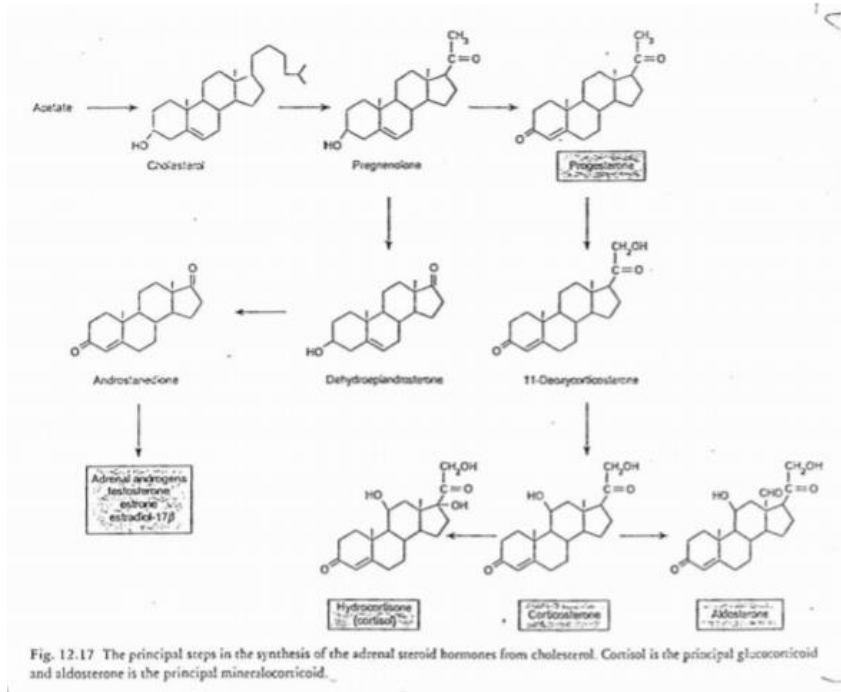
- Remember that the main target hormone for ACTH is **cortisol** and that's why When ACTH changes, cortisol also changes .



- Just a reminder

- I. Hormones are mainly proteins.
- II. Catecholamines & thyroid hormones are amino-acid derivatives .
- III. Steroids are male hormones , female hormones & adrenal cortex hormones .

- This figure shows the steps in the synthesis of the adrenal steroid hormones . they are produced from cholesterol (they are lipid soluble). obviously , we have many steps regulated by many enzymes synthesized in the adrenal cortex itself.



- Cortisol is the main hormone produced by the **Zona Fasciculata** , if the cortisol synthesis is affected , **corticosterone synthesis increases** .
- When the adrenal cortex hormones are produced they are not stored, they are **released immediately**. Any need is met by **new synthesis**.
- Cortisol is a steroid (lipid soluble) therefore it has to be bound to the following proteins to keep normal concentration :

- i. **CBG (corticosteroid-binding protein) → 90%**
- ii. **Albumin → 6%**

- The remaining **4% is free** , this is the functional amount of cortisol .

- Cortisol functions:

- I. **Main function** is the production of glucose from noncarbohydrate sources (gluconeogenesis), which is essential for survival during fasting → Cortisol is essential for life because it supplies the body with glucose in case of starvation therefore cortisol is considered a defense mechanism for the human body especially during fasting , so if a human (or an animal btw) fast in the **absence of cortisol** , they **won't survive** .
- II. **Fat mobilization.** (glycerol & fatty acids)
- III. **Supports vascular responses to any change in the body .**
- IV. **Modulates/regulates CNS function.**

- *Cortisol affects almost all the systems in the body, why is that ?!*

Because it is *lipid-soluble*, it can enter every cell in the body & if it binds with a receptor it can function .

- *Cortisol itself doesn't directly affect glycogenolysis but it has a permissive action to support the function of glucagon (it facilitates the action of glucagon, and glucagon doesn't function properly in the absence of cortisol).*
- *Cortisol binds itself to the mineralocorticoid receptors (aldosterone receptors) but it doesn't usually contribute to the mineralocorticoid action because there is an enzyme produced by the kidney that inactivates cortisol.*
- *Glucocorticoids (either natural or synthetic) can be classified into the following :*
 - Cortisol → natural , very potent , accounts for about 95% of all glucocorticoid activity .*
 - Corticosterone → natural , much less potent than cortisol , provides about 4% of total glucocorticoid activity*
 - Cortisone → synthetic, almost as potent as cortisol*
 - Prednisone → synthetic, four times as potent as cortisol.*
 - Methyl prednisone → synthetic, five times as potent as cortisol.*
 - Dexamethasone → synthetic, 30 times as potent as cortisol.*

Done By :

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