
بسم الله الرحمن الرحيم

Adrenal Medulla

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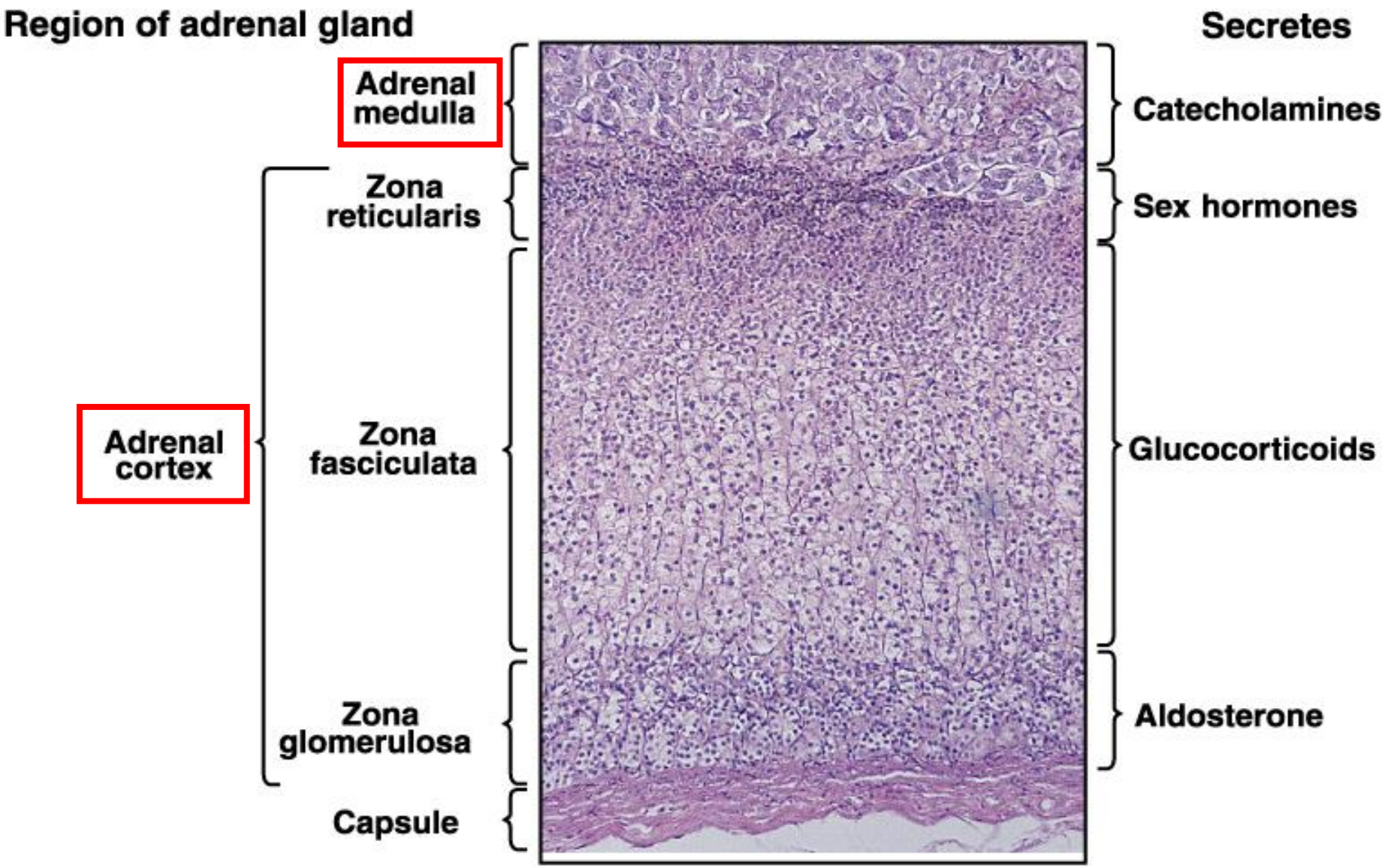

Region of adrenal gland
Secretes
Adrenal medulla
Catecholamines
Zona reticularis
Sex hormones
Adrenal cortex
Zona fasciculata
Glucocorticoids
Zona glomerulosa
Aldosterone
Capsule

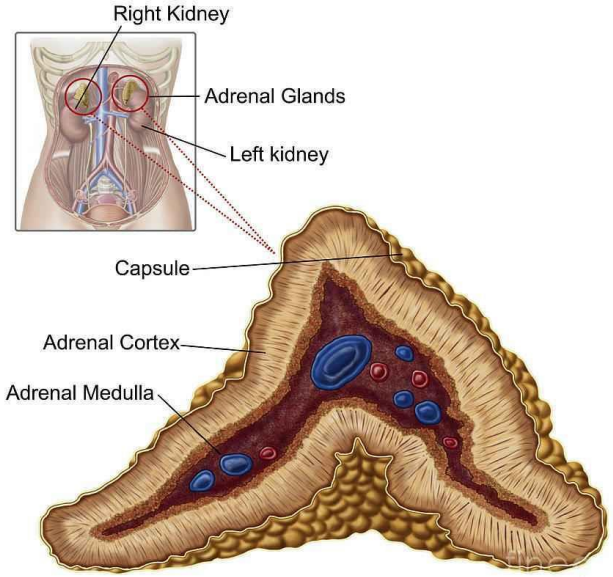
Adrenal medulla

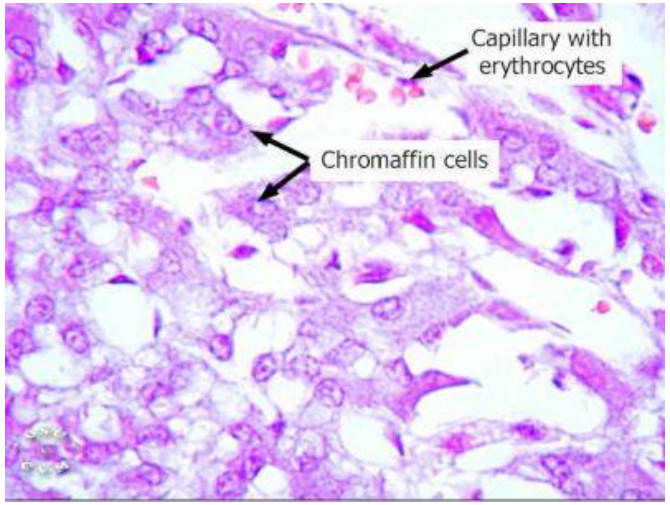
- **The adrenal medulla is the inner part or core of each adrenal gland.**

