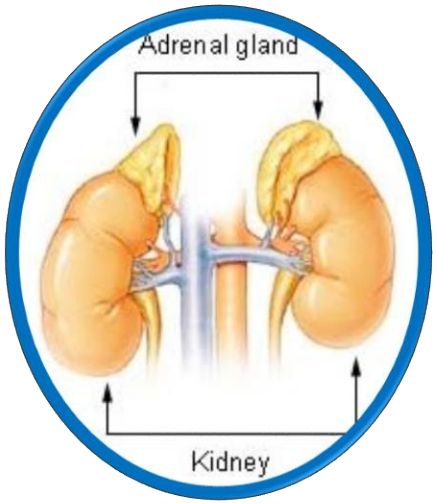
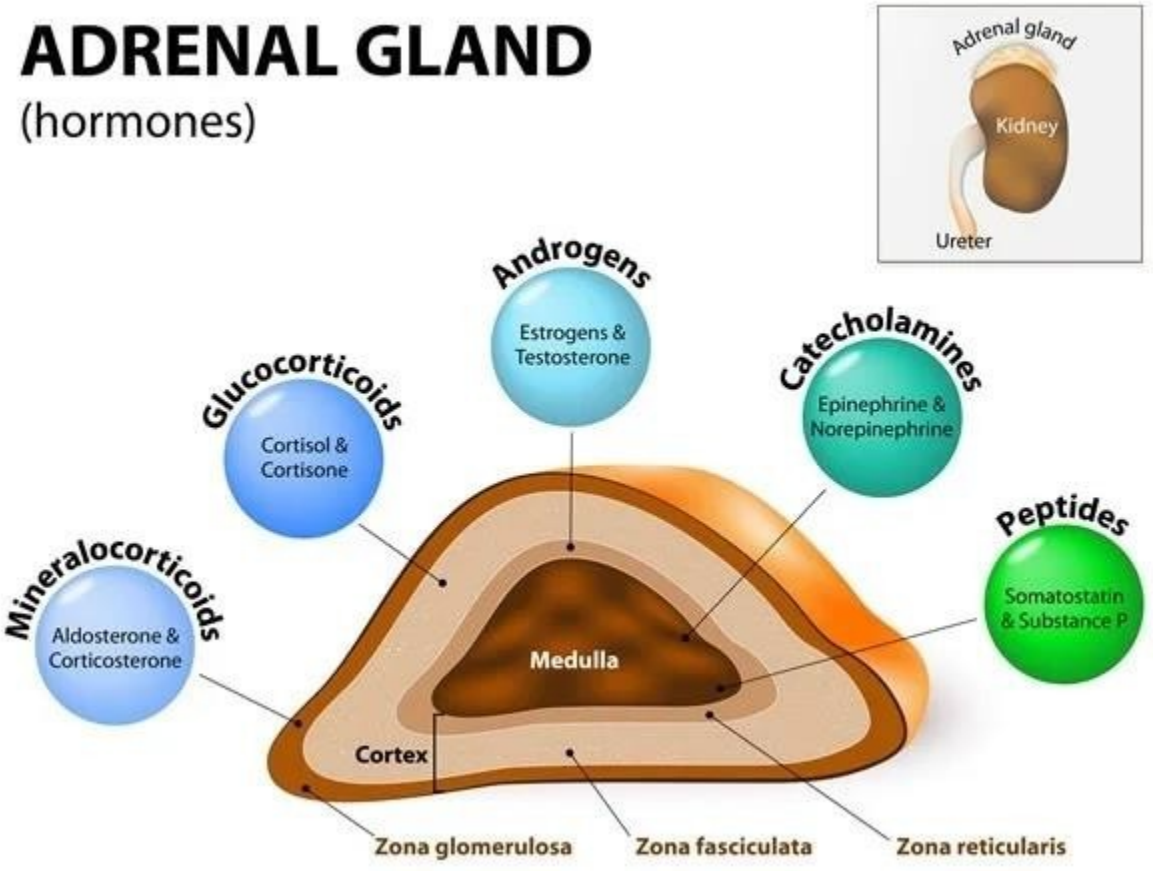
Adrenal Glands

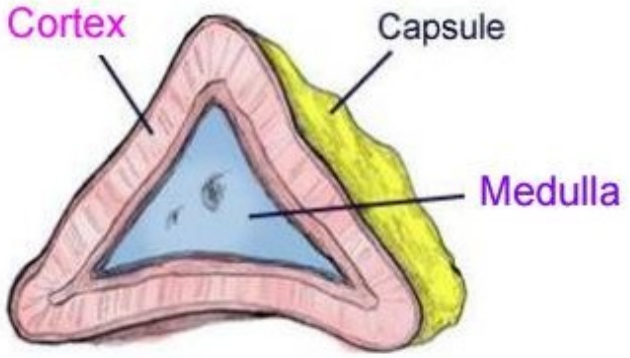
The **adrenal glands** are paired, pyramid-shaped organs behind the peritoneum and close to the upper pole of each kidney. Each adrenal gland consists of two separate portions an outer cortex and an inner medulla.





