

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

In the name of Allah, Most Gracious, Most Merciful.

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ADRENAL MEDULLA

By Dr Farida Mujahid

Learning objectives

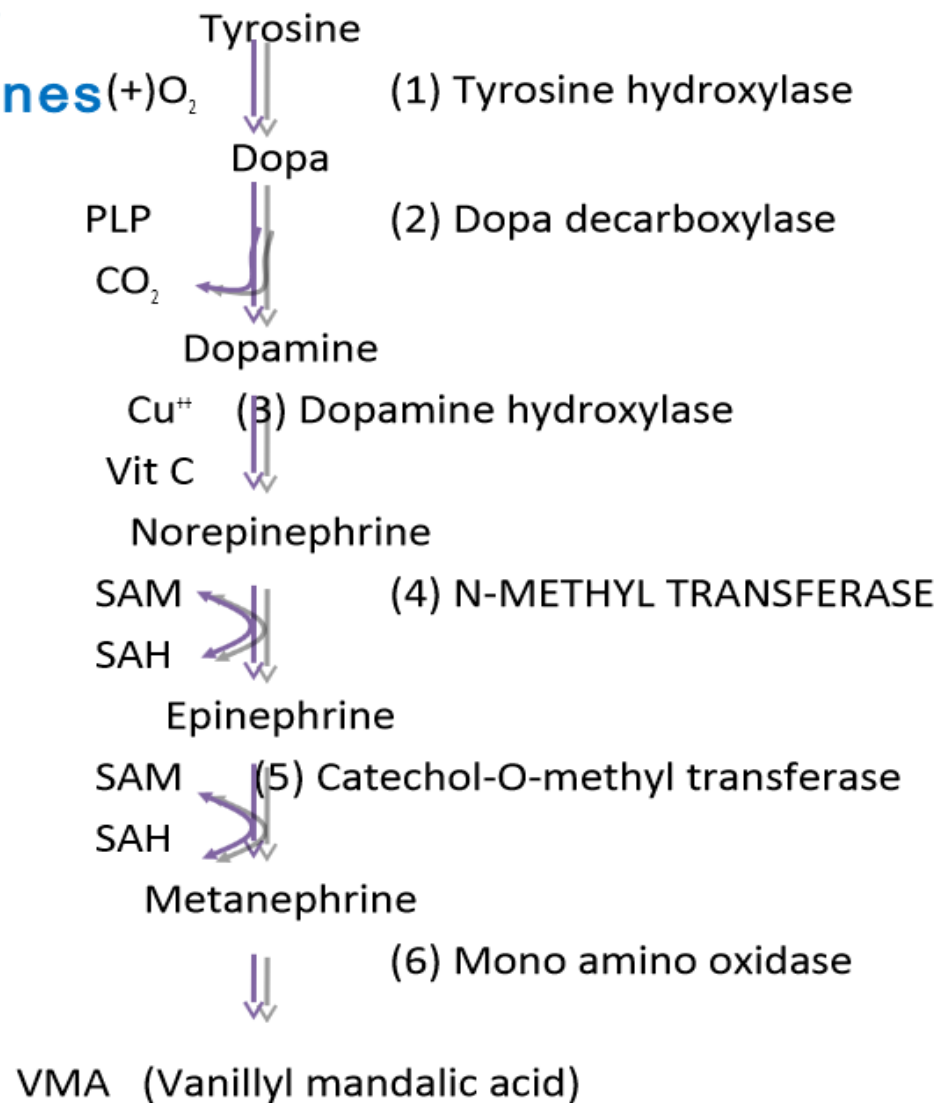
- » Hormones of adrenal medulla
- » Synthesis
- » Mechanism of action
- » Effects
- » Pheochromocytoma

Hormones of adrenal medulla

- » Adrenal medulla is an extension of sympathetic nervous system .
- » It produces two important hormones epinephrine and nor epinephrine
- » Both these hormones are catecholamines since they are amine derivatives of catechol nucleus
- » Epinephrine is a methyl derivative of norepinephrine .

