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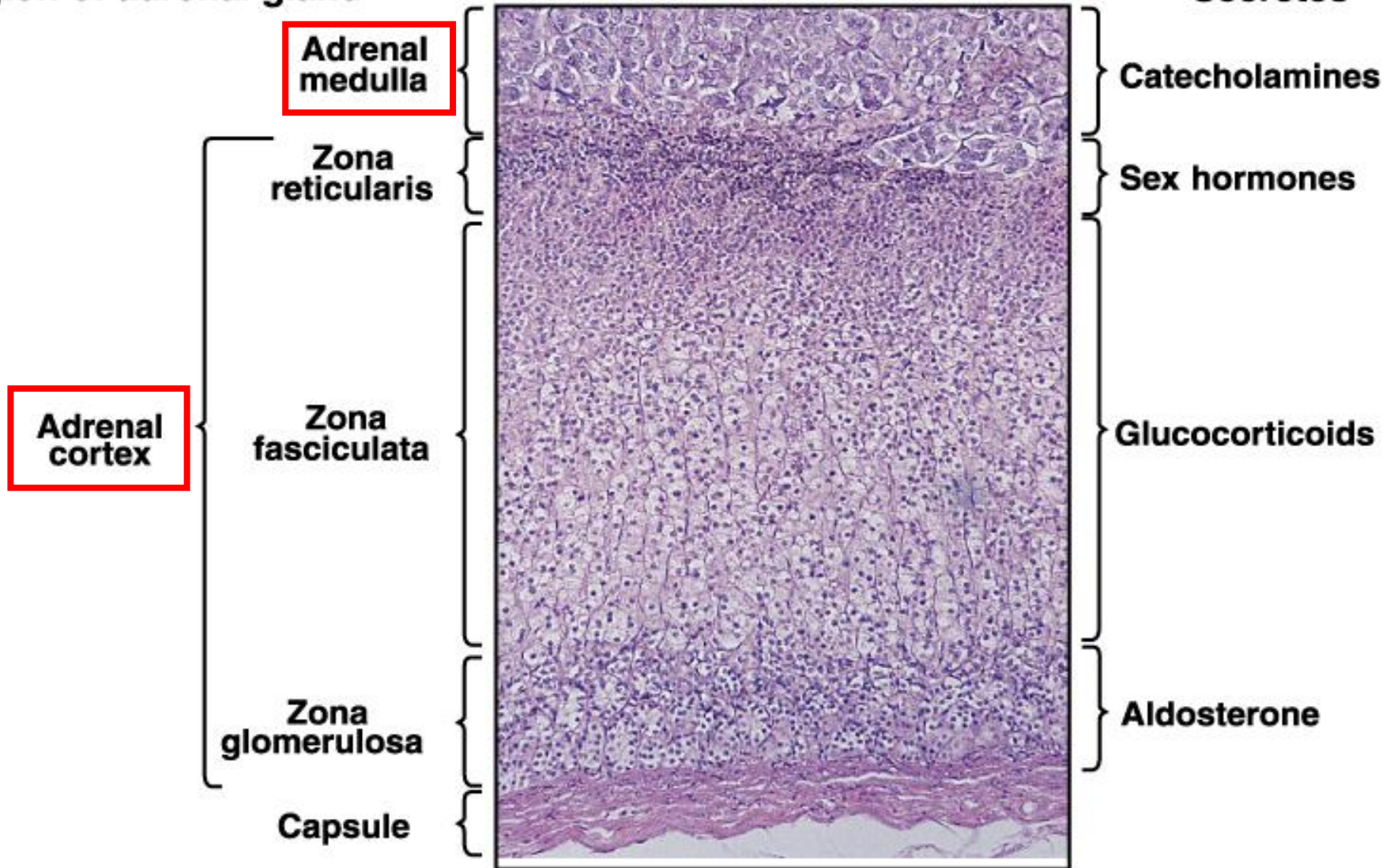
# Adrenal Medulla