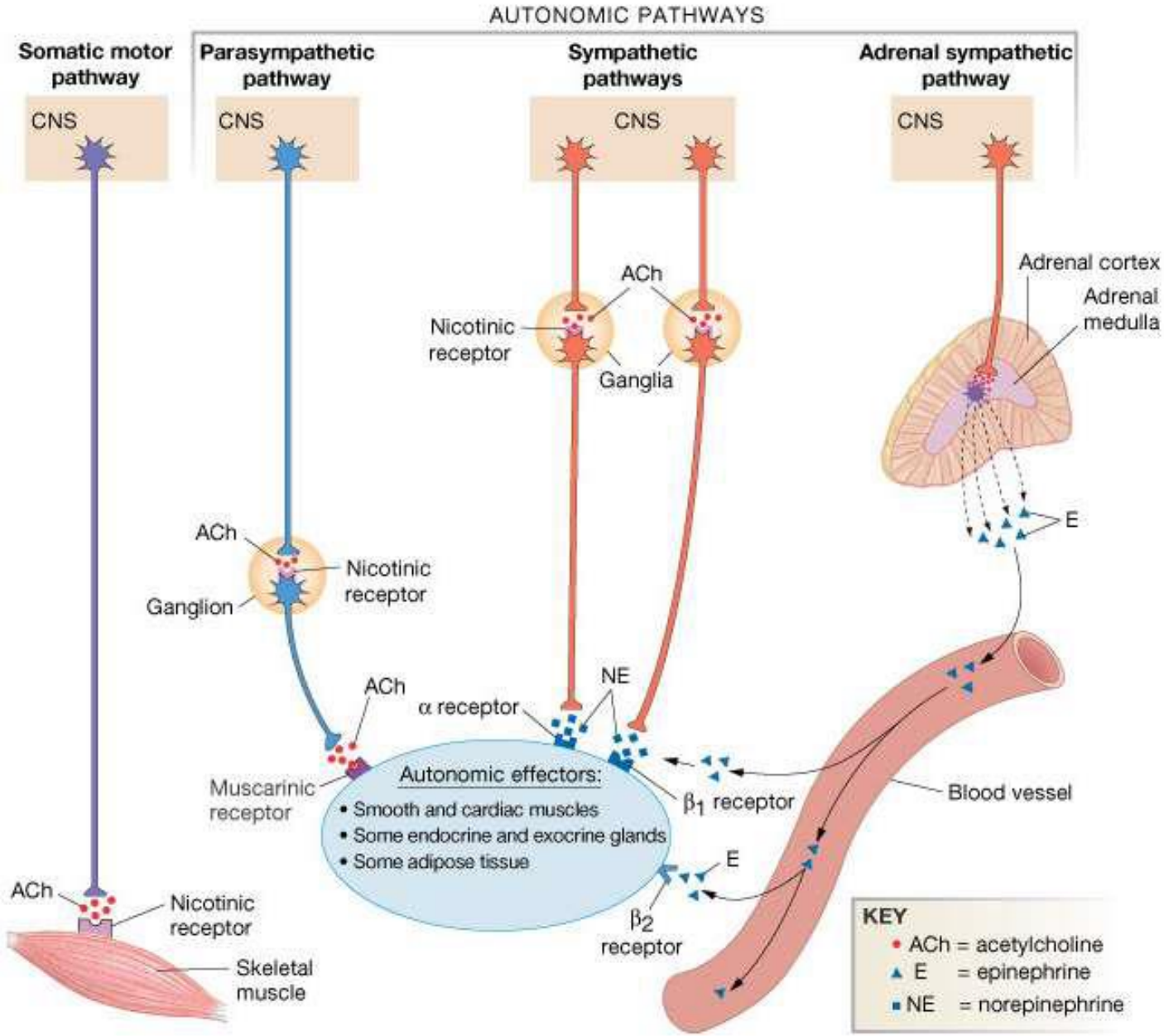
- **It is considered as part of <u>sympathetic nervous system</u>.**

