



ENDOCRINE BLOCK

LECTURE 13

PHYSIOLOGY OF ADRENAL MEDULLA



DONE BY:

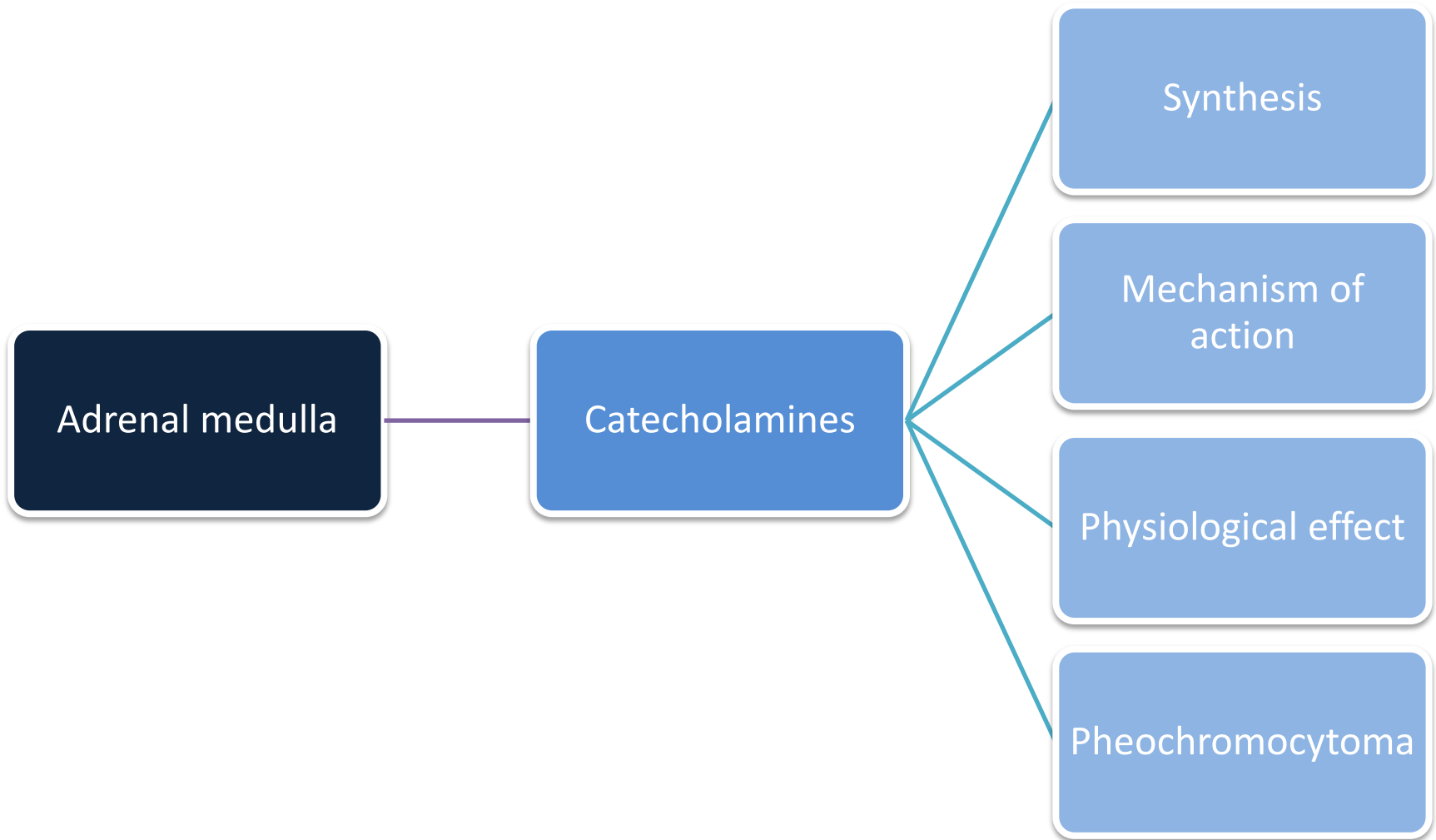
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Not Given