# Learning outcomes

After reviewing the PowerPoint presentation, lecture notes and associated material, the student should be able to:

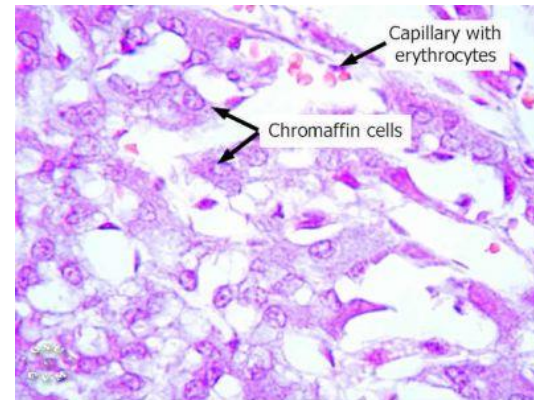
- **Summarize the actions of adrenal androgens.**
- **Describe the causes and major manifestations of hyperadrenocorticism and Hypoadrenocorticism**
- **Describe circumstances in which catecholamines are released from the adrenal gland.**
- **List the major actions of catecholamines.**

**Region of adrenal gland**



# Adrenal medulla

- The adrenal medulla is the inner part or core of each adrenal gland.
- It is considered as part of sympathetic nervous system.
- It secretes catecholamines:
  - Adrenaline (epinephrine) -- 80% of the secretion.
  - Noradrenaline (norepinephrine) -- 20 % of the secretion.
  - small amount of dopamine
- They are released from **chromaffin cells**



# Adrenal medulla

● Secretion of these hormones causes:

Blood to be diverted to the brain, heart, and skeletal muscle

● Epinephrine is the more potent stimulator of the heart and metabolic activities

● Norepinephrine is more influential on peripheral vasoconstriction and blood pressure

# **Role of the adrenal medullary hormones**

- 1. Enhance the effects of the sympathetic nervous system.**
- 2. Prepare the body for a stressful event.**

**The response is known as the “fight or flight” response.**

# Effects of Catecholamines

- 1- Glycogenolysis in liver and skeletal muscle (can lead to hyperglycemia) which increases blood glucose level
- 2- Increase heart rate and blood pressure
- 3- Cause vasoconstriction of blood vessels
- 4- Mobilization of free fatty acids
- 5- Increase metabolic rate
- 6- Increase O<sub>2</sub> consumption



# Actions of adrenal medullary hormones

Typical Responses to stimulation of the adrenal medulla		
Target	Responses	Receptor
<b>Cardiovascular system</b>		
Heart	<ul style="list-style-type: none"> <li>↑ Frequency and rate of contraction</li> <li>↑ Conduction</li> <li>↑ Blood flow (dilation of coronary arterioles)</li> <li>↑ Glycogenolysis</li> </ul>	<ul style="list-style-type: none"> <li><math>\beta</math></li> <li><math>\beta</math></li> <li><math>\alpha</math></li> </ul>
Arterioles		
<i>Skin</i>	Constriction	$\alpha$
<i>Mucosae</i>	Constriction	$\alpha$
<i>Skeletal muscle</i>	Constriction	$\alpha$
	Dilation	$\beta$
<b>Metabolism</b>		
Fat	↑ Lipolysis	$\beta$
	↑ Blood FFA and glycerol	$\beta$
Liver	<ul style="list-style-type: none"> <li>↑ Glycogenolysis and gluconeogenesis</li> <li>↑ Blood sugar</li> </ul>	<ul style="list-style-type: none"> <li><math>\beta</math> &amp; <math>\alpha_1</math></li> <li><math>\beta</math> &amp; <math>\alpha_1</math></li> </ul>
Muscle	<ul style="list-style-type: none"> <li>↑ Glycogenolysis</li> <li>↑ Lactate and pyruvate release</li> </ul>	<ul style="list-style-type: none"> <li><math>\beta</math></li> <li><math>\beta</math></li> </ul>