- **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.**

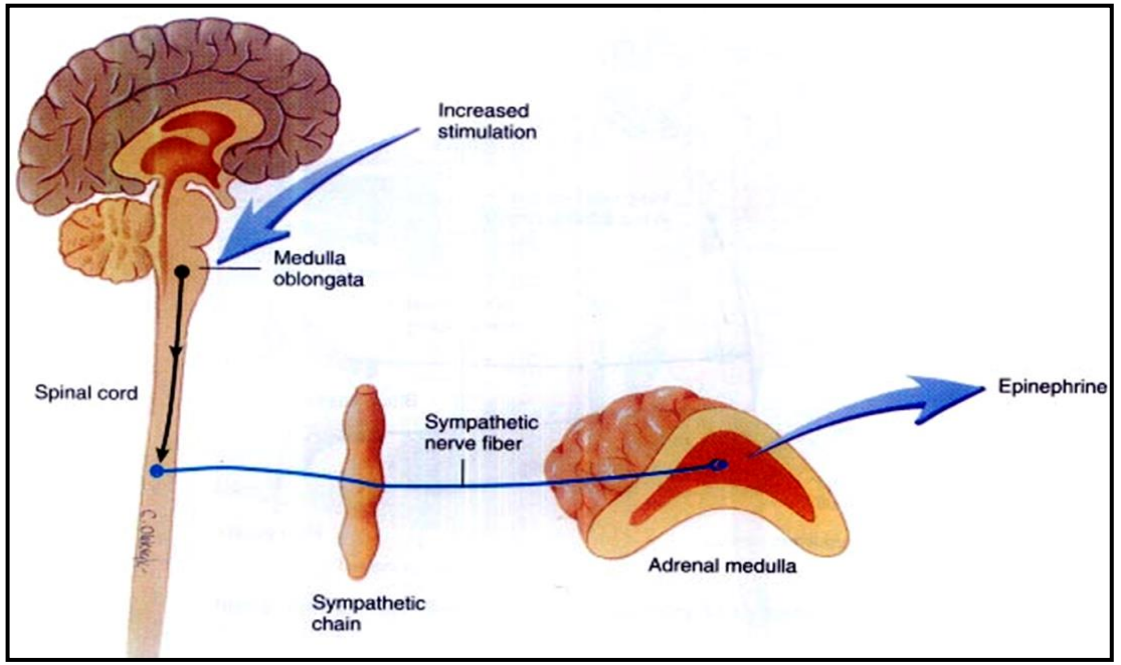





AUTONOMIC PATHWAYS
Somatic motor pathway
Parasympathetic pathway
Sympathetic pathways
Adrenal sympathetic pathway
CNS
CNS
CNS
CNS
ACh
Nicotinic receptor
Ganglia
Adrenal cortex
Adrenal medulla
E
ACh
Nicotinic receptor
Ganglion
ACh
α receptor
NE
Autonomic effectors:
• Smooth and cardiac muscles
• Some endocrine and exocrine glands
• Some adipose tissue
Muscarinic receptor
β1 receptor
Blood vessel
E
β2 receptor
ACh
Nicotinic receptor
Skeletal muscle
KEY
ACh = acetylcholine
E = epinephrine
NE = norepinephrine

Adrenal medulla

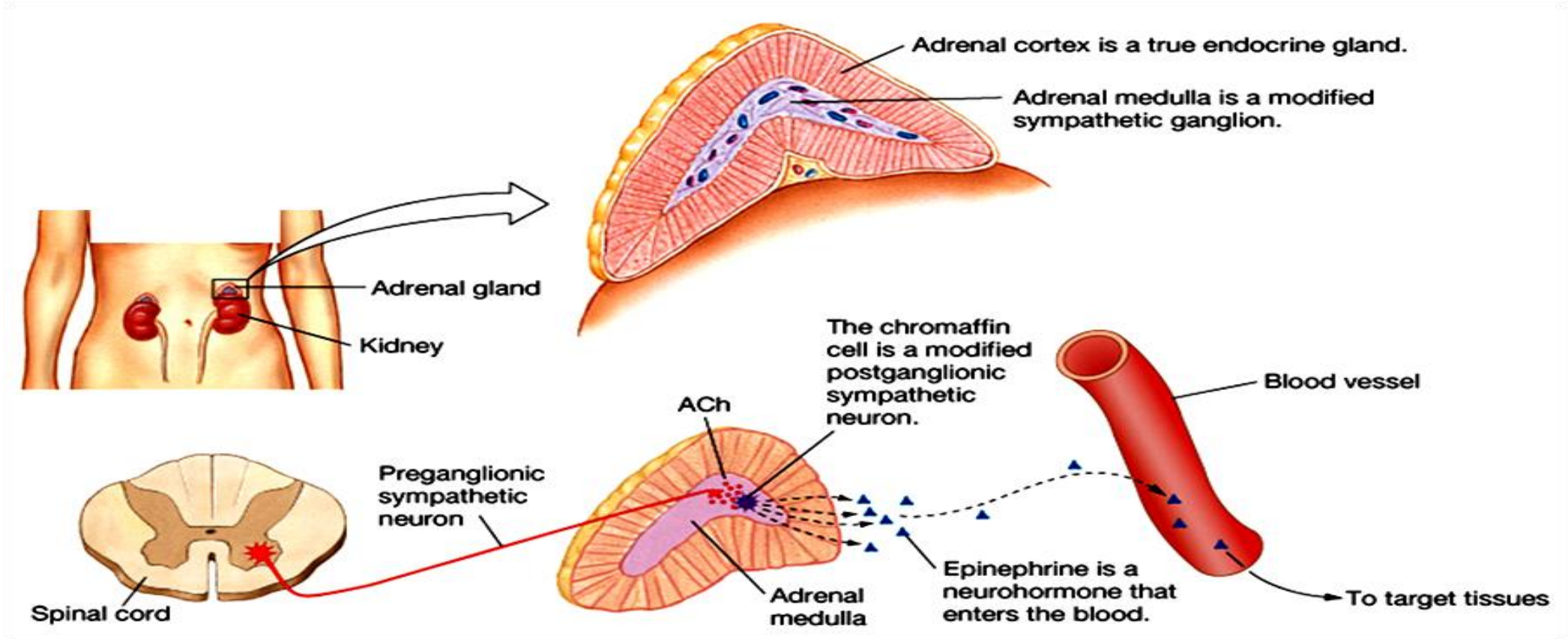
- 80% of its secretion is Epinephrine (EP) and 20% of its secretion is Norepinephrine (NE).
- EP in the bloodstream comes solely from the adrenal medulla.
- NE in blood comes from both adrenal medulla and postganglionic sympathetic nerves.
- This is because postganglionic sympathetic nerves can not synthesize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



- The adrenal medulla is, functionally , integral part (تعتبر جزء لا يتجزأ) of the sympathetic system .

- **Its secretions are derived from <u>tyrosine</u> :**
- Tyrosine → Dopamine → Norepinephrine → Epinephrine

- Phenylethanolamine N-methyltransferase (PNMT) is an enzyme found in the adrenal medulla that converts norepinephrine (noradrenaline) to epinephrine (adrenaline).



