

# Autonomic Nervous System 3

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## □ Catecholamines:

The autonomic fibers that secrete catecholamines are known as adrenergic fibers. They secrete noradrenaline, adrenaline and dopamine (may be chemical transmitters in some neurons of the CNS).



## ✓ *Site of catecholamines release:-*

- Noradrenaline is the chemical transmitter of all sympathetic postganglionic fibers (not adrenaline) except sympathetic postganglionic to sweat gland and skeletal muscle blood vessels (cholinergic).
- Catecholamines (adrenaline 80% and noradrenaline 20%) are also secreted by adrenal medulla in emergency conditions.



## ✓ *Functions of the adrenal medulla;*

- It augments the activity of ANS in conditions of emergency by increasing the amounts of catecholamines in plasma carried by the blood to different tissues.
- The released catecholamines from adrenal medulla have longer effect (10 times) than that of the sympathetic stimulation because it is slowly removed from blood.
- Adrenaline is secreted mainly by the adrenal medulla than by sympathetic nerve endings which secrete mainly noradrenaline.
- Chemical transmitter of adrenal medulla is acetylcholine that acts on the nicotinic receptors of the chromaffin cells to release adrenaline mainly (chemical secretion).

## Adrenaline

- Contain methyl group.
- Released mainly from adrenal medulla.
- Have more affinity to  $\beta$  receptors.
- Strong metabolic and cardiac actions.

## Noradrenaline.

- Devoid from methyl group.
- Released mainly from postganglionic adrenergic sympathetic fibers.
- Have more affinity to  $\alpha$  receptors.
- Vascular action mainly (vasoconstriction)

