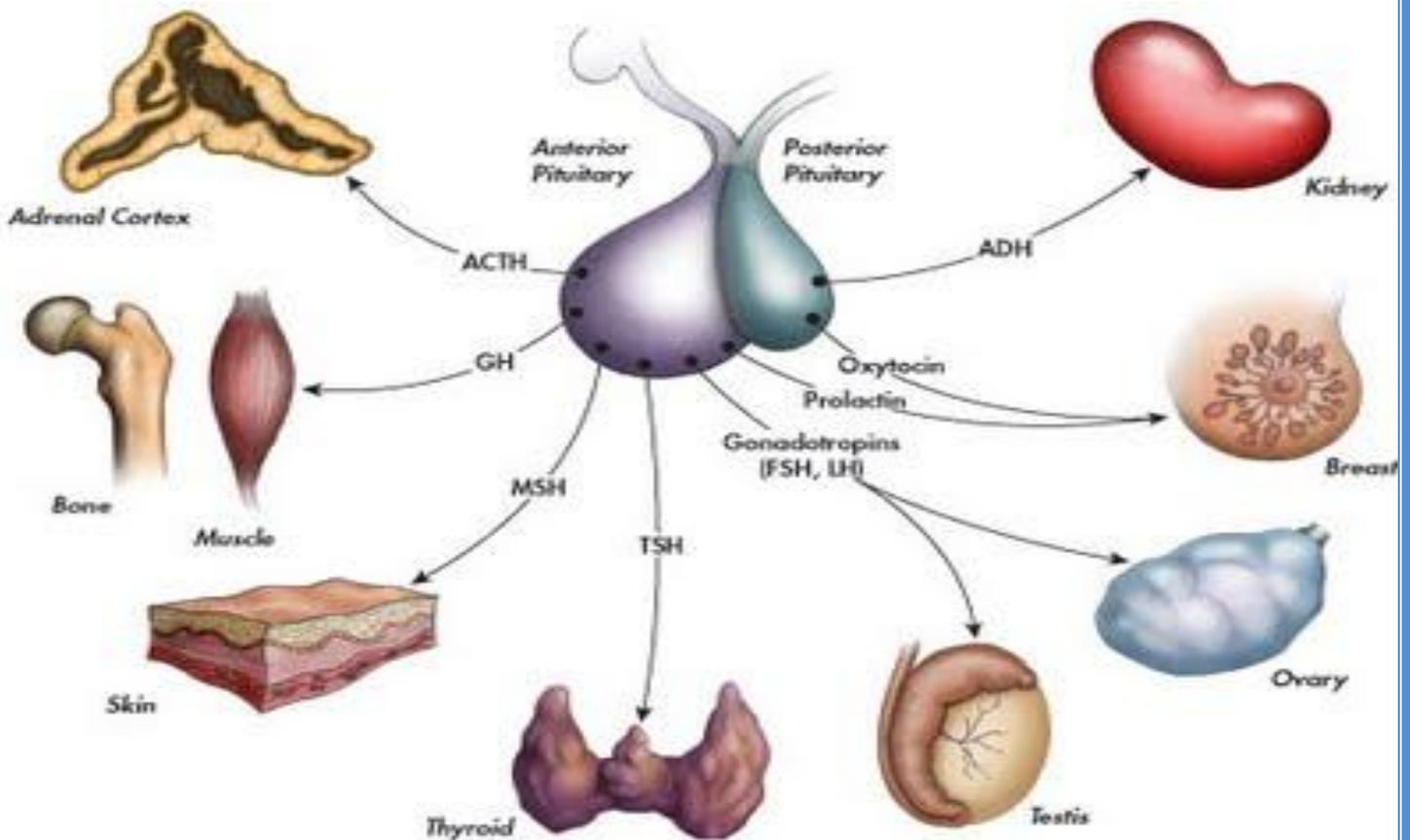


## 13<sup>th</sup> Lecture

# Adrenal Medulla & Pheochromocytoma



### PHYSIOLOGY TEAM - 430

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## Adrenal Medulla

- **Introduction:**

- 10-20% of the adrenal gland
- Made up of chromaffin cells that secrete epinephrine and norepinephrine
- Formed from neural ectoderm
- Can be considered a modified sympathetic ganglion
- Produces epinephrine 80%
- Produces norepinephrine 20%
- Neural stimulation of the cholinergic preganglionic fibers that innervate the chromaffin cells triggers the secretion of catecholamines.
- Stimuli such as injury, anger, anxiety, pain, cold, strenuous exercise, and hypoglycemia generate impulses in these fibers causing rapid release of catecholamines.