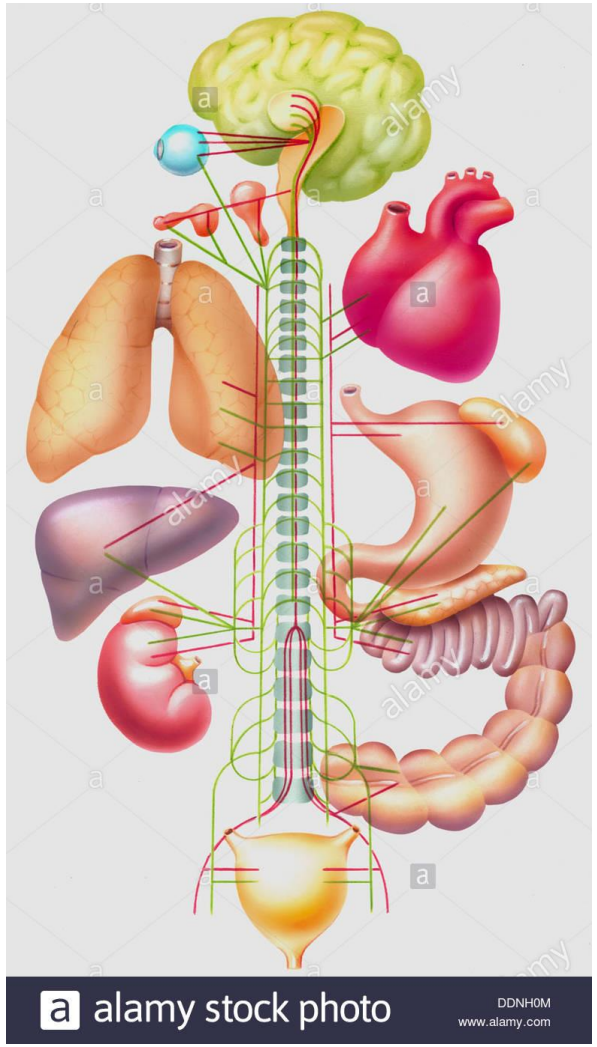
Adrenal medulla

- Secretion of these hormones causes:

➢ Blood to be diverted to the <u>brain</u>, <u>heart</u>, and <u>skeletal muscle</u>

➢ 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

Organs		Metabolic	
Heart		Blood glucose level	
Vessel			
Respiratory			
GIT			
Bladder			
CNS		Lipolysis	
Eyes			
Sweat			

Adrenergic Receptors

Alpha-Adrenergic Receptors

alpha 1:
vasoconstriction
Intestinal relaxation
Uterine contraction
Pupillary dilation

alpha 2:
Platelet aggregation
Decrease insulin secretion

Beta Adrenergic Receptors

beta 1 :
↑HR/contractility, ↑lipolysis, ↑renin Secretion

beta 2 :
Vasodilation
↑Bronchodilation
↑Glycogenolysis

Actions of adrenal medullary hormones

Typical Responses to stimulation of the adrenal medulla

Target	Responses	Receptor
Cardiovascular system		
Heart	↑ Frequency and rate of contraction	
	↑ Conduction	β
	↑ Blood flow (dilation of coronary arterioles)	β
	↑ Glycogenolysis	α
Arterioles		
Skin	Constriction	α
Mucosae	Constriction	α
Skeletal muscle	Constriction	α
	Dilation	β
Metabolism		
Fat	↑ Lipolysis	β
	↑ Blood FFA and glycerol	β
Liver	↑ Glycogenolysis and gluconeogenesis	β & α_1
	↑ Blood sugar	β &α_1
Muscle	↑ Glycogenolysis	β
	↑ Lactate and pyruvate release	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?**

Effects of Catecholamines

1- Glycogenolysis in liver and skeletal muscle (can lead to hyperglycemia) which increases blood glucose level

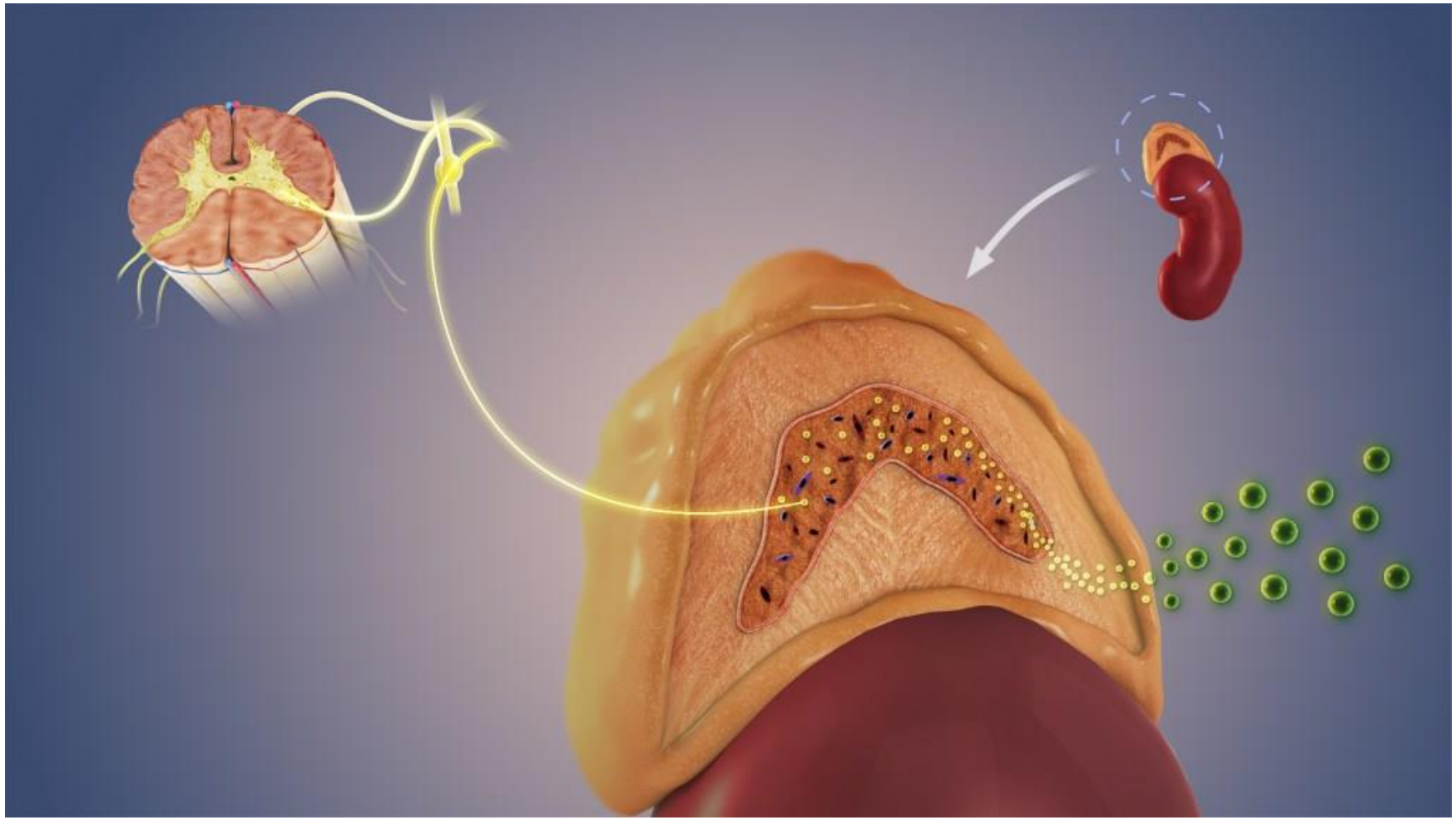
2- Increase heart rate and blood pressure

