

Adrenal gland

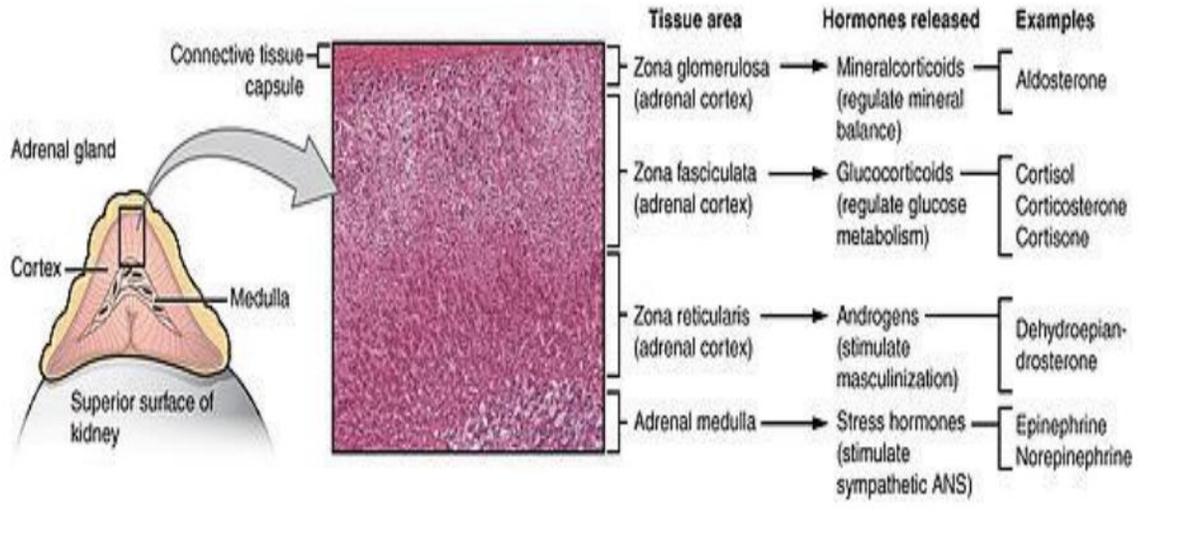
A small gland that makes steroid hormones, adrenaline, and noradrenaline. These hormones help control heart rate, blood pressure, and other important body functions. There are two adrenal glands, one on top of each kidney. Also called suprarenal gland.

Anatomy of the Adrenal Glands

An adrenal gland is made of two main parts:

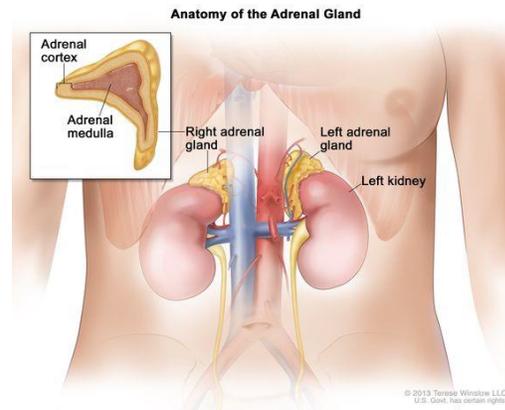
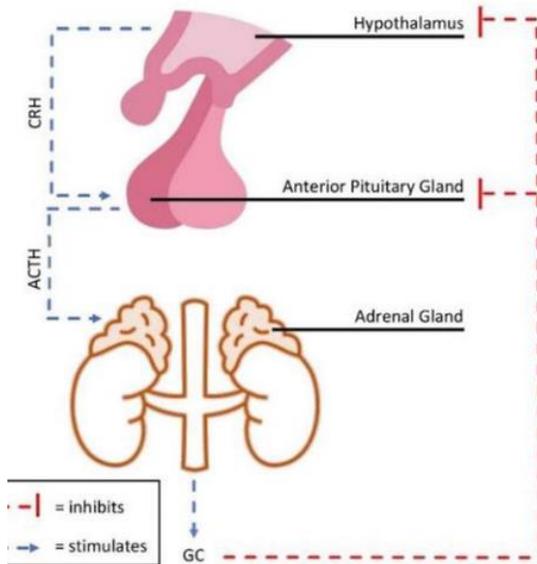
- The **adrenal medulla** is located inside the adrenal cortex in the center of an adrenal gland. It produces “stress hormones,” including adrenaline.
- Outer Cortex:
 - The outer cortex is made up of glandular tissue and is divided into three distinct zones: the zona glomerulosa, the zona fasciculata, and the zona reticularis.
 - **Zona Glomerulosa:** This region secretes mineralocorticoids, primarily aldosterone, which are involved in regulating electrolyte balance and blood pressure by acting on the kidneys.
 - **Zona Fasciculata:** This zone produces glucocorticoids, such as cortisol, which regulate metabolism, immune response, and stress response.
 - **Zona Reticularis:** It synthesizes and secretes androgens, including dehydroepiandrosterone (DHEA), which serve as precursors for sex hormones like testosterone and estrogen.