Adrenal Cortex

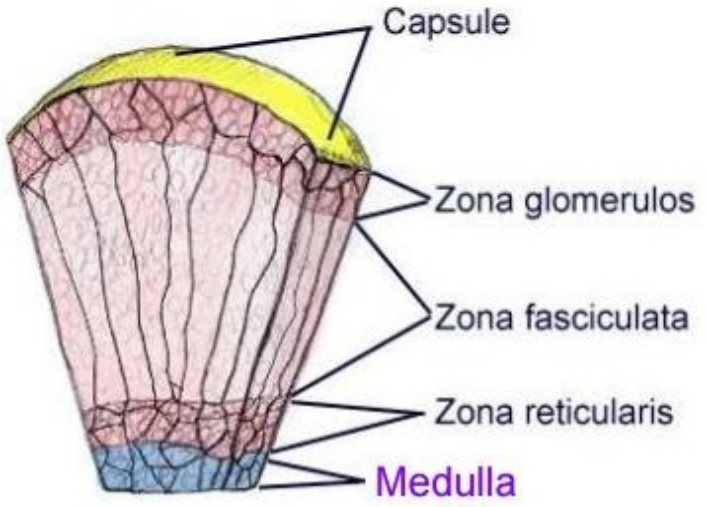
The adrenal cortex accounts for 80% of the weight of the adult gland. The cortex is histologically subdivided into the following three zones



:1 The zona glomerulosa, the outer layer, primarily produces the mineralocorticoid aldosterone.

2-The zona fasciculata, the middle layer, secretes the glucocorticoids cortisol, cortisone, and corticosterone.

3-The zona reticularis, secretes adrenal androgens.



Factors Controlling CRH

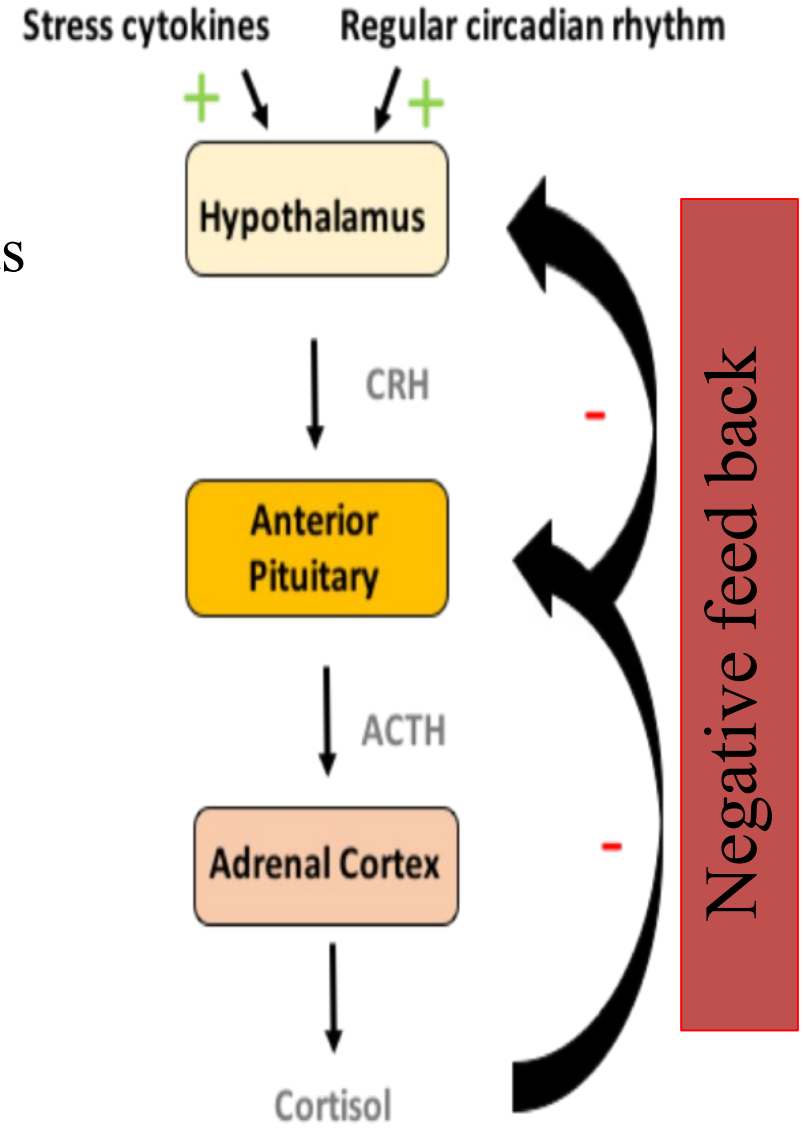
CRH is secreted from the hypothalamus in a diurnal pattern that sets the subsequent release pattern of ACTH from anterior pituitary and cortisol adrenal gland.

