

Fight-or-Flight and Stress Hormones

A comprehensive overview of the Adrenal Gland's anatomy, distinct hormonal zones, and rapid physiological emergency responses.

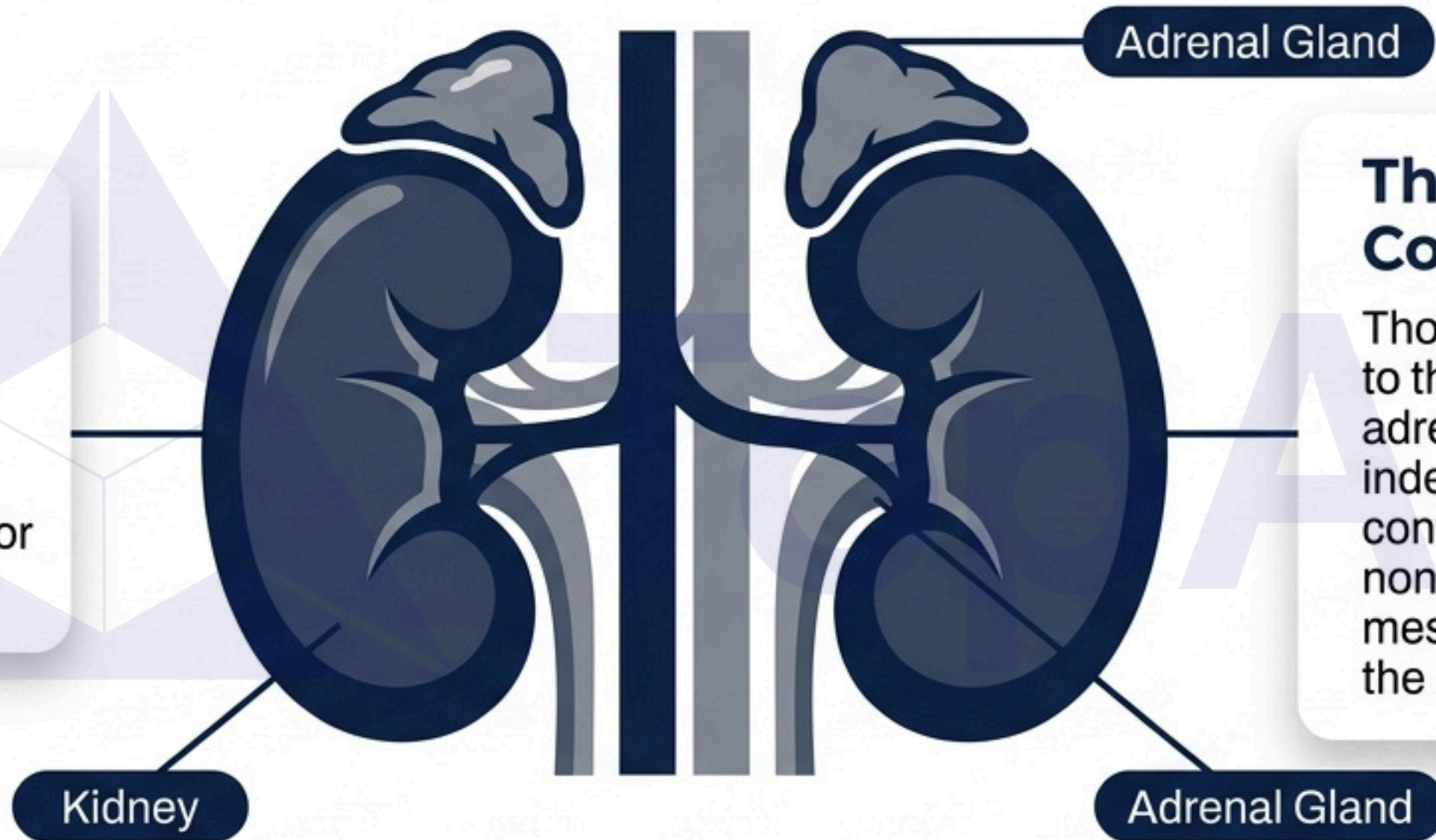
Chapter 19.2.7

Endocrine System

Anatomical Positioning

Bilateral Placement

Our body possesses one pair of adrenal glands, with one situated directly above the anterior-superior aspect of each kidney.