- The Adrenal Medulla is functionally a part of the sympathetic nervous system
- Produces Adrenaline (epinephrine) & Noradrenaline (norepinephrine)
- 80% of released catecholamines are epinephrine.
- Norepinephrine is secreted from adrenal medulla + postganglionic sympathetic fibers.
- Adrenaline is exclusively secreted from adrenal medulla, there's no other source for adrenaline except from adrenal medulla.
 - Postganglionic fibers lack phenylethanolamine-N-methyltransferase (PNMT), an enzyme needed for the conversion of noradrenaline to adrenaline
- Hormones are **secreted and stored** in the adrenal medulla and released in response to appropriate stimuli.
- Because it is an emergency hormone, it must be already synthesized & stored to be released whenever it is needed.



Catecholamine synthesis

Tyrosine
(Tyrosine derivative)



tyrosine hydroxylase

Dihydroxyphenylalanine



L-aromatic amino acid decarboxylase

Dopamine



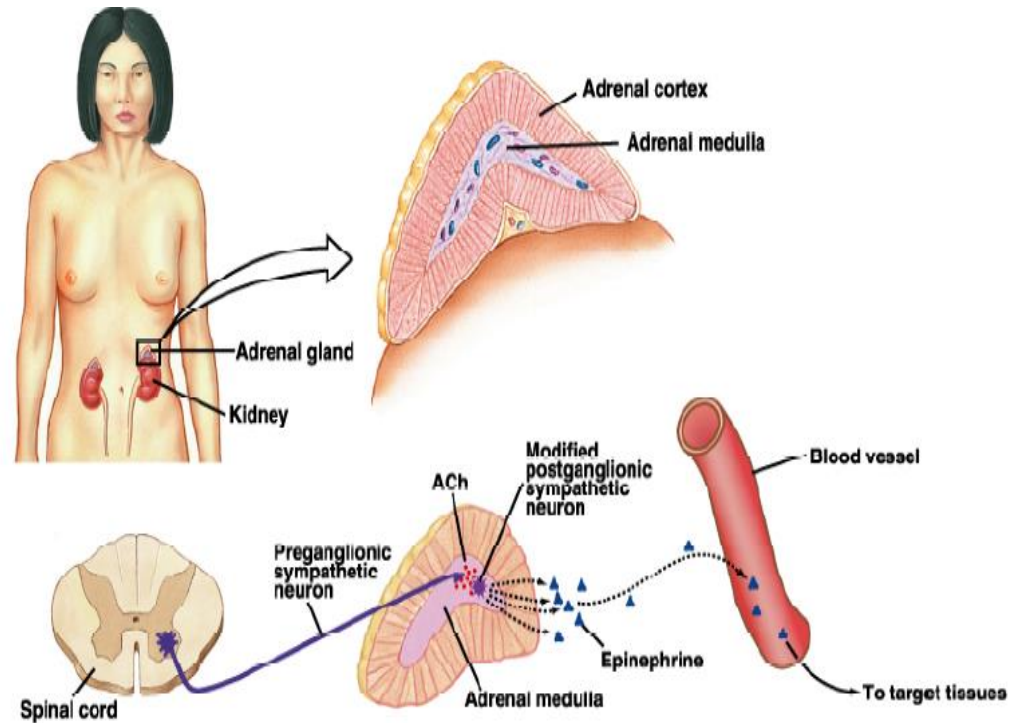
dopamine-β-hydroxylase

Norepinephrine



phenylethanolamine-N-methyltransferase (PNMT)

Epinephrine



- Receptor mediated – **adrenergic receptors**
- Peripheral effects are dependent upon **the type and ratio of receptors in target tissues.**
- Relative effects of epinephrine and norepinephrine on alpha and beta adrenergic receptors:

Receptor	α	β
Norepinephrine	+++++	++
Epinephrine	++++	++++

- Norepinephrine stimulates alpha receptors more than beta receptors. Thus, it mainly mediates vasoconstriction.
- Epinephrine stimulate alpha & beta adrenoreceptors equally.