Stimuli for an increase in CRH include:

1-Stress.

2-Hypoglycemia

3-Decreased circulating levels of glucocorticoids.



Glucocorticoids:

Glucocorticoids are steroid hormones released from the adrenal cortex that affect many aspects of metabolism, especially glucose metabolism.

In humans, the main glucocorticoid is cortisol.

The glucocorticoids also affect many other systems of the body, including the cardiovascular and immune systems.

Glucocorticoids are released in a diurnal (daily) manner, peaking in the early morning hours.

Effects of the Glucocorticoids:

- Increase the level of blood glucose by stimulating gluconeogenesis (conversion in the liver of fats and proteins into glucose.

- Stimulate protein breakdown and inhibit protein synthesis.

- Promote fat buildup in the trunk and face.

- Inhibit growth by antagonizing the effects of growth hormone on protein synthesis.

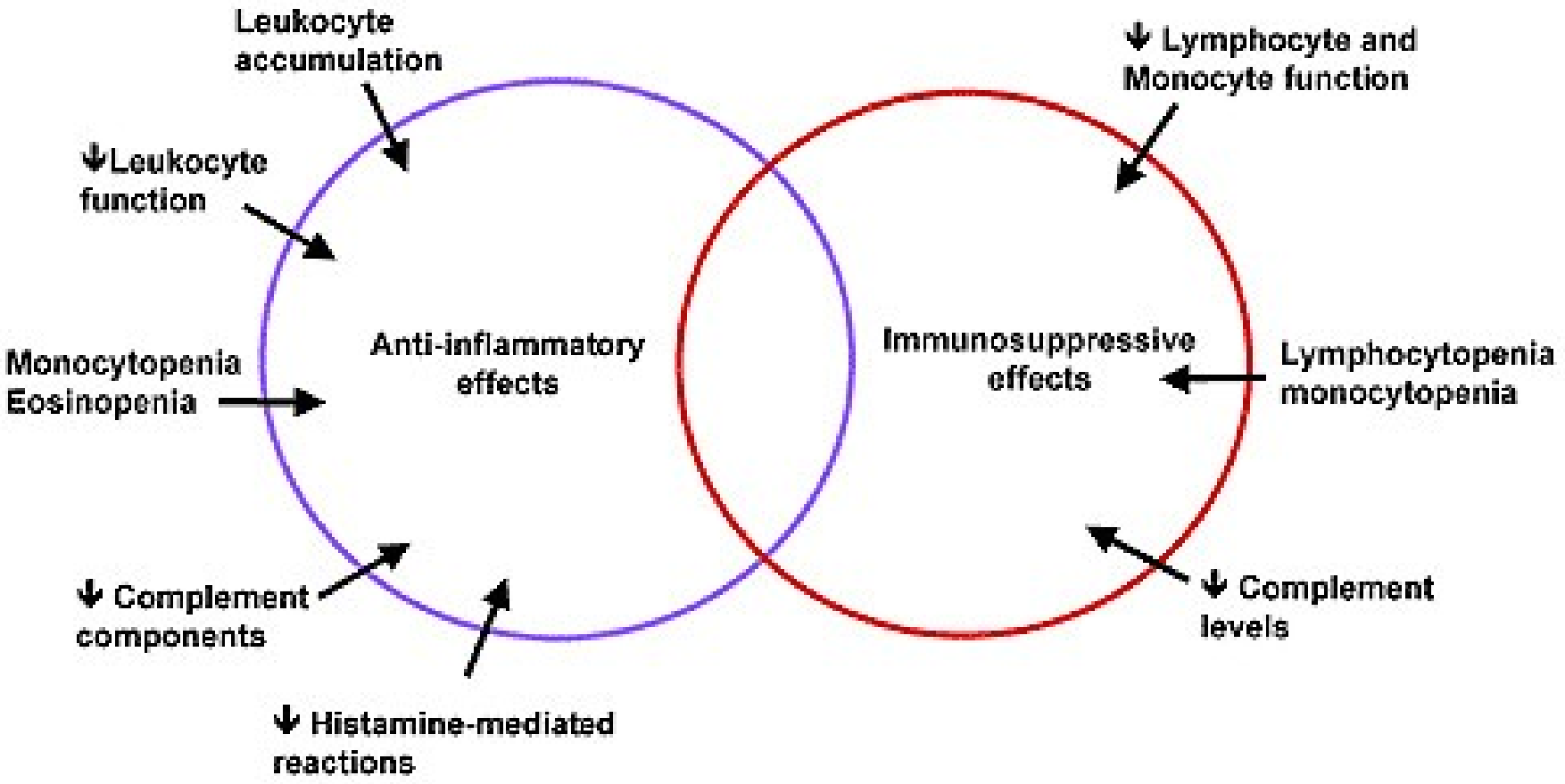
- Increase the effect of growth hormone on adipose tissue and increase the effect of thyroid hormone on its target tissues.