3- Cause vasoconstriction of blood vessels

4- Mobilization of free fatty acids

5- Increase metabolic rate

6- Increase O_2 consumption



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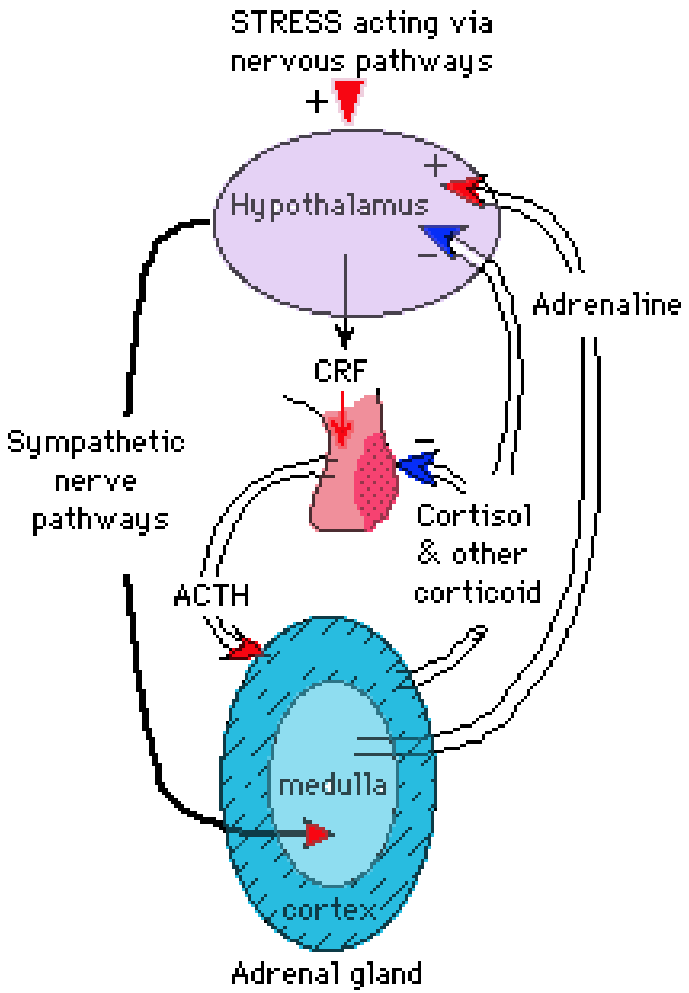
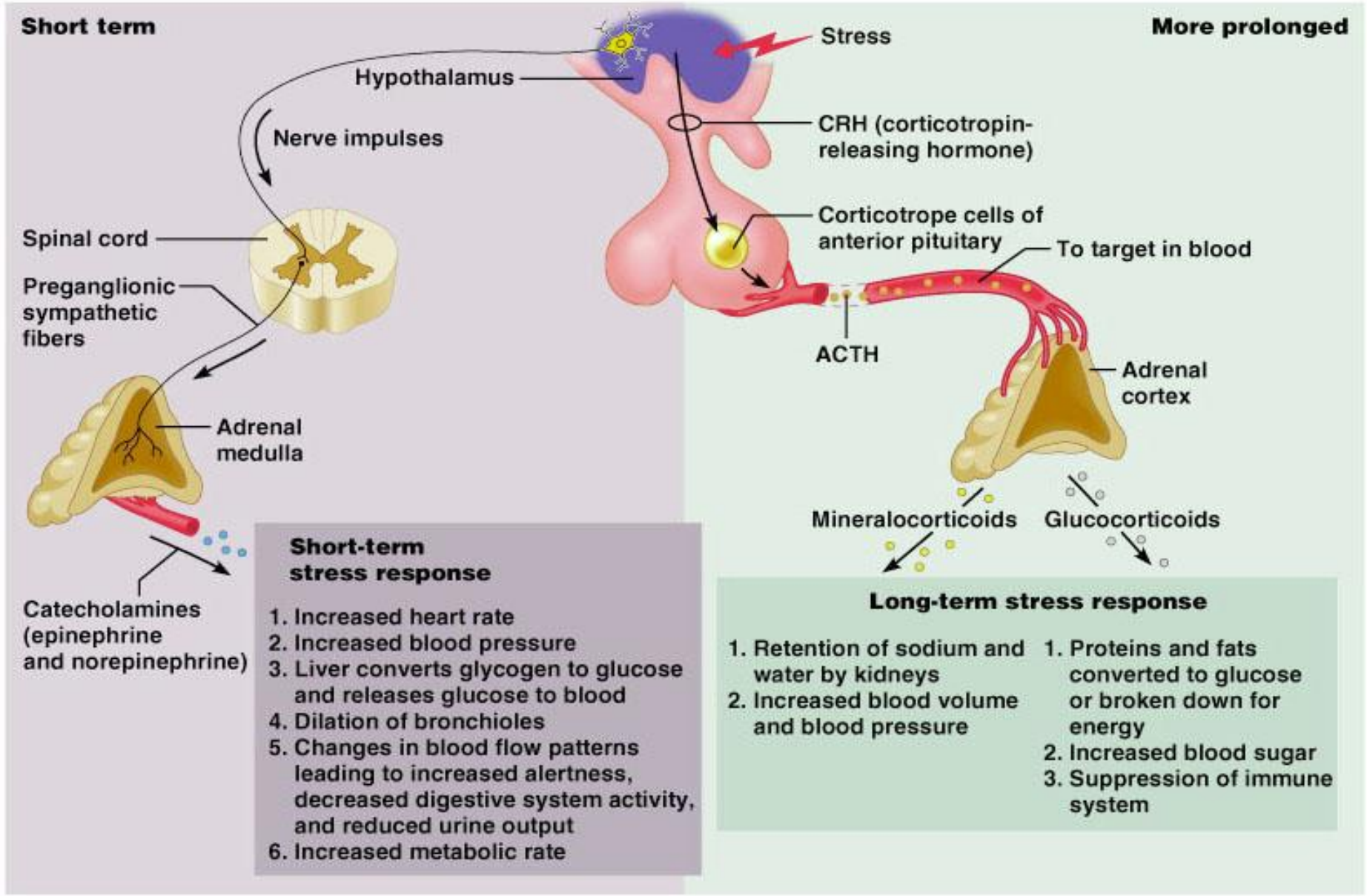
Control of secretion of adrenal medullary hormones