# Actions of adrenal medullary hormones

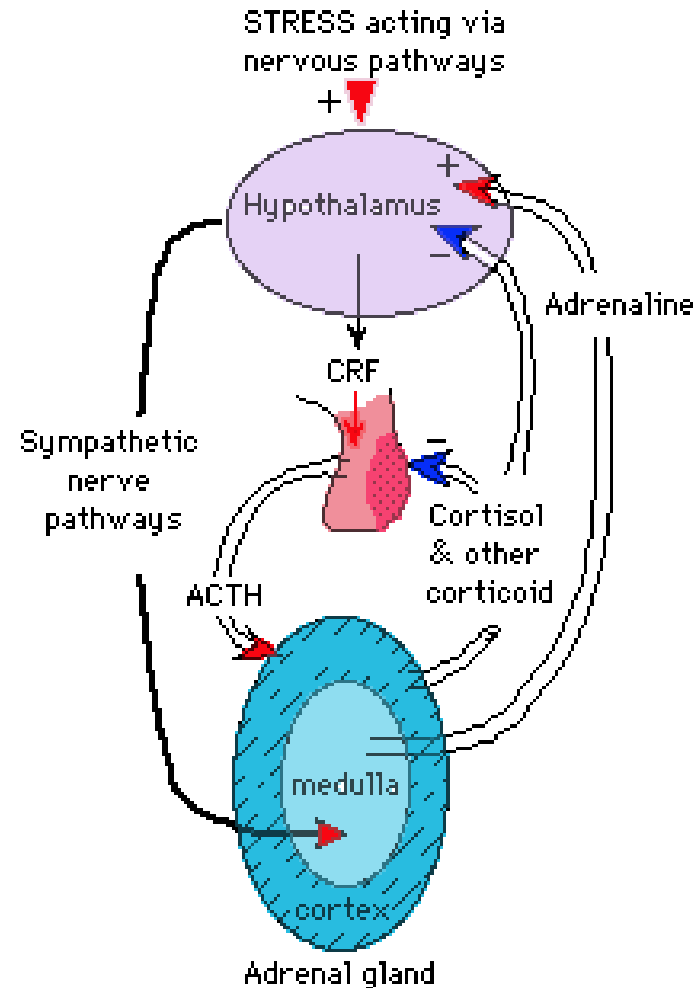
## Typical Responses to stimulation of the adrenal medulla

Target	Responses	Receptor
Bronchial muscle	Relaxation	$\beta$
Stomach and intestines	↓ Motility	$\beta$
	↑ Sphincter contraction	$\alpha$
Urinary bladder	↑ Sphincter contraction	$\alpha$
Skin	↑ Sweating	$\alpha$
Eyes	Contraction of radial muscle of the iris	$\alpha$