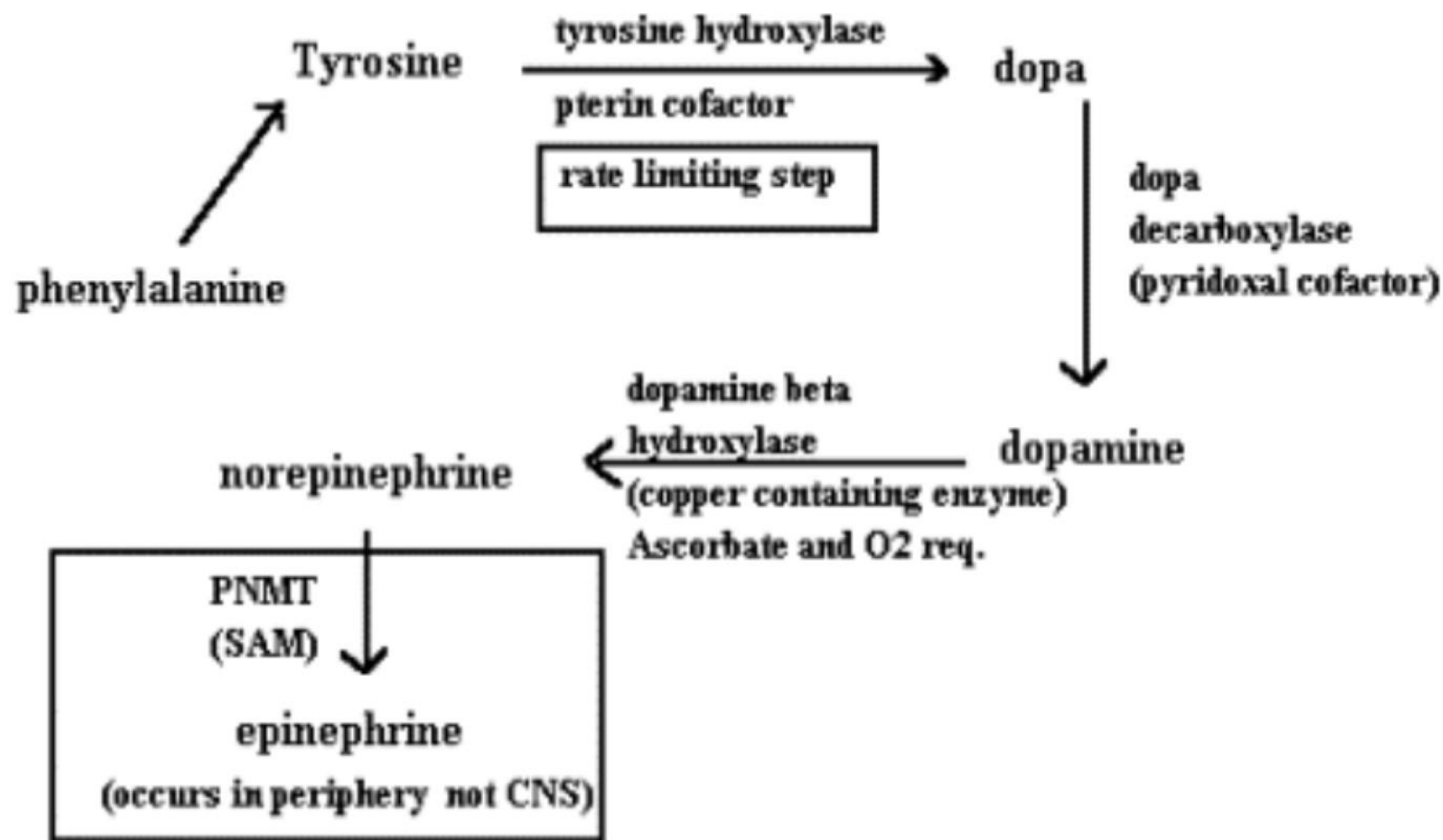


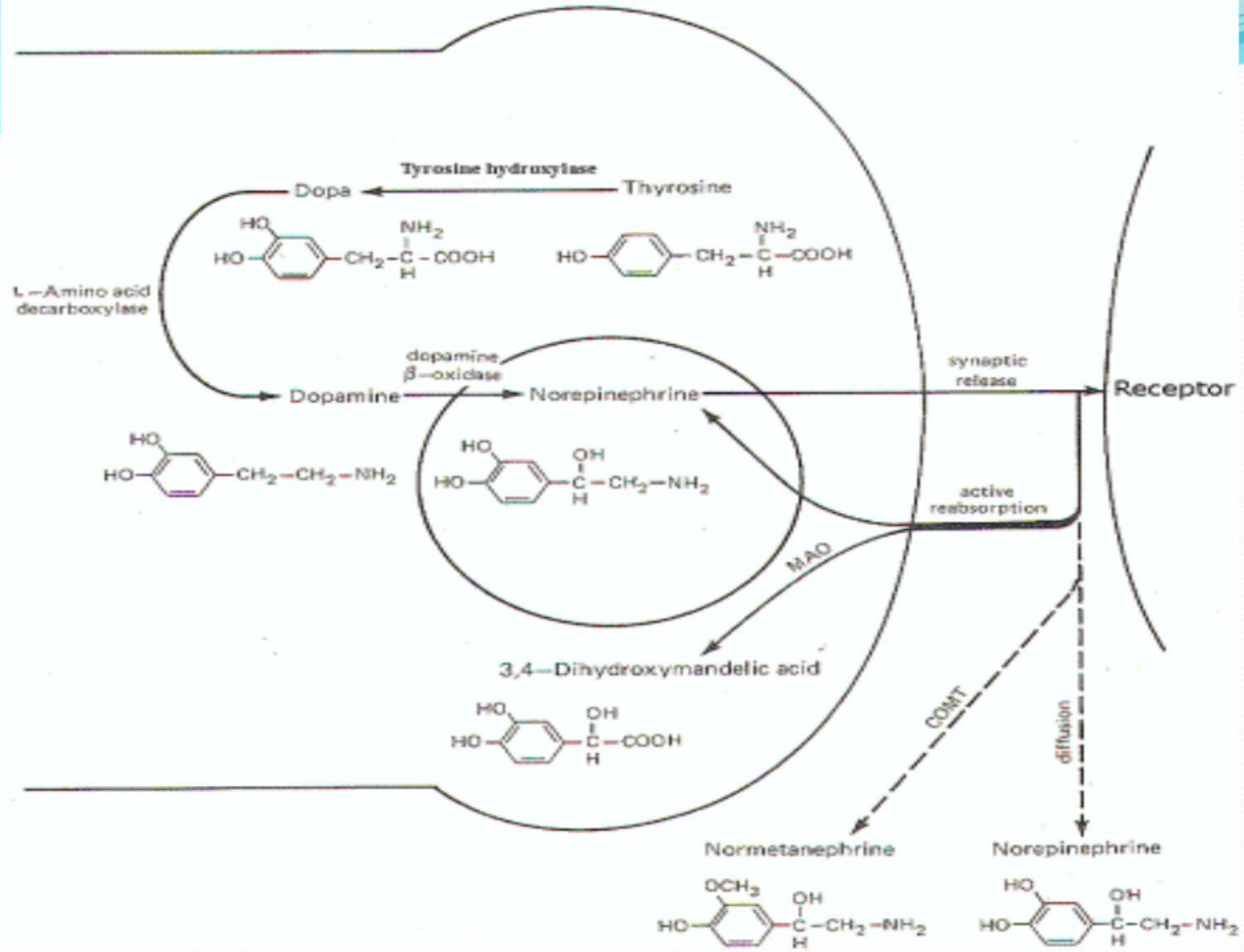
## ✓ *Biosynthesis of catecholamines;*

- They are formed in adrenergic neurons and the adrenal medulla from amino acid tyrosine (from diet or synthesized from amino acid phenylalanine).
- CA are stored inside special vesicles in the adrenergic nerve terminals or adrenomedullary cells called chromaffin granules.

# Catecholamines (dopamine and norepinephrine)

synthesis and metabolism







## ✓ **Methods of inactivation:-**

After release of CA and production of their effects, they are rapidly inactivated by:

- **Active reuptake** into the vesicles of the nerve endings, inhibited by Reserpine.
- **Oxidation by an enzyme** (Monamine oxidase, MAO) that present in high concentration in the mitochondria of adrenergic nerve fibers → Vanilyl mandelic acid derivatives (VMA, 24h. urinary VMA is an indication of plasma CA secretion) → excreted in urine.
- **Orthomethylation** in the liver by an enzyme (catecholamine orthomethyl transferase, COMT).



## ✓ *Adrenergic receptors (Metabotropic receptors):*

They are of two types: alpha and beta receptors.

- Stimulation of  $\alpha$ -receptors produces mainly excitatory effects except in GIT while  $\beta$ -receptors produces inhibitory effects except on the heart.
- *Adrenaline* stimulates both  $\alpha$ ,  $\beta$  receptors, predominantly  $\beta$ -receptors while *Noradrenaline* predominantly  $\alpha$ -receptors.



Items	Alpha ( $\alpha$ )	Beta ( $\beta$ )
