

# Adrenal Medullary Hormones



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# Secretions of the gland



- Catecholamines:
  - Epinephrine
  - Nor-epinephrine
  - Dopamine
- Adrenal medulla is a sympathetic ganglion in which the post ganglionic neurons have lost their axons and become secretory cells

Tyrosine



Tyrosine  
hydroxylase

Dihydroxyphenylalanine  
(DOPA)



Amino acid  
decarboxylase

Dopamine



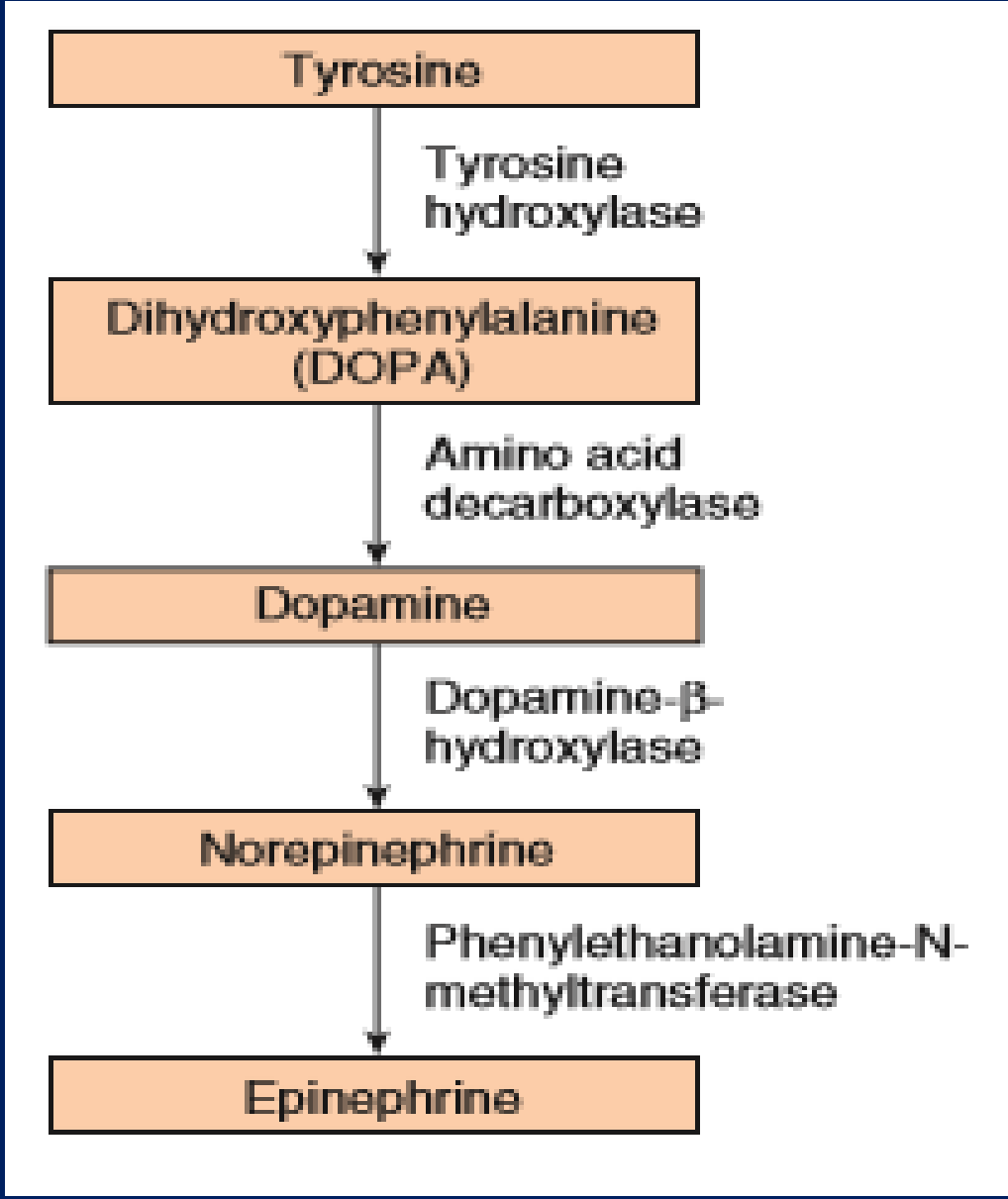
Dopamine- $\beta$ -  
hydroxylase

Norepinephrine



Phenylethanolamine-N-  
methyltransferase

Epinephrine



# Catecholamines



- PNMT is found in brain and adrenal medulla
- Adrenal PNMT is induced by glucocorticoids
- After hypophysectomy, epinephrine concentration decreases
- In 21  $\beta$ -hydroxylase deficiency adrenal medulla is dysplastic