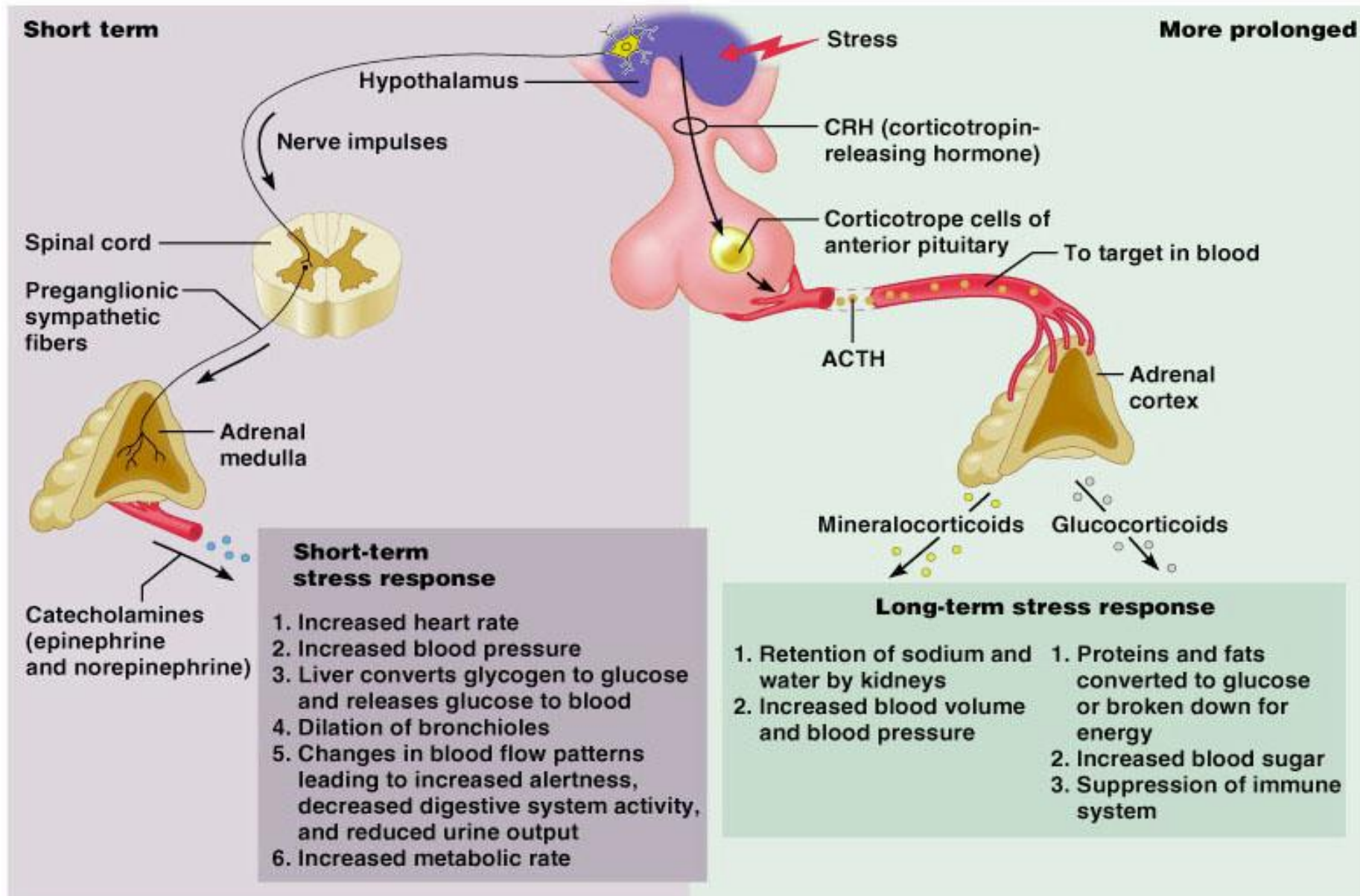
- The effects of the adrenal medullary hormones underlie the role of these hormones in preparation of body for fight or flight.
- The overall effect is to ensue that all requirements for increased muscle activity are available. What are these?

# Control of secretion of adrenal medullary hormones

- The adrenal medulla is innervated by the sympathetic nervous system.
- Adrenal hormones are released from the medulla in response to signals from the sympathetic nervous system.
- The sympathetic nervous system is activated in response to stress also known as the “fight or flight” response. Stress can be physical (exercise), physiological (hypoglycemia, hemorrhage), or emotional,
- Cortisol, when secreted from the adrenal cortex in response to stress, causes release of these hormones from the medulla.

