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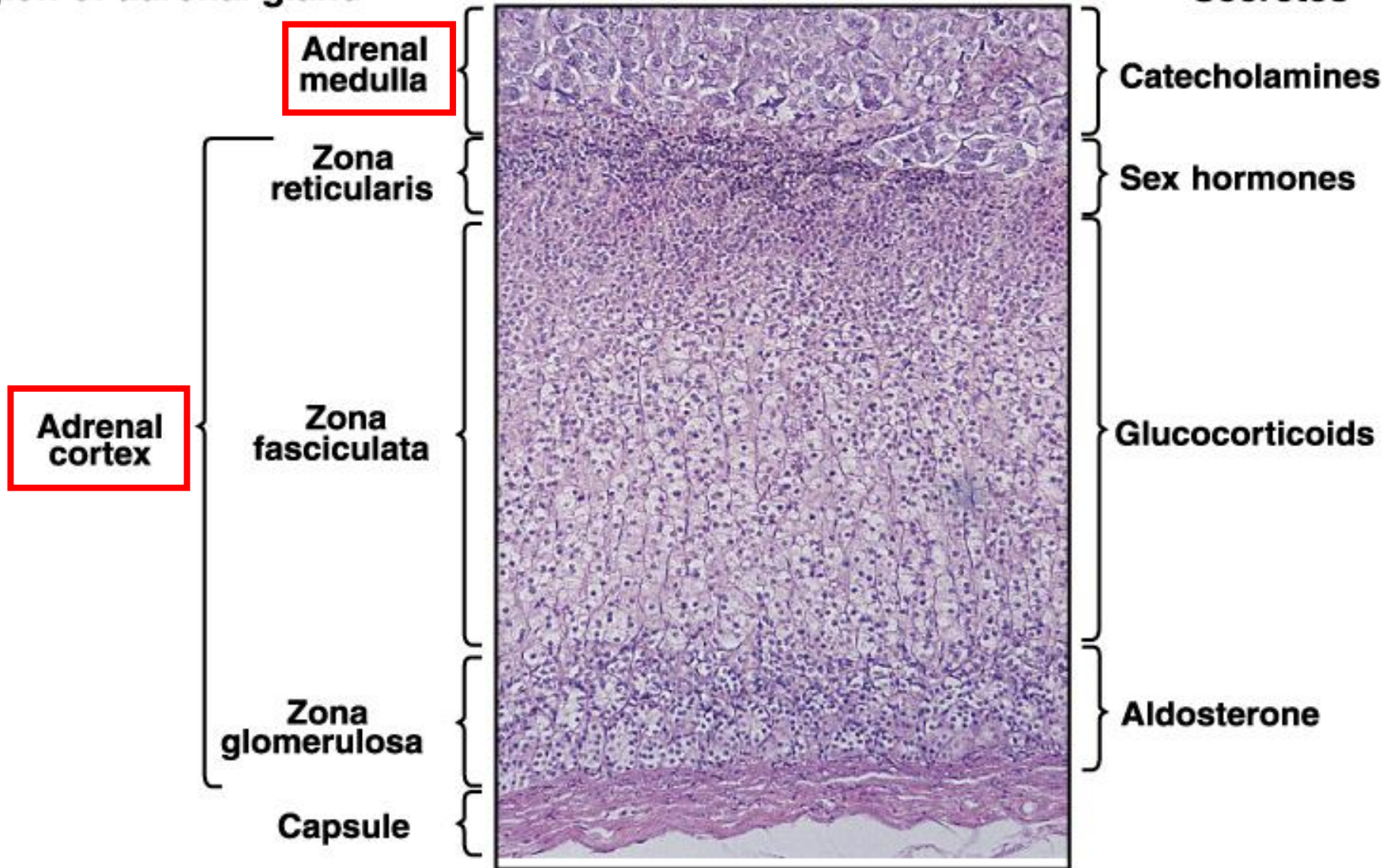
Adrenal Medulla