The Renal Connection

Though physically attached to the kidneys, the adrenal glands function as independent endocrine control centers, releasing non-nutrient chemical messengers directly into the bloodstream.

Note

This unique positioning allows specific hormones like aldosterone immediate physical proximity to their primary target tissue: the renal tubules of the kidney.

Dual Tissues: Cortex vs. Medulla

The adrenal gland is functionally two distinct glands merged into a single organ structure.

Adrenal Cortex

Location: Outer layer.

Structure: Comprises three distinct layers (zona reticularis, zona fasciculata, zona glomerulosa).

Hormone Class: Corticoids.

Key Actors: cortisol (glucocorticoid), aldosterone (mineralocorticoid), androgenic steroids.

Function: Long-term metabolic regulation, water/electrolyte balance (Na^+ , K^+), and immune suppression.

Adrenal Medulla

Location: Centrally located inner core.

Hormone Class: Catecholamines.

Key Actors: adrenaline / epinephrine, noradrenaline / norepinephrine.

Function: Rapid, acute response to physical or psychological stress (Fight-or-Flight).



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Adrenaline / Epinephrine

The primary architect of the acute stress response. It forces the body into a state of hyper-arousal to survive immediate threats.



Cardiac Output

Rapidly increases both the heart rate and the absolute strength of heart muscle contractions.



Respiration

Dilates airways and aggressively increases the rate of respiration to hyper-oxygenate the blood.

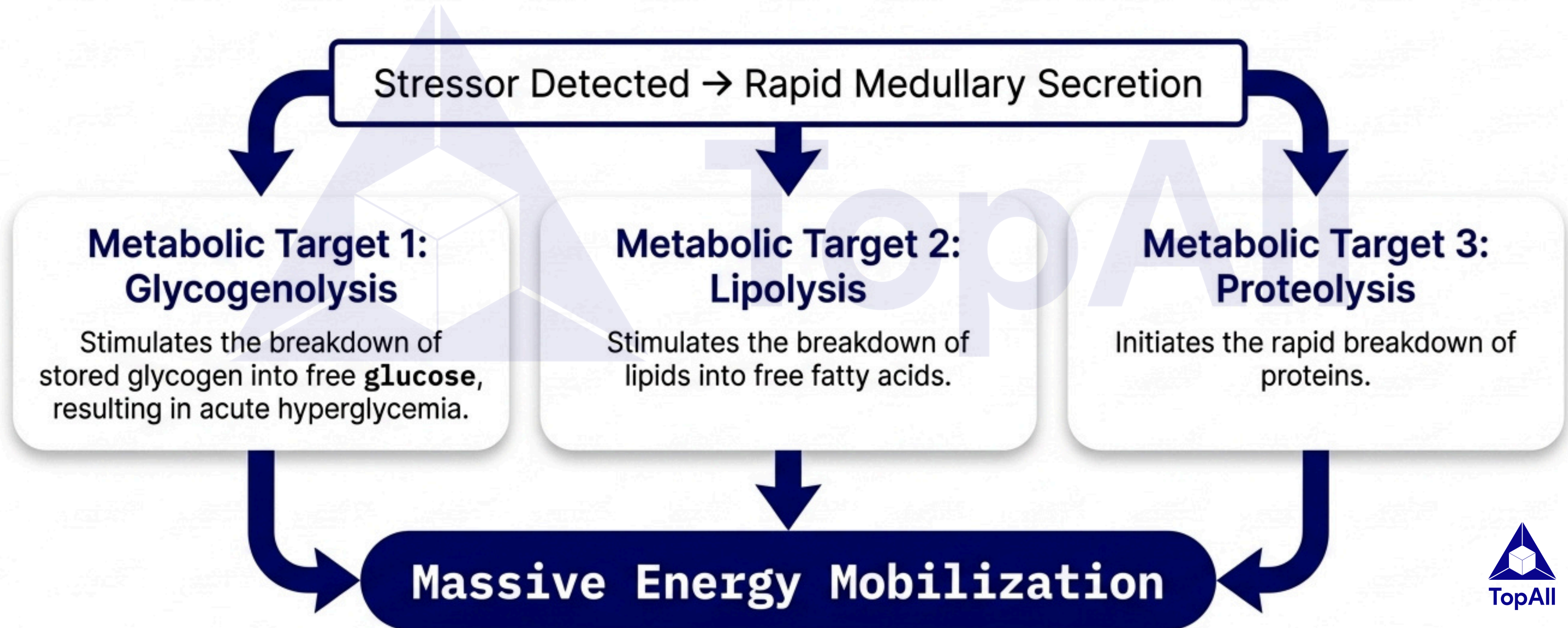


Sensory Alertness

Triggers rapid pupillary dilation for enhanced vision, profuse sweating, and piloerection (raising of body hairs).