- 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 know as the "fight or flight" response. Stress can be physical (exercise), physiological (hypoglycemia, hemorhage), 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

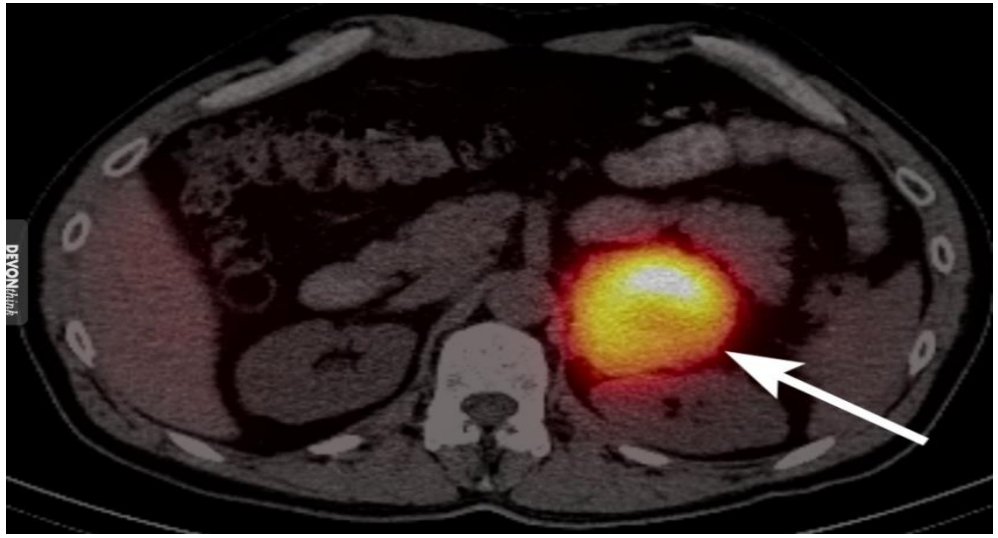


A case study?

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

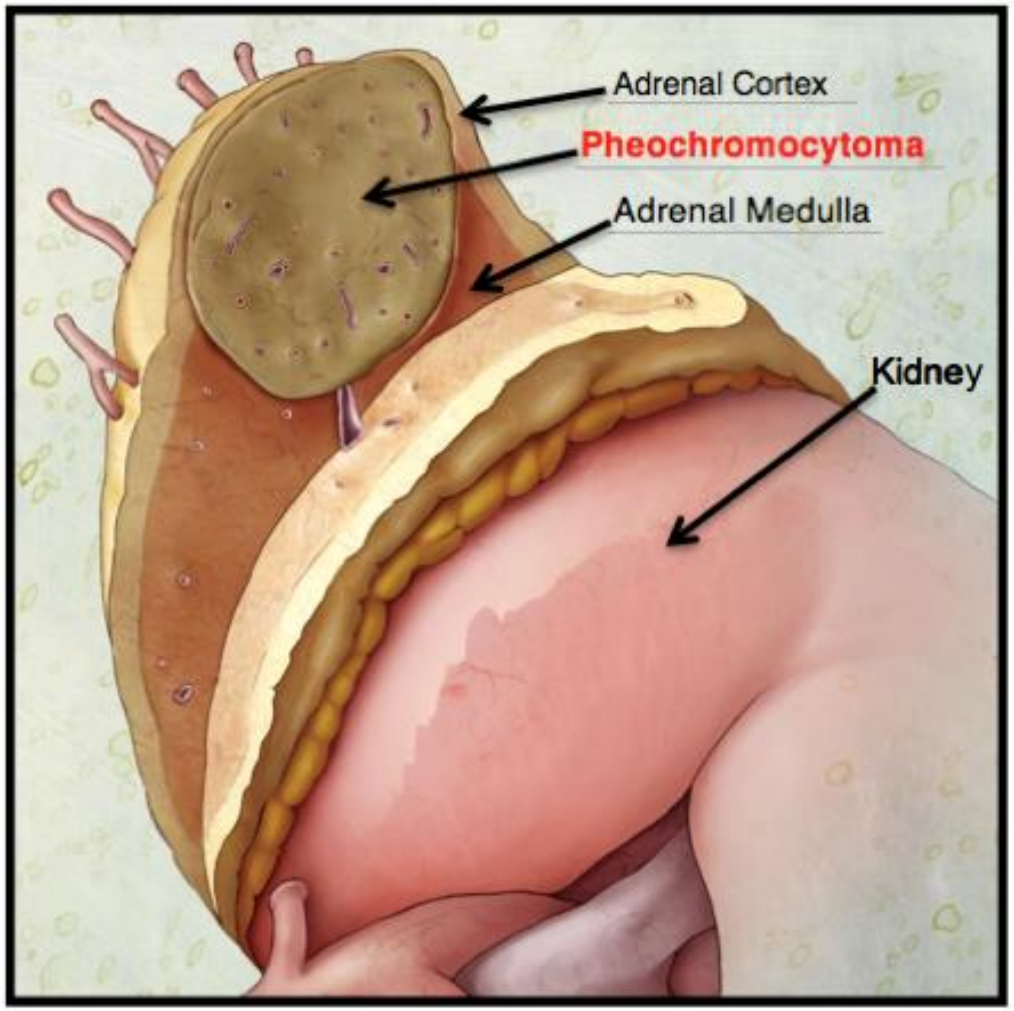
headaches and palpitations of increasing frequency and severity over the past six months.