Learning outcomes

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

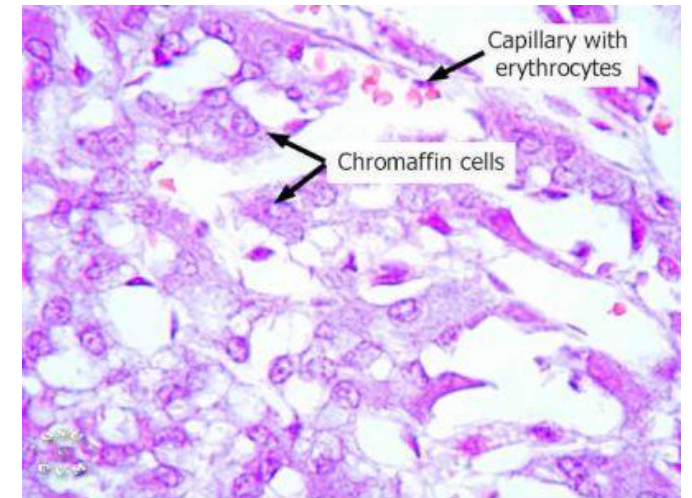
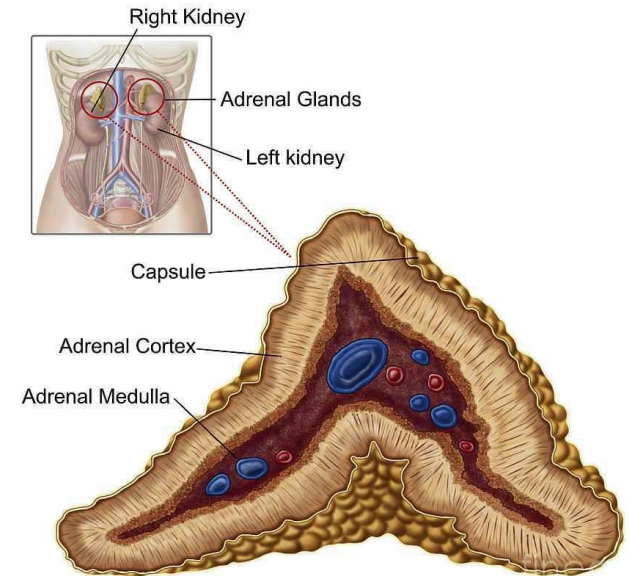
- Summarize the actions of adrenal androgens.
- Describe the causes and major manifestations of hyperadrenocorticism and Hypoadrenocorticism
- Describe circumstances in which catecholamines are released from the adrenal gland.
- List the major actions of catecholamines.

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**



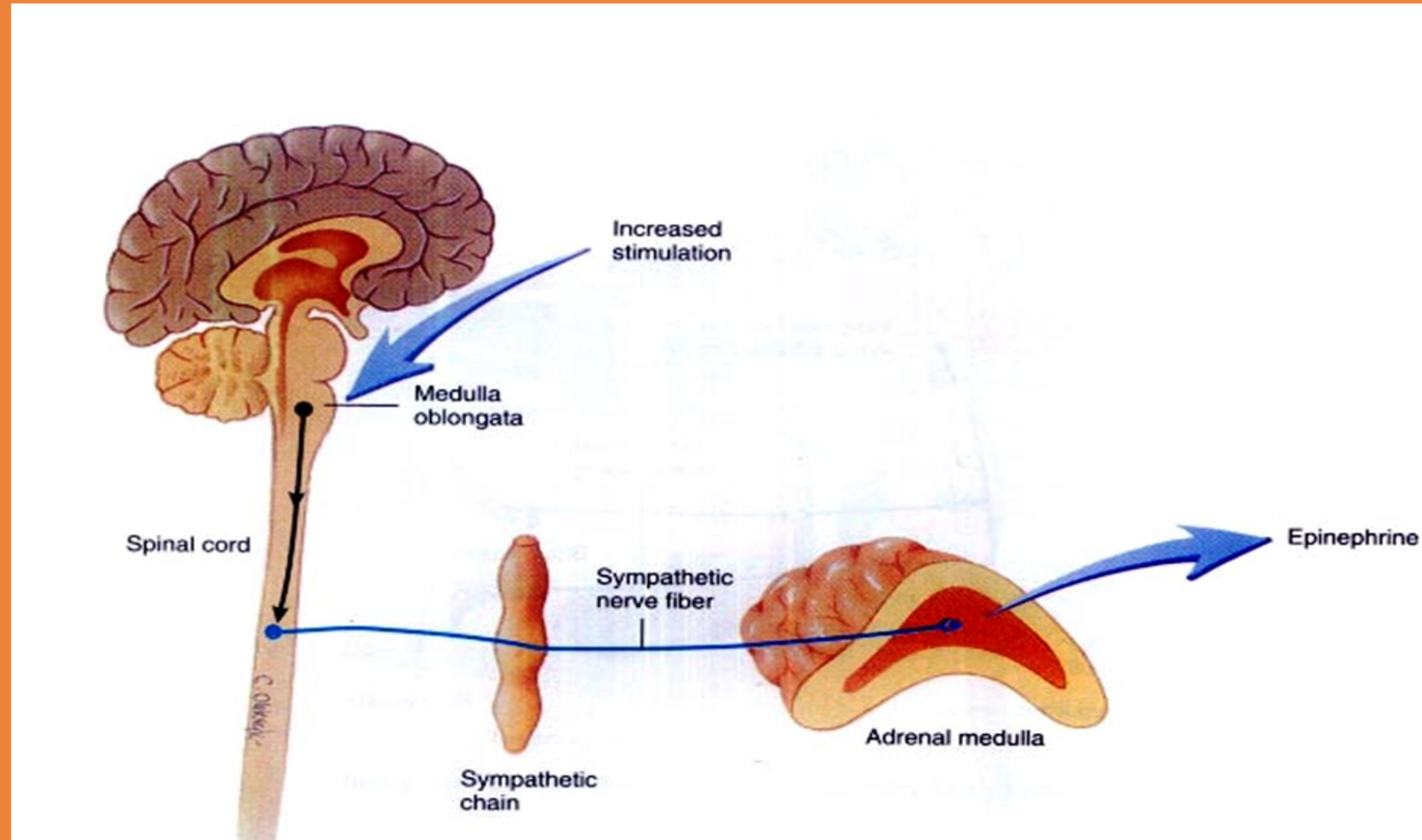
• The adrenal medulla is, functionally , integral part *تعتبر جزء لا يتجزأ* of the sympathetic system .