- Increase the effects of the catecholamines, causing increased heart rate and blood pressure.

- Skin bronzing.

- Strong effect on emotional stability and mood.

inhibition of immune and inflammatory functions by depress cytotoxic T-cell function and suppress the production, release, and activation of many chemical mediators of inflammation, including interleukins, prostaglandins, and histamine.



Disorders of the adrenal cortex

1-Hypofunction or adrenal Insufficiency leads to Addison disease.

2-Hyperfunction of adrenal cortex that causes increased secretion of cortisol leads to Cushing disease or Cushing syndrome.

Hyperfunction that causes increased secretion of adrenal androgens or estrogens leads to virilization or feminization.

Hyperfunction that causes increased levels of aldosterone leads to hyperaldosteronism.

-Hypofunction or adrenal Insufficiency

Adrenal insufficiency is a decrease in the circulating level of the glucocorticoids.

Adrenal insufficiency may be primary caused by dysfunction of the adrenal gland, or secondary caused by dysfunction of the pituitary or hypothalamus.

Addison disease.

Primary adrenal insufficiency is termed **Addison disease**.
Addison disease is caused by autoimmune mechanisms that destroy adrenal cortical cells and is more common in women.

Pathophysiology

Addison disease is characterized by inadequate corticosteroid and mineralocorticoid synthesis and elevated levels of serum ACTH (loss of negative feedback.

Before clinical manifestations are evident, more than 90% of total adrenocortical tissue must be destroyed.

Idiopathic Addison disease (organ-specific autoimmune adrenalitis) causes adrenal atrophy and hypofunction and is an organ-specific autoimmune disease.
It may occur in childhood(type 1) or adulthood (type 2)

Clinical Manifestations

- Depression, because cortisol levels influence mood and emotions.
- Fatigue, related to hypoglycemia.
- Anorexia, vomiting, diarrhea, nausea and weight loss.
- Hyperpigmentation of the skin if ACTH levels are high(primary adrenal insufficiency) as a result of ACTH having melanin-stimulating hormone like effects on the skin.
- Inability to respond to stressful situations, perhaps leading to severe hypotension and shock.

Diagnostic Tools

- A good history and physical examination.
- levels of CRH, ACTH,.
- Hyponatremia, hyperkalemia, and hypotension may be present if the adrenal cells that produce aldosterone are destroyed or if ACTH levels are undetectable.

Complications

- Adrenal crisis may occur after physical or mental stress in an affected individual. This can be life-threatening and is characterized by volume depletion, hypotension, and vascular collapse.

Hyperfunction

Glucocorticoid Excess:

It is any condition in which there are very high levels of circulating glucocorticoids.

If the cause of glucocorticoid excess is primary adrenal gland hypersecretion, there is usually an adrenal tumor present.
In this situation, low ACTH and low CRH levels will be present as a result of negative feedback from high glucocorticoids.
Adrenal androgen levels will be low because ACTH is low.
Bronzing of the skin will not occur.

If pituitary cells producing excess ACTH, the elevated ACTH also will cause excess adrenal androgen production. Bronzing of the skin will occur because of crossover effects between ACTH and melanin-stimulating hormone. CRH levels will be low as a result of negative feedback from ACTH and the glucocorticoids.

High levels of glucocorticoids also may result from chronic administration of high-dose corticosteroids, especially cortisol, for treatment of inflammatory conditions e.g. asthma

Cushing's syndrome refers to any condition of high glucocorticoids and includes glucocorticoid excess caused by therapeutic administration of corticosteroids.