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



Pheochromocytoma

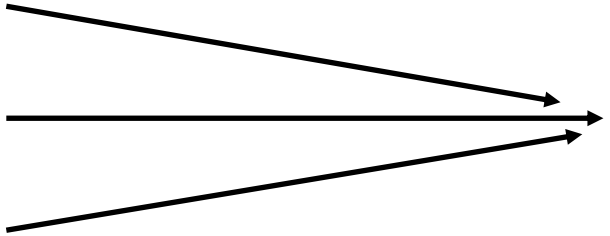
- Pheochromocytoma is a tumor of adrenal medulla .
- derived from chromaffin cells (arise from neural crest).
- Most often occurs in middle age.
- It can be life threatening if not recognized & not treated.
- Most tumors secret epinephrine, NE, and dopamine and can cause episodic hypertension.
- Associated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



Signs and Symptoms of Pheochromocytoma

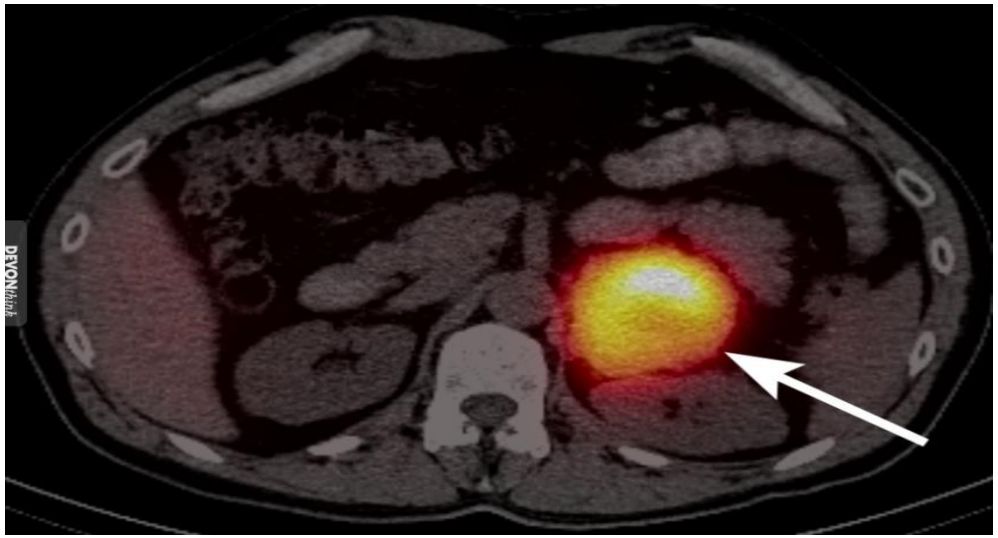
- resistant hypertension (95%)

- headache
- sweating
- palpitations



classic triad

- chest pain
- anxiety
- glucose intolerance
- increased metabolic rate



Pheochromocytoma

Pheochromocytoma: 3 most common symptoms

"**PHE**ochromocytoma"