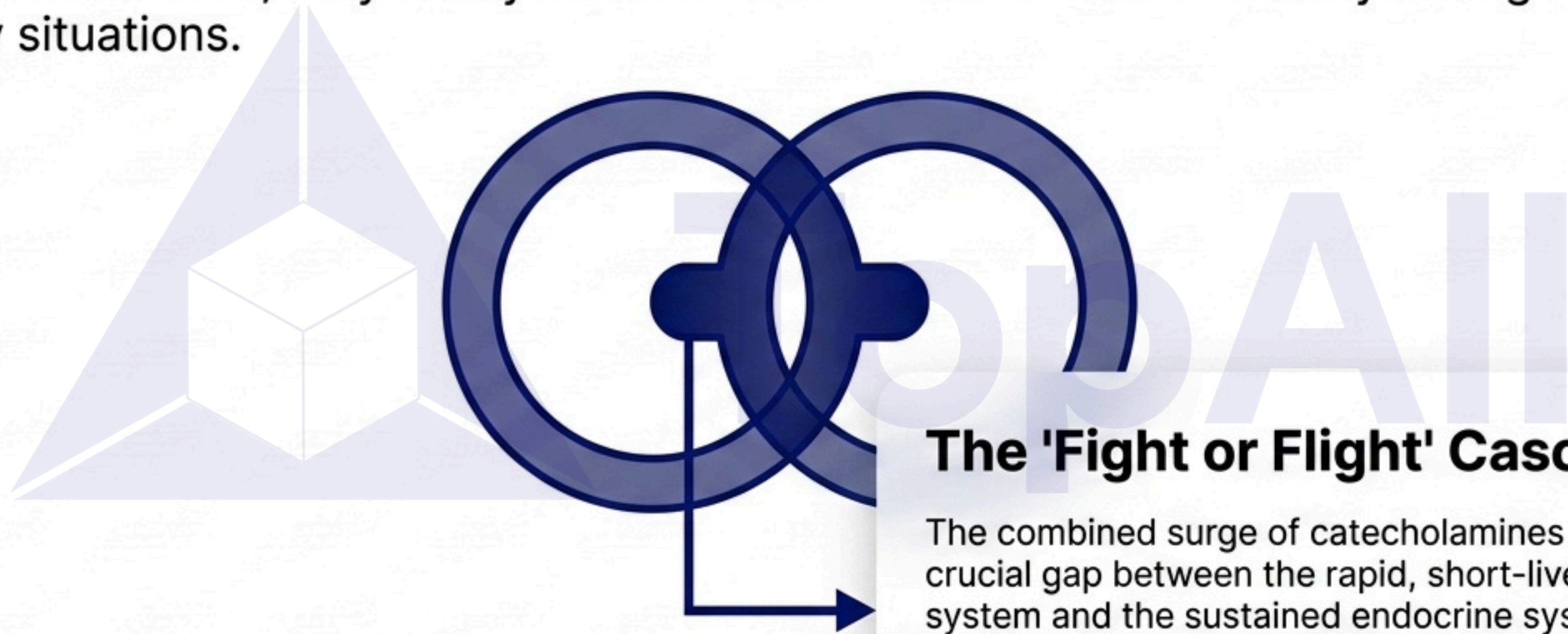
Noradrenaline / Norepinephrine

Working in tandem with epinephrine, this hormone guarantees the body has the metabolic fuel necessary to sustain the fight-or-flight response.



Catecholamines: The Emergency Hormones

epinephrine and norepinephrine are collectively classified as catecholamines. They do not operate in isolation; they are synthesized and secreted simultaneously during emergency situations.