• 80% of its secretion is Epinephrine (EP) and 20% of its secretion is Norepinephrine (NE).

• EP in the bloodstream comes solely from the adrenal medulla

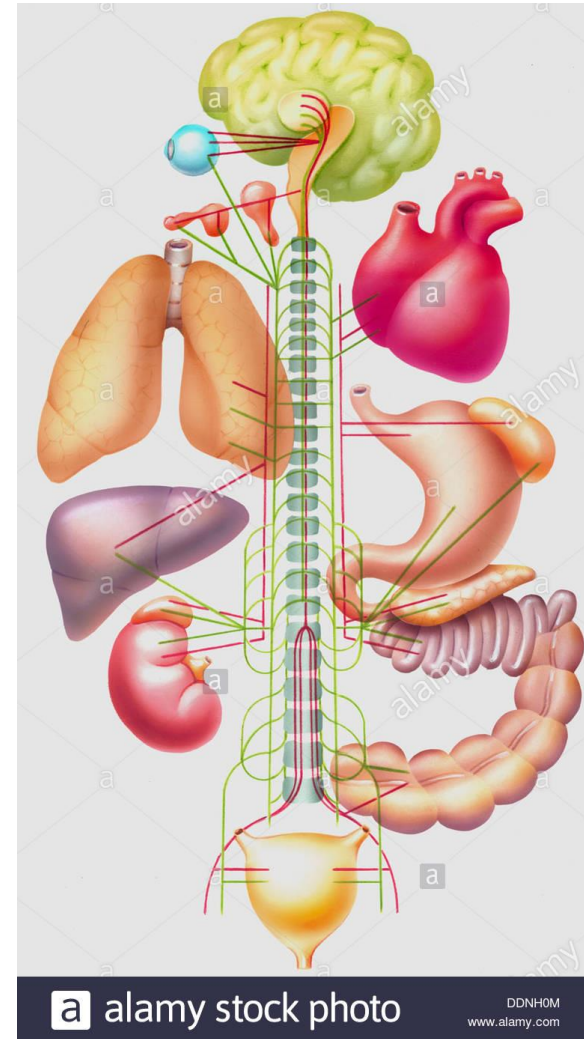
• NE in blood comes from BOTH adrenal medulla and postganglionic sympathetic nerves

• 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 .