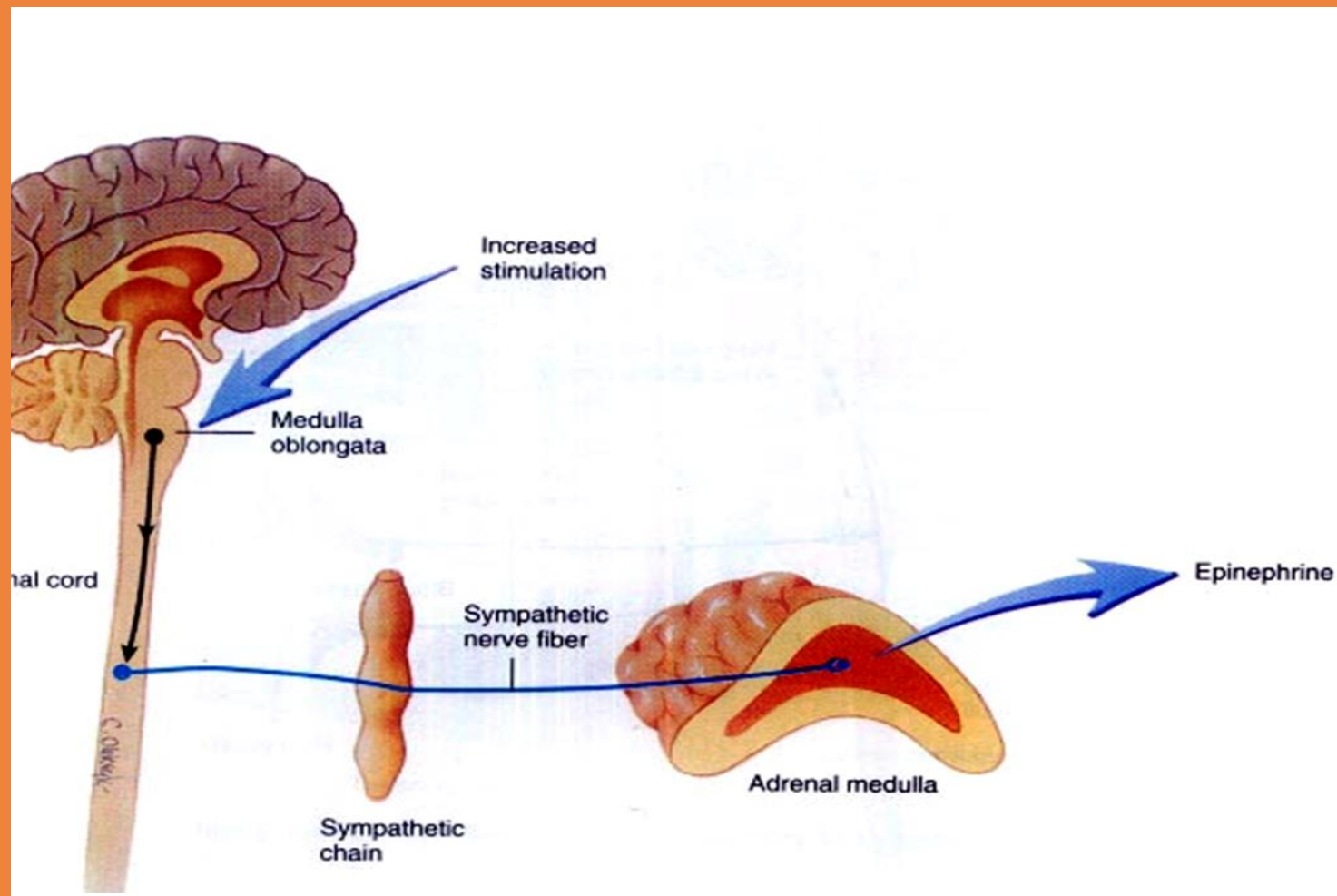


# Stress and the Adrenal Gland



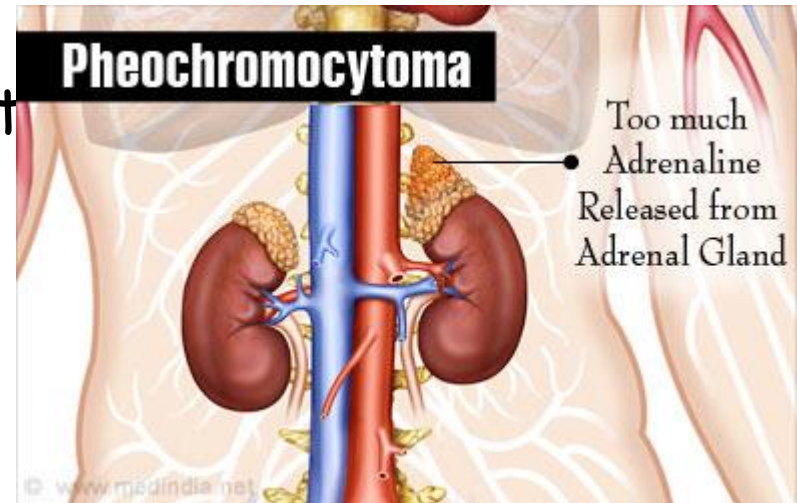
• The adrenal medulla is, functionally , integral part *تعتبر جزء لا يتجزأ* of the sympathetic system .

- 80% of its secretion is Epinephrine ( EP) and 20% of its secretion is Norepinephrine (NE ).
- EP in the bloodstream , on the other hand , comes solely from the adrenal medulla .
- BUT → NE in blood comes from BOTH adrenal medulla and postganglionic sympathetic nerves