The adrenal cortex and adrenal medulla are enveloped in an **adipose capsule** that forms a protective layer around an adrenal gland.



Regulation of Adrenal Hormone Secretion:

- The secretion of hormones from the adrenal cortex is primarily regulated by the hypothalamic-pituitary-adrenal (HPA) axis.
- In response to stress or low blood sugar levels, the hypothalamus releases corticotropin releasing hormone (CRH), which stimulates the pituitary gland to release adrenocorticotropic hormone (ACTH).
- ACTH then stimulates the adrenal cortex to produce and release cortisol into the bloodstream. Cortisol, in turn, negatively regulates the production of CRH and ACTH through a negative feedback loop.



Adrenal Medullary Hormones: The adrenal medulla, a crucial part of the adrenal glands, synthesizes and secretes catecholamines derived from the amino acid tyrosine. The primary catecholamines released are adrenaline (epinephrine) and noradrenaline (norepinephrine), with a smaller amount of dopamine also produced.

Types and Secretion:

1. Adrenaline (Epinephrine): Accounts for approximately 80% of the total secretion of catecholamines from the adrenal medulla.
2. Noradrenaline (Norepinephrine): Constitutes around 20% of the catecholamine secretion.
3. Dopamine: Present in smaller quantities compared to adrenaline and noradrenaline.

Release Mechanism:

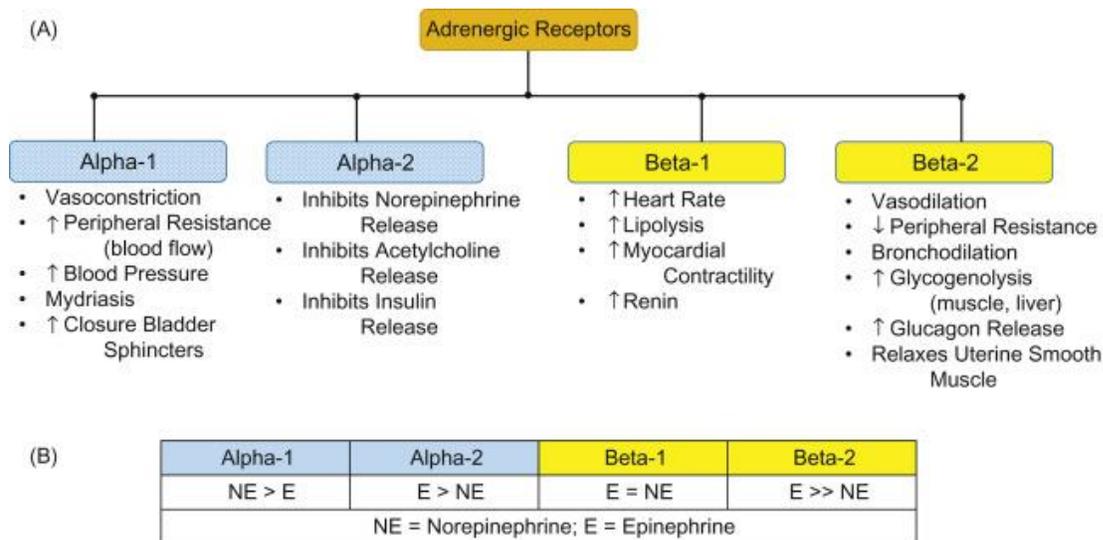
- These hormones are released from specialized cells called chromaffin cells within the adrenal medulla.
- Upon stimulation, the chromaffin cells release adrenaline and noradrenaline directly into the bloodstream.

Physiological Effects:

- The secretion of adrenaline and noradrenaline elicits various physiological responses in the body.

Functional Differences:

- Epinephrine (Adrenaline): Epinephrine is known for its potent stimulatory effects on the heart and metabolic activities. It increases heart rate, cardiac output, and metabolic rate, preparing the body for "fight or flight" responses to stress.
- Norepinephrine (Noradrenaline): Norepinephrine primarily influences peripheral vasoconstriction and regulation of blood pressure. It constricts blood vessels, thereby increasing peripheral resistance and raising blood pressure.



Effect of Catecholamines on Blood Sugar and Heart rate

Procedure

This experiment may be carried out by making sequential determinations of blood sugar in rats. Six rats can be used, each weighing 150-200 grams. The animals are fasted for 24 hours and then orally administered 600 mg of glucose per 100 grams of body weight. Two hours after glucose treatment, inject the animals as follows:

2 rats: Control group receiving 0.2 saline

2 rats: Epinephrine at 0.04 $\mu\text{g}/100\text{ gm}$ in saline subcutaneously

Each group will be assigned a time interval during which blood samples are withdrawn for glucose determination:

15 minutes, 30 minutes, 60 minutes, 90 minutes, 120 minutes

Stress and the Adrenal Gland