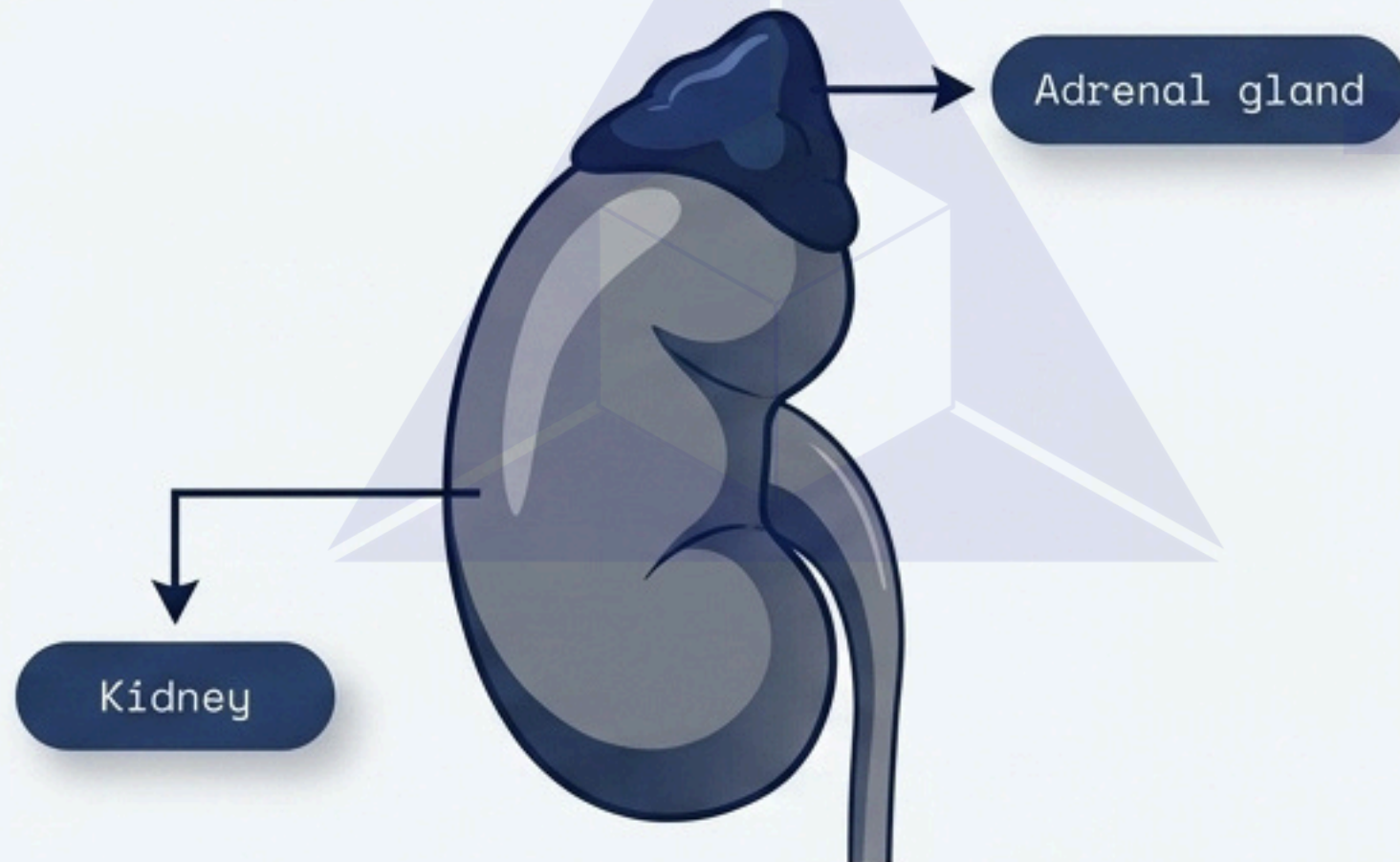
The 'Fight or Flight' Cascade

The combined surge of catecholamines bridges the crucial gap between the rapid, short-lived neural system and the sustained endocrine system. By simultaneously amplifying cardiovascular output and aggressively mobilizing cellular glucose, they transform a resting organism into an optimized survival machine in a matter of seconds.

Anatomy of the Adrenal Gland

A diagrammatic representation of macro organ positioning and internal tissue segregation.