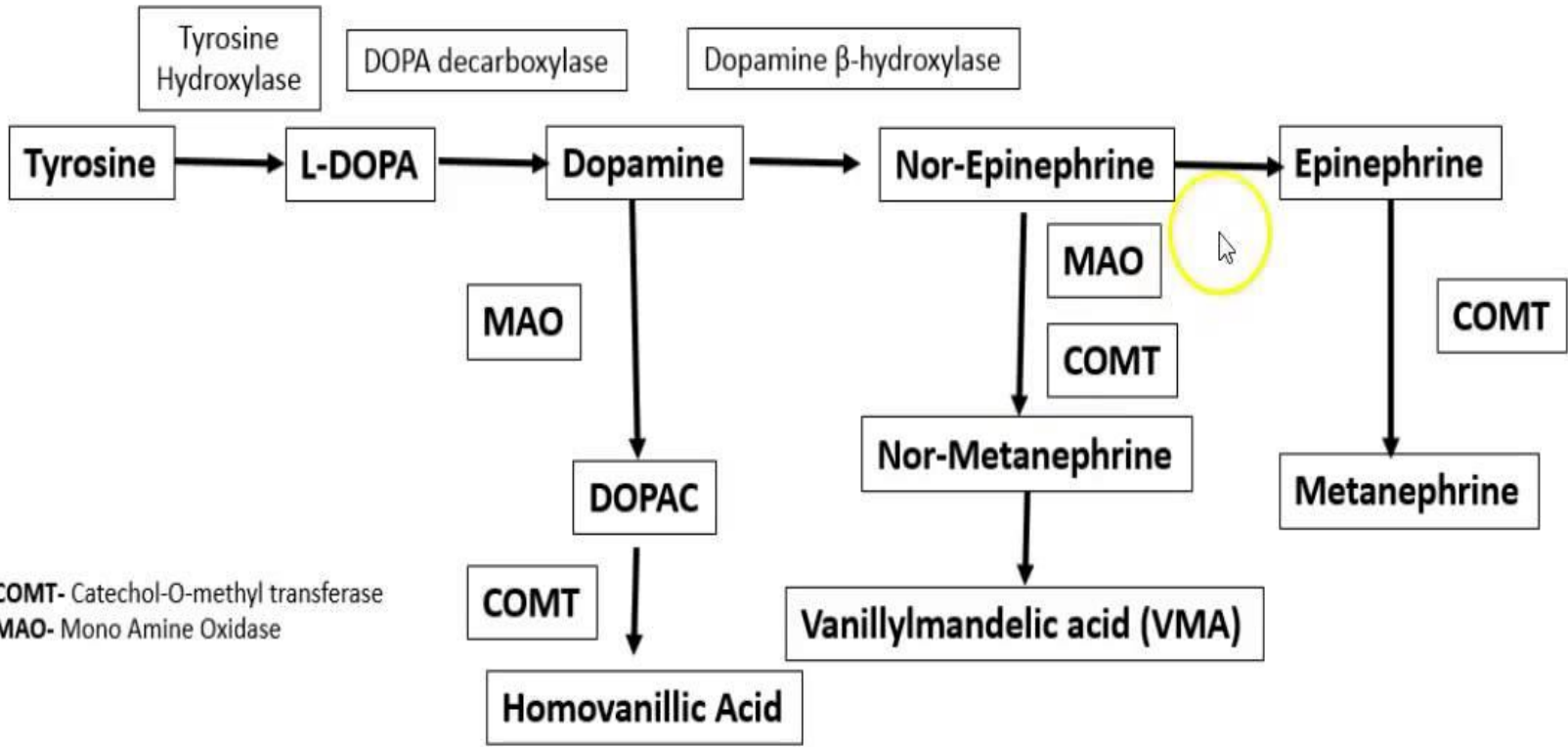
# Catecholamines



- 95% dopamine and 70% Nor-epinephrine and epinephrine is conjugated to sulfate
- On standing the levels of free nor-epinephrine increases by 50-100%
- After adrenalectomy, plasma nor-epinephrine levels remain unchanged but free epinephrine level falls

**Adrenergic Neurotransmission  
and  
Drugs affecting it**

**Synthesis and Metabolism of Catechol amines**





- Catecholamines are stored in granules with ATP
- Granules also contain chromogranin A, opioid peptides
- Adrenomedullin is also found

## Catecholamines

Dopamine

D<sub>1</sub>, D<sub>5</sub>

↑Cyclic AMP

D<sub>2</sub>

↓Cyclic AMP

↑K<sup>+</sup>, ↓Ca<sup>2+</sup>

D<sub>3</sub>, D<sub>4</sub>

↓Cyclic AMP

Norepinephrine

α<sub>1</sub>

↑IP<sub>3</sub>, DAG

↓K<sup>+</sup>

α<sub>2</sub>

↓Cyclic AMP

↑K<sup>+</sup>, ↓Ca<sup>2+</sup>

β<sub>1</sub>

↑Cyclic AMP

β<sub>2</sub>

↑Cyclic AMP

β<sub>3</sub>

↑Cyclic AMP



# Regulation of catecholamines



- Reduced in sleep
- Increased in emergency situations
- **W.B.Cannon** called it “ **The emergency function of sympathoadrenal system**”
- Drugs
- NE is increased by emotional stresses with which the individual is familiar
- Epinephrine rises in stresses due to unexpected situation

# Effects of Catecholamines



- Increases glycogenolysis in liver and skeletal muscles
- Increases insulin and glucagon secretion by  $\beta$ -adrenergic mechanisms