Clinical Manifestations

1 Fat pads on the face and back (moon face(

2Muscle weakness from protein breakdown and thinning around arms and legs.

3Hypertension as a result of increased catecholamine responsiveness.

4 Weight gain.

5 Reversible form of diabetes mellitus.

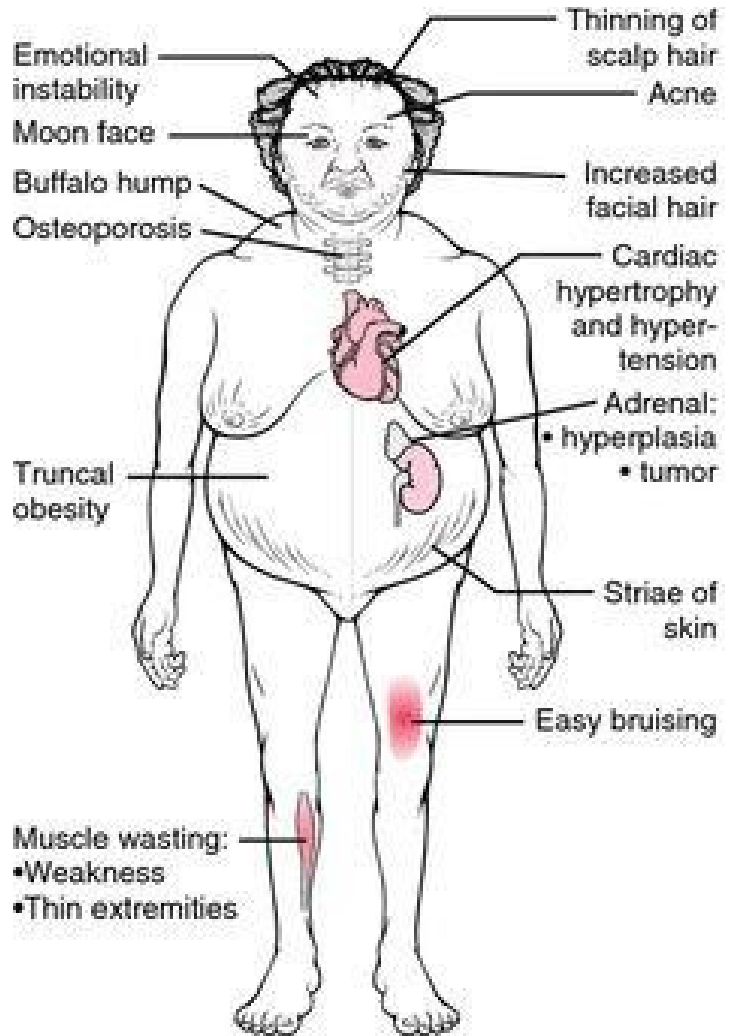
6Inhibition of immune and inflammatory reactions, leading to poor wound healing.

7 Extreme emotional lability.

8Masculinization of women and children as a result of adrenal androgen stimulation.

9 Bone osteoporosis and fracture.

10Bronzing of the skin if ACTH levels are high.



Diagnostic Tools

A good history and physical examination. Blood

tests measuring levels of CRH, ACTH.

Loss of normal diurnal (morning) pattern of cortisol release. Hyperglycemia, hypernatremia and hypokalemia may be present because of aldosterone-like properties of the glucocorticoids.

This can contribute to hypertension and cardiac and neural irregularities.

A dexamethasone challenge test is commonly used in clinical practice to evaluate states of glucocorticoid excess. In healthy individuals, a low dose of dexamethasone will suppress ACTH secretion; in those with Cushing's syndrome, suppression does not occur.

Complications

- Morbidity and mortality are high without treatment and approximately 50% of individuals die within 5 years.
- Causes of death include suicide, infections, and coronary artery disease from severe hypertension.
- Insulin resistance and hyperglycemia may develop in those with glucocorticoid excess.
- These may be due to abnormal changes in hepatic fatty acid metabolism.

Pheochromocytoma

It results in the release of too much epinephrine and norepinephrine, hormones that control heart rate, metabolism, and blood pressure.

It usually develops in the center (medulla) of one or both adrenal glands.

Symptoms

Most people with this tumor have attacks of a set of symptoms, which happen when the tumor releases hormones.

The attacks usually last from a few minutes to hours. The set of symptoms include:

Headaches, heart palpitations, sweating, High blood pressure

Treatment

Treatment involves removing the tumor with surgery. When the tumor cannot be surgically removed, a combination of medicine will used to manage it.

Reference: Corwin , Pathophysiology, 3rd Edition

Thank you