Left Graphic Panel (Macro)



Right Graphic Panel (Micro)

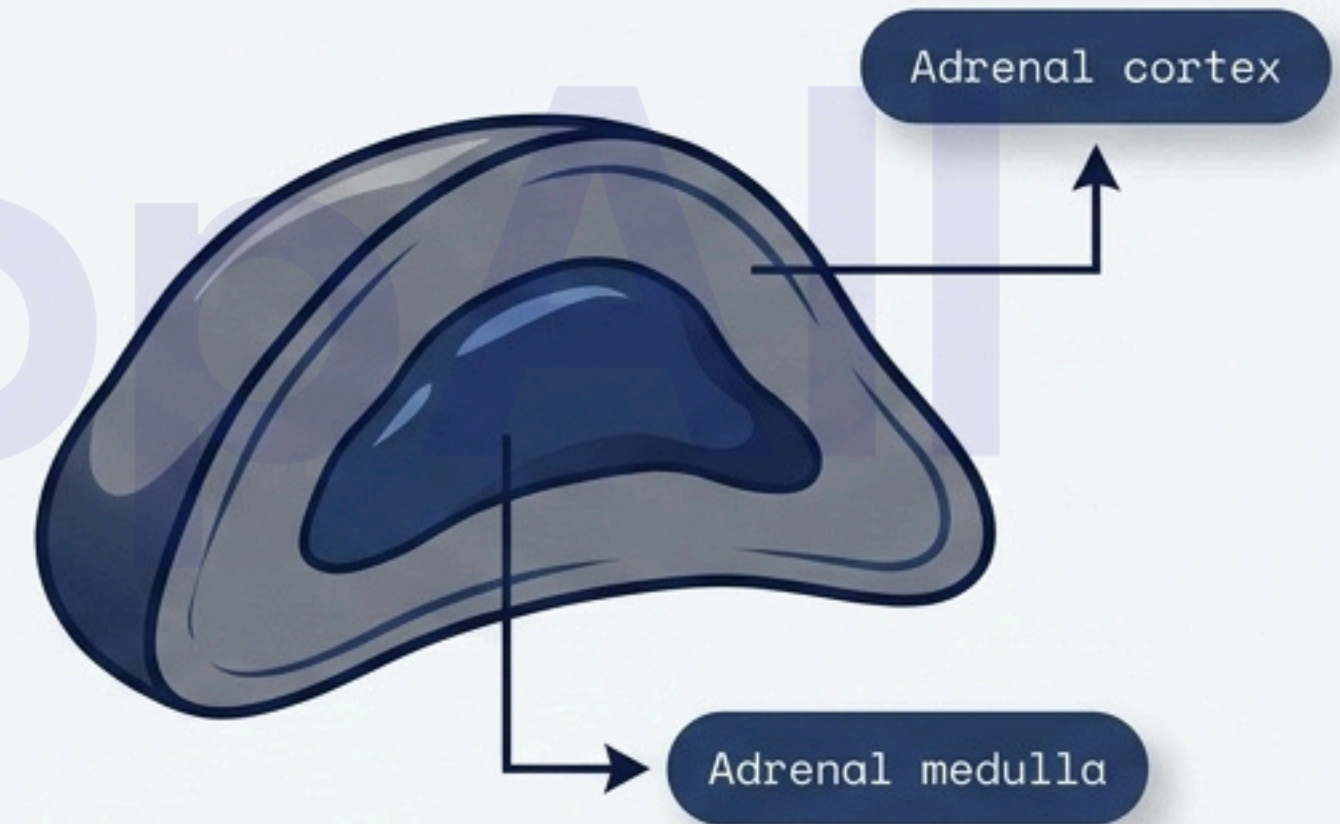


Figure 19.4: Diagrammatic representation of (a) Adrenal gland above kidney
(b) Section showing two parts of adrenal gland.

Key Takeaways & Clinical Impact

A Dual-Function Center

The adrenal gland acts as two distinct regulatory centers. The inner medulla rapidly deploys catecholamines (epinephrine / norepinephrine) to survive immediate stress (Fight-or-Flight). The outer cortex deploys corticoids (cortisol / aldosterone) to manage long-term carbohydrate metabolism, fluid volume, and Na^+/K^+ electrolyte balance.

Clinical Pathology: Addison's Disease

Underproduction of hormones by the adrenal cortex severely alters carbohydrate metabolism. This critical failure results in acute, chronic weakness and fatigue, manifesting clinically as Addison's disease.



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