- Decreases insulin and glucagon secretion by  $\alpha$ -adrenergic mechanisms
- Increases FFA mobilization
- Increases plasma lactates
- Stimulates metabolic rate

# Effects of Catecholamines



- NE and Epinephrine both increase rate and force of myocardial contraction
- Increases myocardial excitability
- Can lead to extrasystoles and arrhythmias
- NE produces vasoconstriction
- Epinephrine causes vasodilatation

# ADRENOCEPTORS

$\alpha_1$

Vasoconstriction

Increased peripheral resistance

Increased blood pressure

Mydriasis

Increased closure of internal sphincter of the bladder

$\alpha_2$

Inhibition of norepinephrine release

Inhibition of acetylcholine release

Inhibition of insulin release

$\beta_1$

Tachycardia

Increased lipolysis

Increased myocardial contractility

Increased release of renin

$\beta_2$

Vasodilation

Slightly decreased peripheral resistance

Bronchodilation

Increased muscle and liver glycogenolysis

Increased release of glucagon

Relaxed uterine smooth muscle

# Effects of Catecholamines

- Catecholamines increase alertness
- Increases metabolic rate due to vasoconstriction and lactate oxidation
- When injected increases potassium levels and later decreases
- Dopamine causes **renal and mesenteric vasodilatation**
- Elsewhere DA causes vasoconstriction
- DA has positive inotropic effect on heart
- DA is useful in treatment of shock