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 O₂ consumption

Actions of adrenal medullary hormones

Typical Responses to stimulation of the adrenal medulla		
Target	Responses	Receptor
Cardiovascular system		
Heart	<ul style="list-style-type: none"> ↑ Frequency and rate of contraction ↑ Conduction ↑ Blood flow (dilation of coronary arterioles) ↑ Glycogenolysis 	<ul style="list-style-type: none"> β β α
Arterioles		
<i>Skin</i>	Constriction	α
<i>Mucosae</i>	Constriction	α
<i>Skeletal muscle</i>	Constriction	α
	Dilation	β
Metabolism		
Fat	↑ Lipolysis	β
	↑ Blood FFA and glycerol	β
Liver	<ul style="list-style-type: none"> ↑ Glycogenolysis and gluconeogenesis ↑ Blood sugar 	<ul style="list-style-type: none"> β & α_1 β & α_1
Muscle	<ul style="list-style-type: none"> ↑ Glycogenolysis ↑ Lactate and pyruvate release 	<ul style="list-style-type: none"> β β

Actions of adrenal medullary hormones

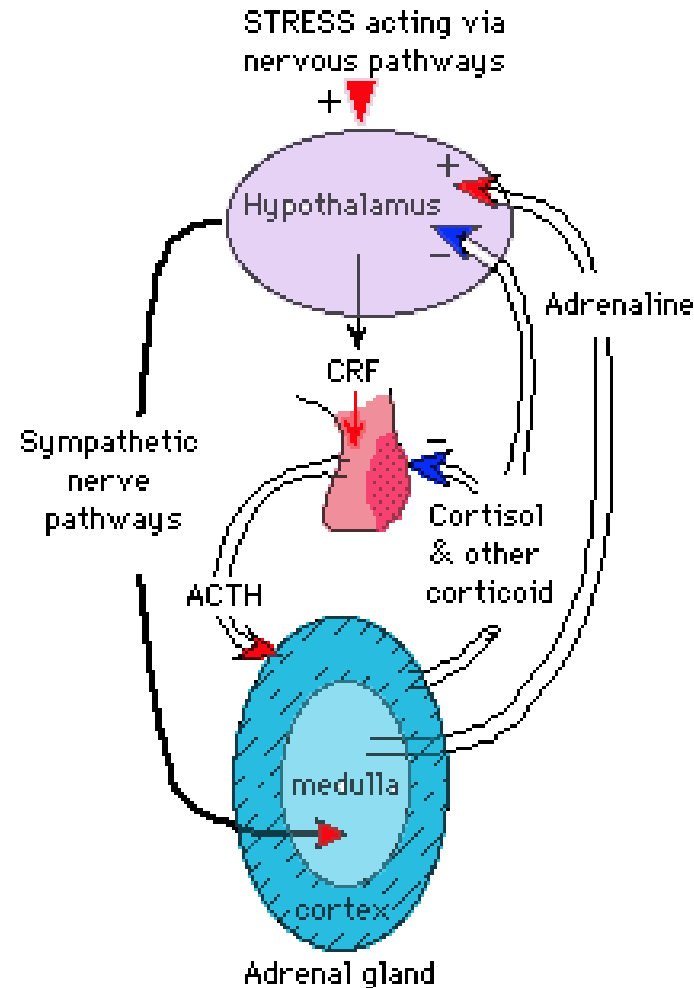
Typical Responses to stimulation of the adrenal medulla