- This is because postganglionic sympathetic nerves can not synthesize EP from its precursor NE , because they lack the enzyme ( PNMT) needed for conversion of NE into EP .



# Pheochromocytoma

- Pheochromocytoma is a tumor of adrenal medulla .
- It can be life threatening if not recognized & not treated
- Most often occurs in middle age.
- Symptoms & signs →



**Pheochromocytoma: 3 most common symptoms**

**"PHEochromocytoma"**

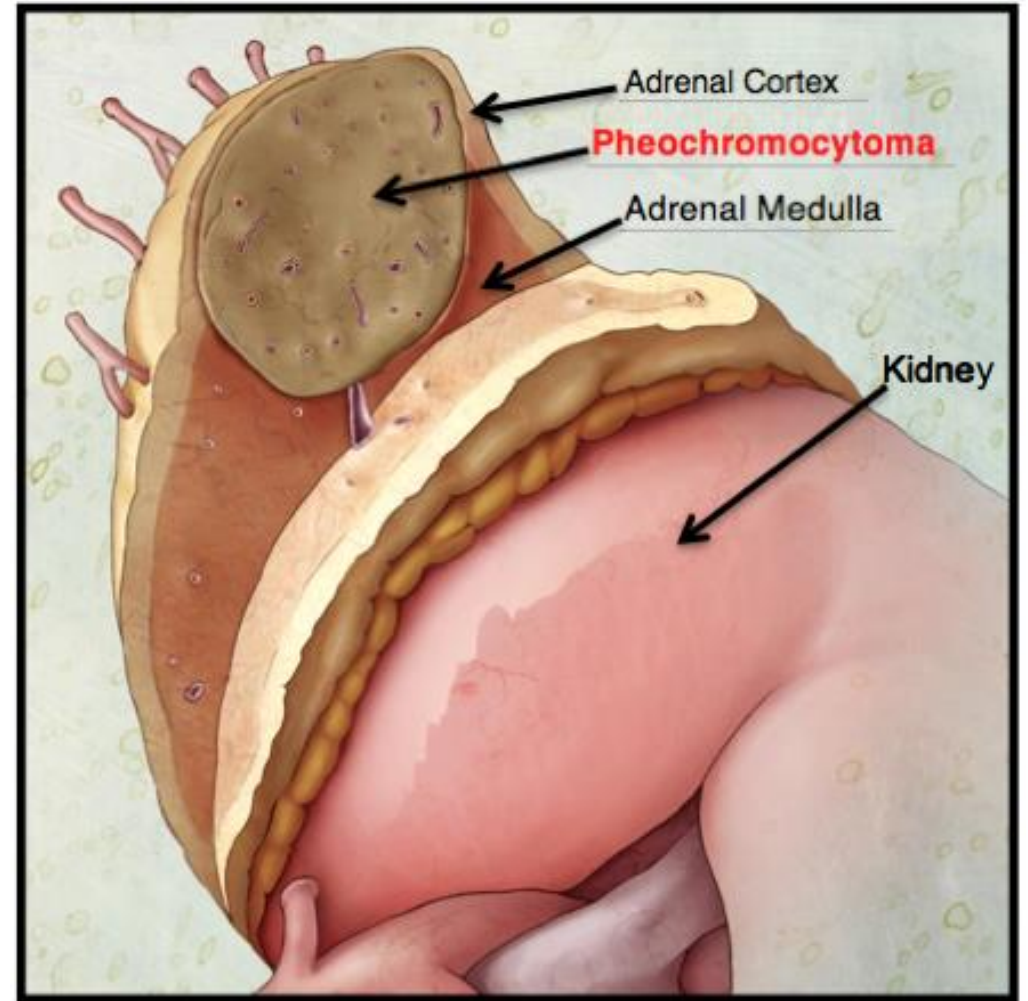
- **P**alpitations
- **H**eadache
- **E**pisodic sweating (diaphoresis)