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

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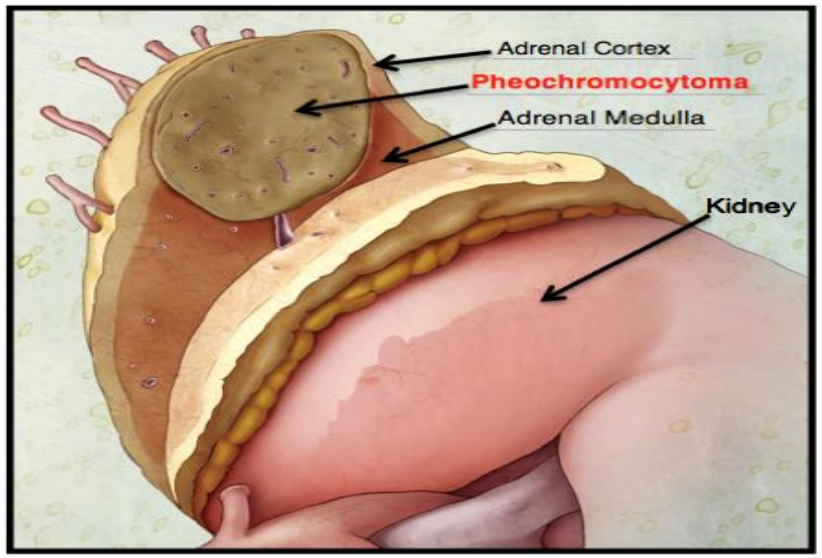
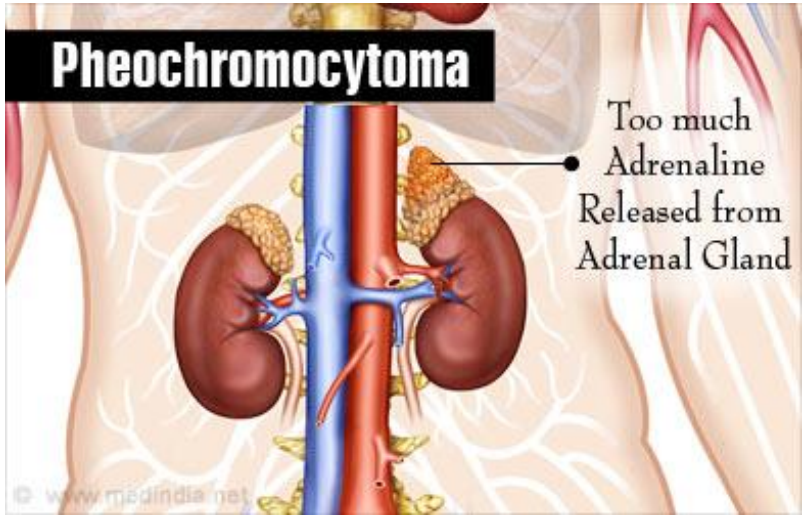
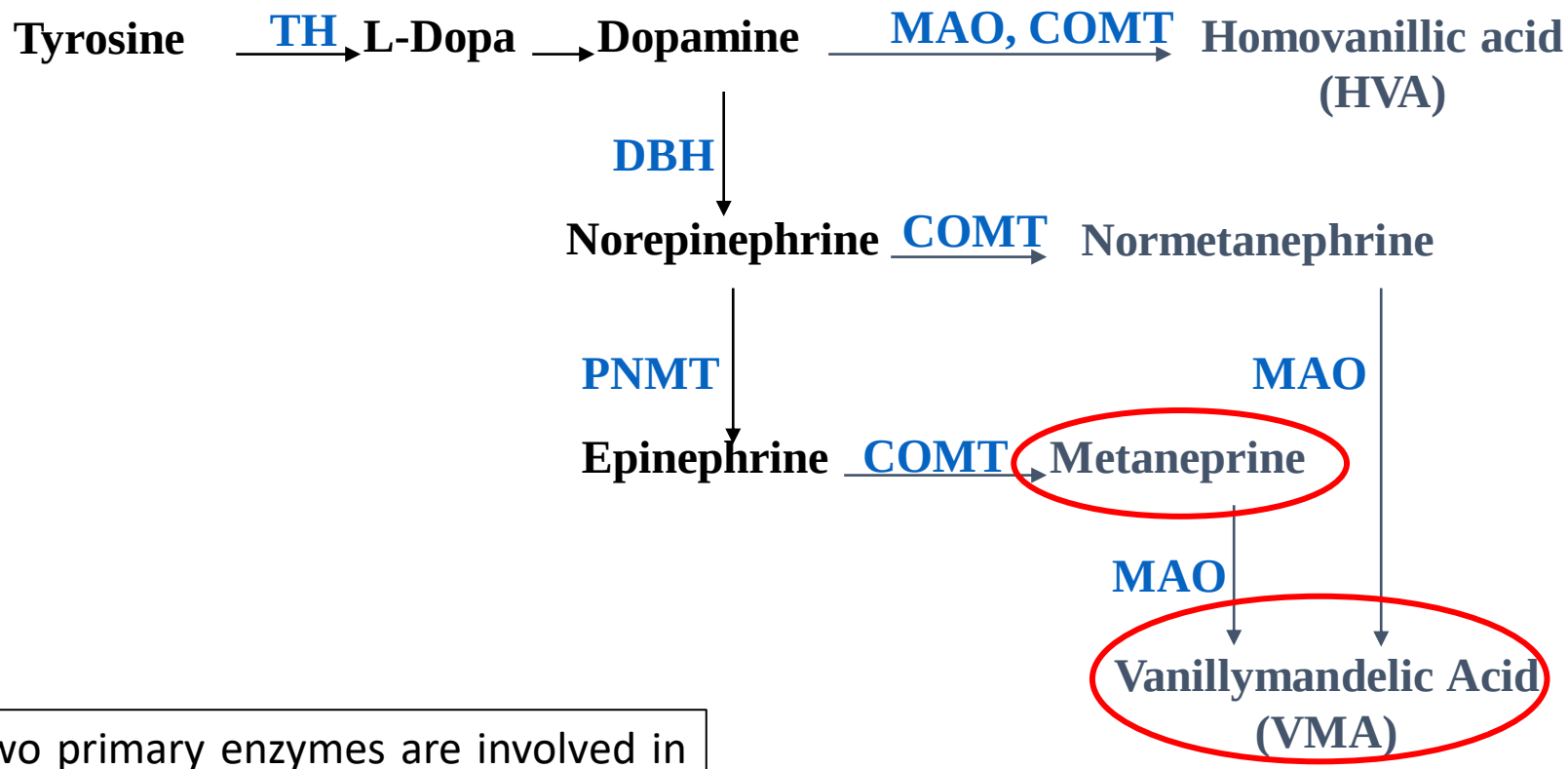


- Urinary vanillylmandelic acid, VMA (a breakdown products of norepinephrine) and Metanephrines: ↑
- Plasma catecholamines: ↑
- Treatment is surgical resection



Metabolism of Catecholamines

Catecholamines **Metabolites**



Two primary enzymes are involved in the degradation of catecholamines:

1. **monoamine oxidase (MAO)**
2. **catechol-O-methyltransferase (COMT)**.

Urinary **vanillylmandelic acid (VMA)** and **metanephrine** are sometimes used clinically to assess the level of catecholamine production in a patient.

Learning outcomes

Objectives:

- 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.

Reduce the Stress in Your Life

Oatmeal fight anxiety's negative effects

Half an avocado a day should do the trick for your stress

A handful of walnuts is all you need to tame stress

Spinach and Broccoli improves your body's response to stress

Eat Blueberries to reduce stress

Eating dark chocolate lowered stress level hormones

Water
Sip the stress away

One glass of wine a day can reduce stress

A glass of warm milk really is calming

The secret anti-stress ingredient in parsley and orange is Vitamin C


Thank You
FREEDOM