15.10B: Adrenal Cortex

The adrenal cortex is devoted to the synthesis of corticosteroid and androgen hormones.

LEARNING OBJECTIVES

Differentiate among the zones and hormones of the adrenal cortex

KEY TAKEAWAYS

Key Points

- Specific cortical cells produce particular hormones, including aldosterone, cortisol, and androgens such as androstenedione.
- The adrenal cortex comprises three zones, or layers: Zona glomerulosa (outer), Zona fasciculata and Zona reticularis.
- The outermost layer, the zona glomerulosa, is the main site for production of mineralocorticoids, mainly aldosterone.
- Zona fasciculata is the layer situated between the glomerulosa and reticularis. This layer is responsible for producing glucocorticoids, such as cortisol.
- Zona reticularis is the inner most cortical layer; the zona reticularis produces androgens, mainly DHEA.

Key Terms

- adrenal cortex: The outer portion of the adrenal glands that produces hormones essential to homeostasis.
• **zona glomerulosa**: The outermost layer of the adrenal cortex, responsible for producing mineralocorticoids such as aldosterone.

• **zona fasciculata**: The middle layer of the adrenal cortex, responsible for producing glucocorticoids such as cortisol.

• **zona reticularis**: The inner most layer of the adrenal cortex, responsible for producing androgens such as DHEA.

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**Zones of the Adrenal Cortex**

The cortex is regulated by neuroendocrine hormones secreted by the pituitary gland, which are under the control of the hypothalamus, as well as by the renin-angiotensin system. The adrenal cortex has three zones or layers:

1. Zona glomerulosa (outer)
2. Zona fasciculata
3. Zona reticularis

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**Zona Glomerulosa**

The outermost layer, the zona glomerulosa, is the main site for production of mineralocorticoids, mainly aldosterone, that are largely responsible for the long-term regulation of blood pressure.

Aldosterone exerts its effects on the distal convoluted tubule and collecting duct of the kidney, where it causes increased reabsorption of sodium and increased excretion of both potassium (by principal cells) and hydrogen ions (by intercalated cells of the collecting duct). The major stimulus to produce aldosterone is angiotensin II, as ACTH from the pituitary only produces a transient effect. Angiotensin is stimulated by the juxtaglomerular cells when renal blood pressure drops below 90 mmHg.

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**Zona Fasciculata**

Zona fasciculata is the layer situated between the glomerulosa and reticularis. This layer is responsible for producing glucocorticoids, such as 11-deoxycorticosterone, corticosterone, and cortisol in humans. Cortisol enhances the activity of other hormones including glucagon and catecholamines.
**Zona Reticularis**

**Adrenal Cortex:** The three layers of the adrenal cortex are shown, the outermost zona glomerulosa, zona fasciculata and the innermost zona reticularis.

Zona reticularis is the innermost cortical layer, and it produces androgens, mainly dehydroepiandrosterone (DHEA), DHEA sulfate (DHEA-S), and androstenedone (the precursor to testosterone) in humans.

**Hormones of the Adrenal Cortex**

The different zones of the adrenal cortex produce different hormones.

**Mineralocorticoids**

These are produced in the zona glomerulosa. The primary mineralocorticoid is aldosterone. Its secretion is regulated by the oligopeptide angiotensin II. Aldosterone is secreted in response to high extracellular potassium levels, low extracellular sodium levels, and low fluid levels and blood volume. Aldosterone secretion affects metabolism in different ways:

- It increases urinary excretion of potassium ions
- It increases interstitial levels of sodium ions
• It increases water retention and blood volume.

**Glucocorticoids**

These are produced in the zona fasciculata. The primary glucocorticoid released by the adrenal gland in humans is cortisol. Its secretion is regulated by the hormone ACTH from the anterior pituitary gland. Upon binding to its target, cortisol enhances metabolism in several ways:

• It stimulates the release of amino acids from the body
• It stimulates lipolysis, the breakdown of fat
• It stimulates gluconeogenesis, the production of glucose from newly-released amino acids and lipids
• It increases blood glucose levels in response to stress, by inhibiting glucose uptake into muscle and fat cells
• It strengthens cardiac muscle contractions
• It increases water retention
• It has anti-inflammatory and anti-allergic effects.

**Androgens**

The zona reticularis produces androgens, the most important of which is DHEA. In general, these hormones do not have an overall effect in the male body, and are converted to more potent androgens such as testosterone and DHT or to estrogens (female sex hormones) in the gonads, acting in this way as a metabolic intermediate.