- **Adrenergic Receptors**

- **Alpha-Adrenergic Receptors**

- ✓  $\alpha_1$ : vasoconstriction, intestinal relaxation, uterine contraction, pupillary dilation
- ✓  $\alpha_2$ : platelet aggregation, vasoconstriction, ↓ insulin secretion

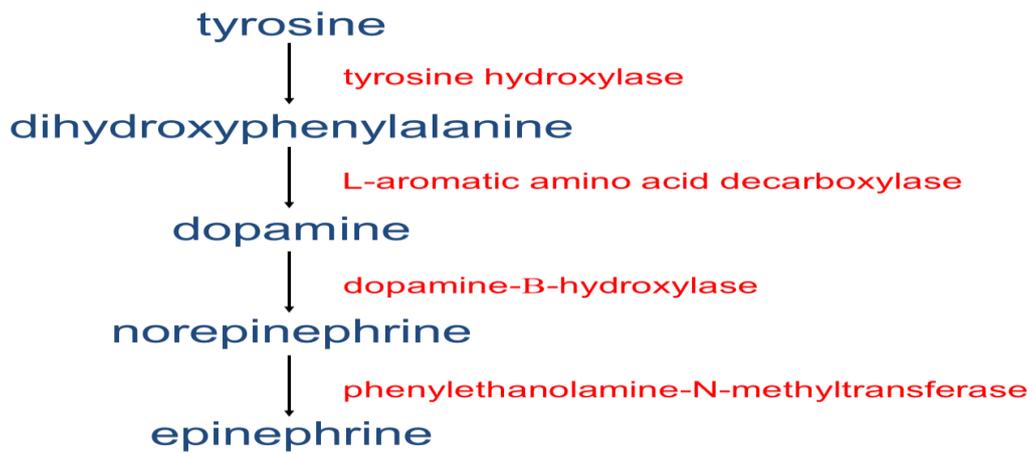
- **Beta-Adrenergic Receptors**

- ✓  $\beta_1$ : ↑ HR/contractility, ↑ lipolysis, ↑ renin secretion
- ✓  $\beta_2$ : vasodilation, bronchodilation, ↑ glycogenolysis
- ✓  $\beta_3$ : ↑ lipolysis, ↑ brown fat thermogenesis