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

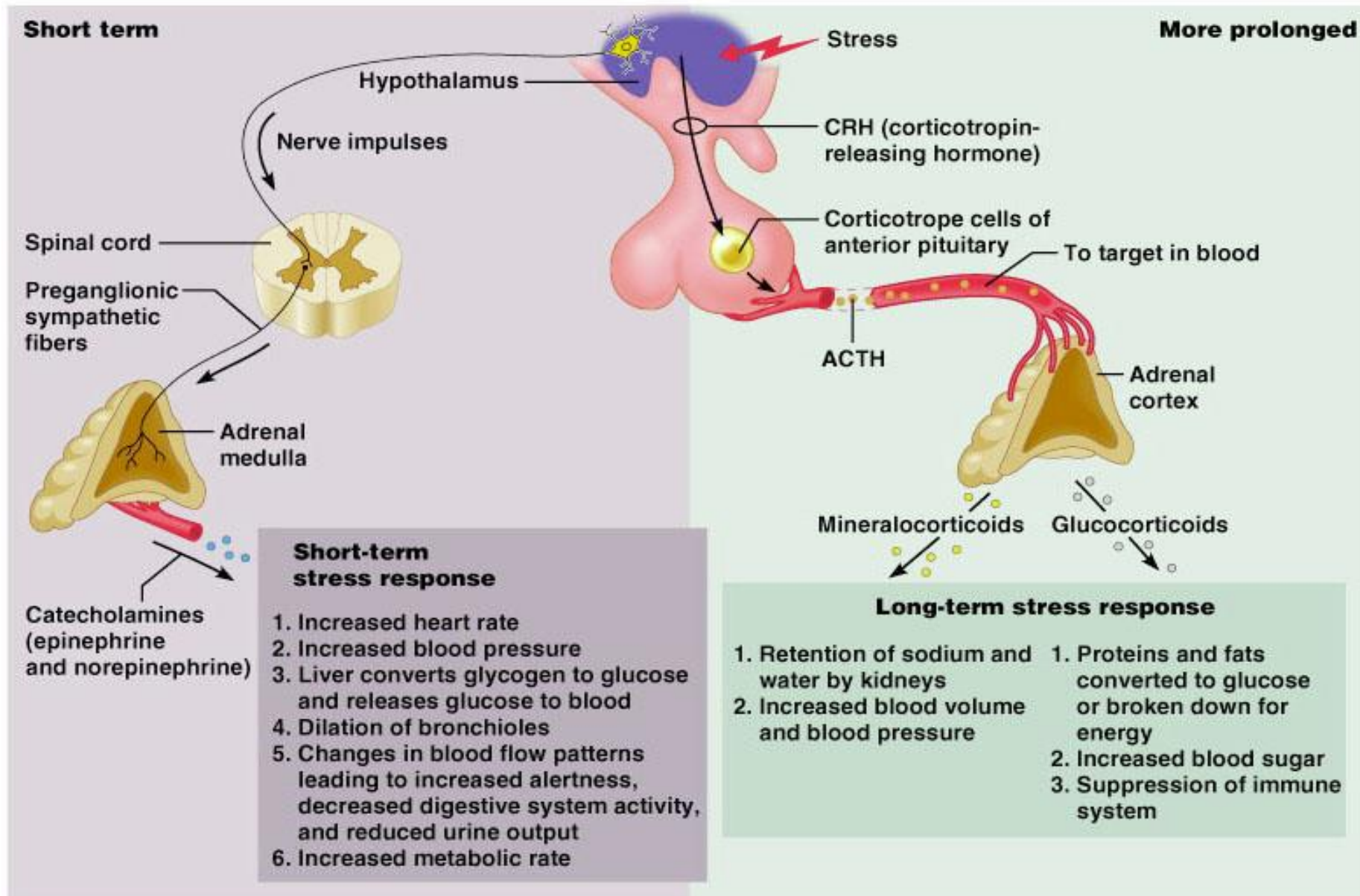
- The effects of the adrenal medullary hormones underlie the role of these hormones in preparation of body for fight or flight.
- The overall effect is to ensue that all requirements for increased muscle activity are available. What are these?

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



A case study?