Differences between epinephrine and norepinephrine

- **Epinephrine** >> norepinephrine – in terms of cardiac stimulation leading to greater cardiac output (beta stimulation).
- Epinephrine < **norepinephrine** – in terms of constriction of blood vessels → leading to increased peripheral resistance → increased arterial pressure.
- **Epinephrine** >> norepinephrine – in terms of increasing metabolism Epi = 5-10 x Norepi. = 100% normal
- (Epinephrine has 5 to 10 times greater metabolic effect than norepinephrine)



Metabolism:

- Glycogenolysis in liver and skeletal muscle → can lead to hyperglycemia
- (One of the strong stimuli for catecholamines secretion is acute hypoglycemia)
- Mobilization of free fatty acids. (Lipolysis)
- (from adipose tissue) also this causes elevated blood sugar
- Increase metabolic rate → Thermogenesis
- (leading to increased heat production and increased sweating)
- O₂ consumption **increases**.

Cardiovascular:

- **Increase** Heart rate & cardiac contractility
- **Increase** Blood Pressure.

Respiration:

- **Increase** oxygen consumption & respiratory rate
- Patients with chronic liver disease e.g. Impending hepatic coma → the liver is unable to synthesize or store glycogen → if the patients develops hypoglycemia → epinephrine will be released but cannot produce any action on liver. However, other effects of epinephrine will occur. **Symptoms:** Excessive hot sweating, strong tapping pulse, tachycardia.



- A **catecholamine**-secreting **tumor** of chromaffin cells of the **adrenal medulla**
- adrenal pheochromocytoma (90%)
- Extra-adrenal pheochromocytoma

Signs and symptoms of the pheochromocytoma:

- resistant hypertension (95%)
- headache
- sweating
- palpitations → Can lead to tachyarrhythmia and even fibrillation
- chest pain
- anxiety → Insomnia
- glucose intolerance > hyperglycemia.
- increased metabolic rate

} Classic triad



Diagnosis:

- Diagnosed by **high plasma catecholamines** and **increased metabolites [VMA] in urine**
- Catecholamines are unstable => we test for their metabolites, metanephrine & vanillylmandelic acid (VMA)
- 24h urine levels of catecholamines & metabolites:
 - high VMA levels indicate pheochromocytoma
- Plasma metanephrine test
- Thyroid function tests to exclude hyperthyroidism
- MRI

Treatment:

Surgical resection of tumor.



- 80% of adrenal medullary secretion is epinephrine.
- Catecholamines are amino acid tyrosine derivatives.
- Norepinephrine has a stronger effect on **alpha** adrenergic receptors → vasoconstriction → increased BP
- Epinephrine affects both **alpha & beta receptors equally** → Cardiac stimulation → increased cardiac output.
- Epinephrine affects metabolism **by increasing**:
 - 1) Blood glucose.
 - 2) Free fatty acids.
 - 3) Metabolic rate.
 - 4) O₂ consumption.

Conclusion: (from Guyton)

- Adrenal medulla, the central 20% of the gland, is functionally related to the sympathetic nervous system; it secretes the hormones epinephrine & norepinephrine in response to sympathetic stimulation. In turn, the hormones cause almost the same effect as direct stimulation of the sympathetic nerves in all parts of the body.

1. Which one of the following is the main effect of norepinephrine:

- A) Tachycardia
- B) Stimulation of cardiac contractility
- C) Bronchodilation
- D) Increased blood pressure

2. Increased epinephrine secretion results in:

- A) Hypoglycemia
- B) Hyperglycemia
- C) Hypotension
- D) Hypoventilation

3. Which one of the following result can be used to confirm pheochromocytoma:

- A) Low vanillin mandelic acid
- B) High ACTH
- C) High vanillin mandelic acid
- D) Low ACTH

1	D
2	B
3	C

THE END

If there are any Problems or Suggestions,
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THANK YOU



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