<ul style="list-style-type: none"> <li>- Types</li> <li>- Action</li> </ul>	<ul style="list-style-type: none"> <li>- <math>\alpha_1, \alpha_2</math></li> <li>- Mainly excitatory (<math>\alpha_1</math>) as it is produced muscle contraction (sphincters), mydriasis and blood vessels vasoconstriction except in intestine (<math>\alpha_2</math>) inhibitory.</li> <li>- Presynaptic <math>\alpha_2</math> are called autoreceptors.</li> </ul>	<ul style="list-style-type: none"> <li>- <math>\beta_1, \beta_2</math></li> <li>- Mainly inhibitory (<math>\beta_2</math>) as it is produced muscle relaxation (GIT and urinary bladder), bronchodilatation and blood vessels vasodilatation but in heart, it is excitatory (<math>\beta_1</math>).</li> <li>- Lipolysis (<math>\beta_3</math>)</li> <li>- Glycogenolysis (<math>\beta_2</math>)</li> </ul>
<ul style="list-style-type: none"> <li>- Response to catecholamines</li> </ul>	<p>Sensitive to noradrenaline more than adrenaline</p>	<p>Sensitive to adrenaline more than noradrenaline</p>

## ✓ *The sympathomimetics drugs:*

These are the drugs that have an effect similar to sympathetic stimulation, they include;

- Ganglion stimulants: *small doses of Nicotine.*
- Drugs that stimulate  $\alpha$ -receptors directly: *Phenylephrine (is better than atropine in fundus examination as it have short duration of action), adrenaline and noradrenaline (life saving in bronchial asthma).*
- Drugs that stimulate  $\beta$ -receptors directly: *Isoprenaline (used in cases of severe bradycardia).*



## ✓ *The sympatholytics drugs:*

These are drugs which block the actions of sympathetic nervous system, they include:

- Ganglion blockers: *large dose of nicotine.*
- Drugs that prevent storage: *Reserpine (given to irritable patient but must be sure that liver function is normal, why?)*
- Drugs that prevent synthesis:  *$\alpha$ -methyl-p-tyrosine.*
- Alpha-blockers (anti-hypertensive):  
*Phentolamine.*
- Beta-blockers (act on heart to treat tachycardia, arrhythmia): *Propranolol.*