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# Pheochromocytoma

- Pheochromocytoma is derived from chromaffin cells (arise from neural crest).
- Most tumors secrete epinephrine, NE, and dopamine and can cause episodic hypertension.
- Urinary vanillylmandelic acid, VMA (a breakdown product of norepinephrine) and plasma catecholamines are elevated.
- Associated with neurofibromatosis.



## Signs and Symptoms of Pheochromocytoma

- resistant hypertension (95%)

- headache

- sweating

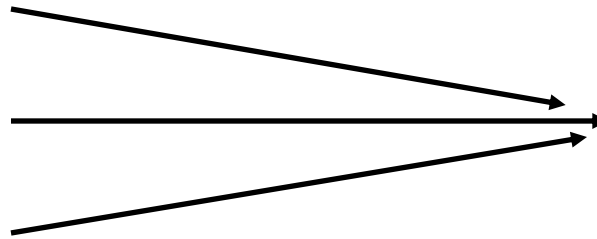
- palpitations

- chest pain

- anxiety

- glucose intolerance

- increased metabolic rate

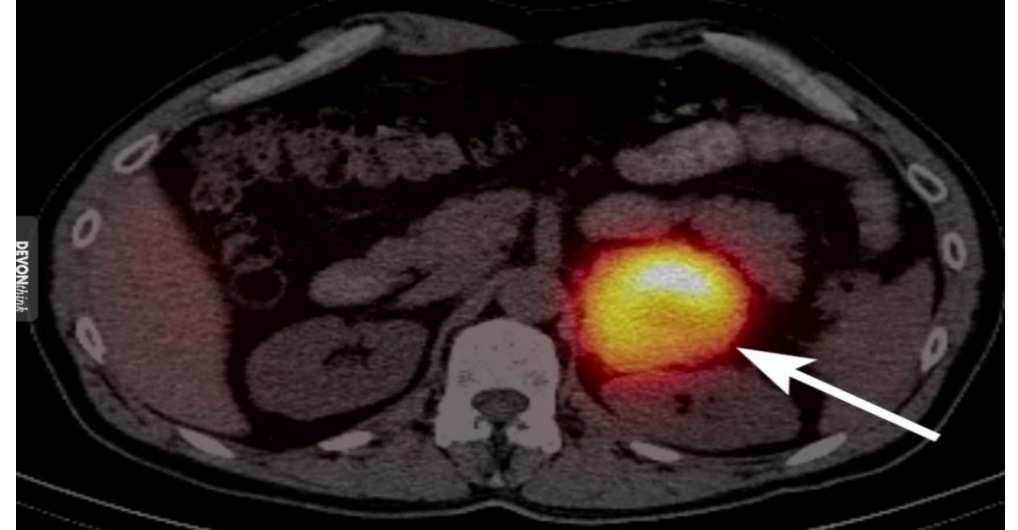


classic triad



## Diagnosis and Treatment

- High plasma catecholamine.
- Increased metabolites [VMA] in urine
- Treatment is surgical resection



**Thank You**