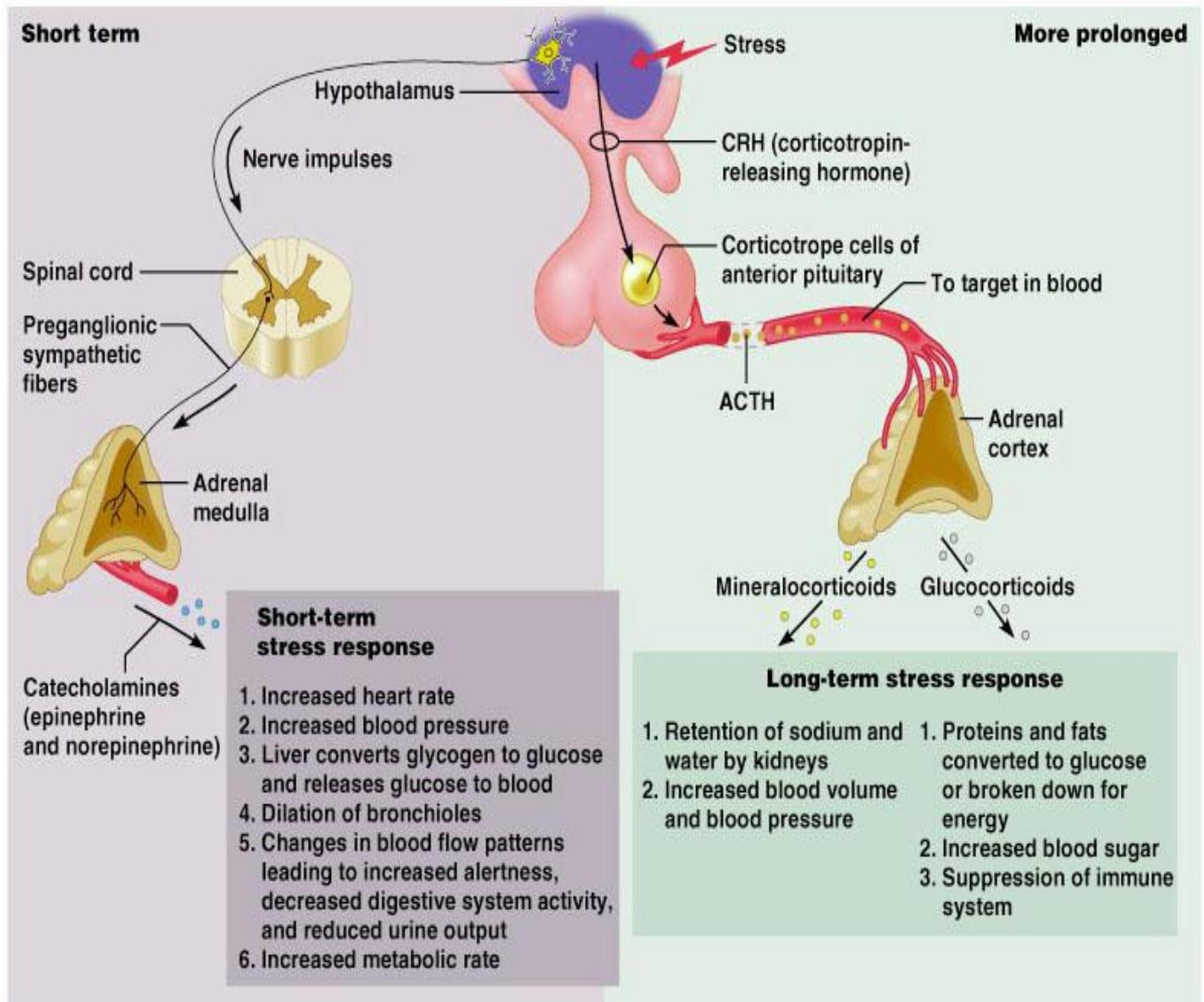
- **Fight or Flight Response**

- ✓ In response to a sudden rise of plasma catecholamines levels, heart rate increases, coronary blood vessels dilate, and blood flow to muscles increases due to dilatation, smooth muscle in the airways, GI tract, and urinary bladder relax. Muscles in hair follicles contract causing piloerection. Blood glucose levels rise.
- ✓ Catecholamines act on liver and skeletal muscle to stimulate glucose production by activating glycogen hydrolysis and/or gluconeogenesis.
- ✓ They act on adipose tissue to stimulate hormone-sensitive lipase causing hydrolysis of triglycerides and the release of free fatty acids and glycerol

- **Catecholamine Synthesis:**



- **Stress and the Adrenal Gland**



- **Effect of catecholamines during stress (Alarm reaction - immediate)**

- 1) Increased hepatic and muscle glycogenolysis
- 2) Increased breakdown of adipose tissue - lipolysis
- 3) Blockade of insulin
- 4) Increased cardiac output (increased contractility, heart rate)
- 5) Shunting blood from visceral to skeletal muscles by means of vasoconstriction in visceral and vasodilatation in skeletal
- 6) Increased ventilation
- 7) Decreased fatigue of skeletal muscle
- 8) Increased coagulability of blood

- **Effect of cortisol during stress**

- 1) stimulates gluconeogenesis
  - 2) stimulates protein catabolism
  - 3) vascular effect – sensibilization of vessels to the effect of norepinephrine - vasoconstriction
  - 4) Effect on memory – ACTH facilitates learning and memory in experimental animals – helps to cope with the stress
- ✓ N.B long-lasting stress impairs learning
  - ✓ Cortisol damages neurons in hippocampus

- **Pheochromocytoma:**

- Catecholamine-producing neuroendocrine tumor that arises from chromaffin cells
- **Adrenal Medulla:**
  - ✓ 80-85% of pheochromocytomas
- **Extra-adrenal paragangliomas :**
  - ✓ Often in head and neck and rarely produce catecholamines.
  - ✓ Some can be dopamine producing.

- **Clinical Presentation:**

- Skin sensations - Flank pain - Elevated heart rate - Hyperglycemia
- Elevated blood pressure, including paroxysmal (sporadic, episodic) high blood pressure, which sometimes can be more difficult to detect; another clue to the presence of pheochromocytoma is orthostatic hypotension (a fall in systolic blood pressure greater than 20 mmHg or a fall in diastolic blood pressure greater than 10 mmHg upon standing)
- Palpitations - Anxiety often resembling that of a panic attack
- Diaphoresis (excessive sweating) – Headaches – Pallor - Weight loss

- **Epidemiology:**

- 1 in 100,000 each year
- Patients with hypertension
- In adults – 0.1-0.6%
- In children – 1%
- Traditional rule of 10
- 10% bilateral, 10% familial, 10% extra-adrenal, and 10% malignant.

- **Epidemiology – Pediatrics:**

- 1 in 500,000
- 10-20% of all tumors reported are found in children.
- Majority are adrenal in origin.
- Usually present between ages 6-14 yrs.
- 2:1 male to female ratio often reported.

- **Testing:**

- **Blood Tests:** analysis of free metanephrine in blood plasma. High levels are indicative of pheochromocytoma
- **Urine Tests:** Although this test is slightly less effective than plasma testing it is still considered highly effective in diagnosis.

**Metanephrine:**

A metabolite of epinephrine excreted in urine and found in certain tissues

- **Treatment:**

- Surgical resection of the tumor is the treatment of choice and usually results in cure of the hypertension.
- Careful treatment with alpha and beta blockers is required pre-operatively to control blood pressure and prevent intra-operative hypertensive crises