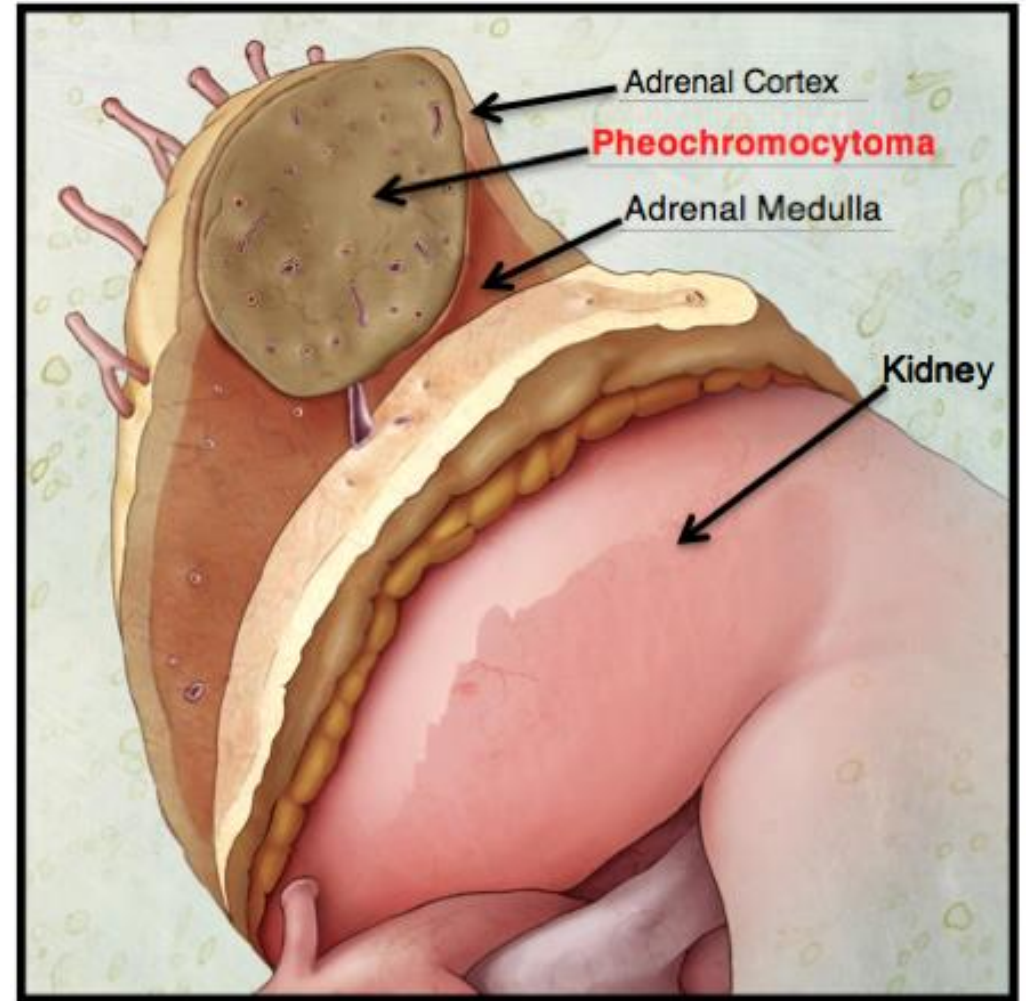
“James” a 35-year-old husband and father of three children, has been experiencing

headaches and palpitations of increasing frequency and severity over the past six months.

In addition, he has had periods of intense anxiety and panic attacks.

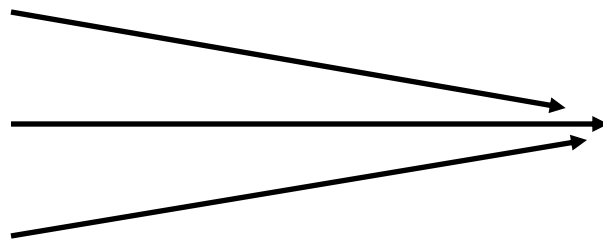
Pheochromocytoma

- Pheochromocytoma is a tumor of adrenal medulla .
- derived from chromaffin cells (arise from neural crest).
- Most often occurs in middle age.
- It can be life threatening if not recognized & not treated.
- Most tumors secrete epinephrine, NE, and dopamine and can cause episodic hypertension.
- Associated with neurofibromatosis.