- » Dopamine is another catecholamine produced as an intermediate during the synthesis of epinephrine .
- » Norepinephrine and dopamine are important neurotransmitters in the brain and autonomic nervous system .

Synthesis of Catecholamines



The difference between epinephrine and norepinephrine is only methyl group .

Norepinephrine has got no methyl group .

Catecholamines are rapidly inactivated and metabolized .

The enzymes catechol - o – methyl transferase (COMT) and

Monoamine oxidase (MAO) found in many tissues act on catecholamines.

The metabolic products metanephrine and vanillyl mandelic acid (VMA) are excreted in urine .

- » Catecholamines are produced in response to fight , fright and flight .
- » These include emergencies like shock, fatigue , anger , stress .

Actions of Adrenaline and Noradrenaline

- » Adrenaline and noradrenaline stimulate the nervous system
Adrenaline has significant effects on metabolic functions
- » Adrenaline and noradrenaline both have significant effects on cardiovascular system .

Mode of action of Adrenaline and Noradrenaline

- » Adrenergic receptors
- » The actions of adrenaline and noradrenaline are done by binding with receptors called adrenergic receptors which are present in the target organs.
- » Adrenergic receptors are of two types
 - » Alpha receptors
 - » Beta receptors

- » Alpha receptors are subdivided into alpha 1 and alpha 2
- » Beta receptors are also subdivided into beta 1 and beta 2
- » **ALPHA ADRENERGIC RECEPTORS**
- » Alpha adrenergic receptors mediate more noradrenaline actions than the adrenergic actions .

» ALPHA 1 RECEPTORS

» Alpha receptors exert their actions by activating the second messenger inositol triphosphate through phospholipase C .

» ALPHA 2 RECEPTORS

» Alpha 2 receptors exerts their effects by inhibiting adenyl cyclase and reducing intra cellular cyclic AMP .

» BETA ADRENERGIC RECEPTORS

» Beta 1 receptors

» Beta 1 receptors mediate the actions of both adrenaline and noradrenaline equally

» Beta 2 receptors

» Beta 2 receptors are larger than beta 1 receptors and mediate more of adrenaline actions than noradrenaline .

» Both beta 1 and beta 2 receptors exert their actions by activating adenylyl cyclase through G proteins and increasing intracellular cyclic AMP .

Table 24.4. Adrenergic Responses of Selected Tissues

Organ or Tissue	Receptor	Effect
Heart (myocardium)	β_1	Increased force of contraction Increased rate of contraction
Blood vessels	α β_2	Vasoconstriction Vasodilation
Gut	α, β	Decreased motility and increased sphincter tone
Liver	α, β	Increased glycogenolysis
Adipose tissue	β	Increased lipolysis
Skin (apocrine glands on hands, axillae, etc.)	α	Increased sweating
Bronchioles	β_2	Dilation

Metabolic Role Of Catecholamines

Catecholamines causes various biochemical effects on the body .

The ultimate goal is to mobilize the energy resources and prepare the person to meet emergencies

Effect On Carbohydrate Metabolism

- » Adrenaline and Noradrenaline increases the degradation of glycogen (glycogenolysis)
- » Increases the synthesis of glucose (gluconeogenesis)
- » Decrease the formation of glycogen .
- » The overall effect of catecholamines is to increase the blood glucose level and make it available to brain and other tissues to meet the emergencies .

Effect On Lipid Metabolism

- » Both adrenaline and noradrenaline increases the break down of triacylglycerols in adipose tissue .
- » Causes increase in the free fatty acids in the circulation which are utilized by the heart and muscle as fuel .
- » The metabolic effects of catecholamines is increase in adenylate cyclase activity causing increase cyclic AMP level .

Other Effects

- » On the whole catecholamines causes increase cardiac out put , increase blood pressure , and increase oxygen consumption .

Pheochromocytoma

- » Catecholamine secreting tumour of adrenal medulla(ADRENAL pheochromocytoma)
- » The characteristic feature of pheochromocytoma is hypertention .
- » **DIAGNOSIS**
- » Only possible when there is excessive production of epinephrine and norepinephrine .

» The measurement of urinary vanillylmandelic acid is helpful in diagnosis of pheochromocytoma .