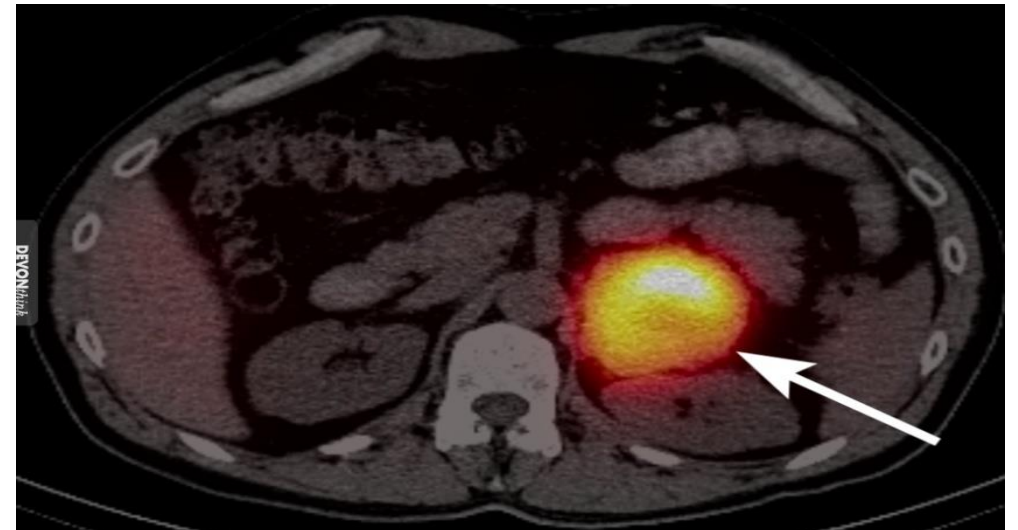


Signs and Symptoms of Pheochromocytoma

- resistant hypertension (95%)
- headache
- sweating
- palpitations
- chest pain
- anxiety
- glucose intolerance
- increased metabolic rate



classic triad



Pheochromocytoma

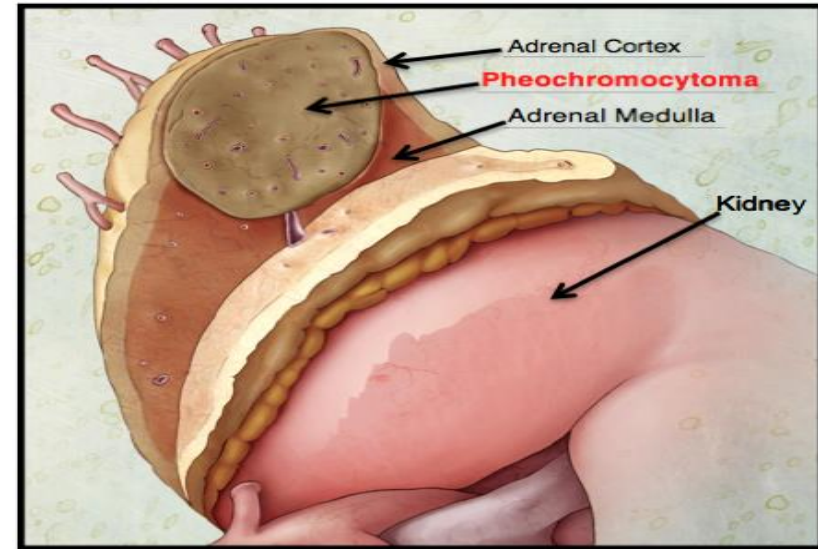
Pheochromocytoma: 3 most common symptoms

"PHEochromocytoma"

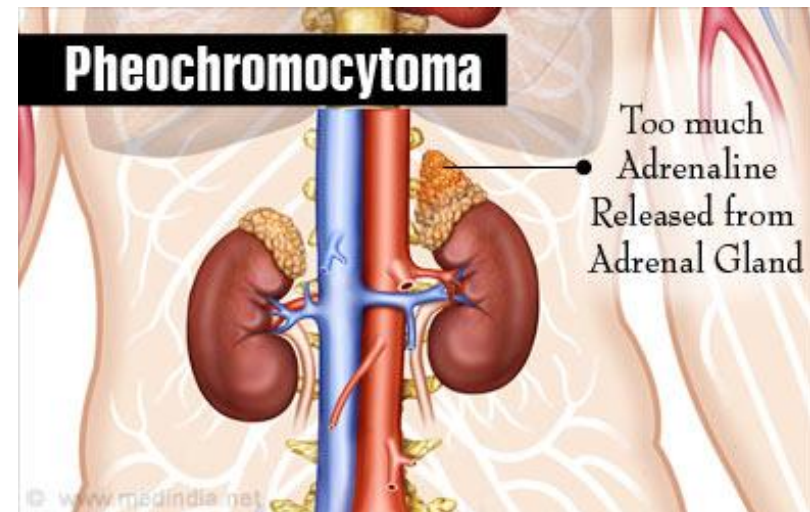
- **P**alpitations
- **H**eadache
- **E**pisodic sweating (diaphoresis)



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- Urinary vanillylmandelic acid, VMA (a breakdown products of norepinephrine) and Metanephrines: ↑
- Plasma catecholamines: ↑
- Treatment is surgical resection





Thank You

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