

Review of Biochemistry of Dopamine and it's Biological Significance

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Abstract

The chemical formula of dopamine is $C_6H_3(OH)_2-CH_2-CH_2-NH_2$. Normally dopamine is abbreviated as DA, that is, dopamine (DA). There are many chemicals in the category of catecholamine and dopamine is one among them. Dopamine plays crucial role in the life of human beings and many other animals. Dopamine is essential for feel good factors in humans and many other mammals. They deficiency of dopamine stimuli or secretion in brain can lead to many mental diseases.

Keywords: Amino acid, Catecholamine, Deficiency, Dopamine, Mental disease.

INTRODUCTION

In every living being cell-to-cell communication is very important for healthy survival. The communication process among cells is called transduction. Dopamine is a neurotransmitter that helps in transduction and chemically is a monoamine catecholamine and a hormone that carries out many functions. It is definitely made in our brain. Being a neurotransmitter the role of dopamine in our brain is to help us in movement, memory, mood control, sleep, attention, motivation, pleasure reward, arousal, behaviour and cognition.

High or low secretion level leads to many neuromotor diseases in humans. Some of the common such diseases are hyperactivity disorder, restless leg and Parkinson's disease.

Most of the addictive chemical leads to secretion of high dose of dopamine hormone in our body

and brain. This high dose gives us great sense of satisfaction and pleasure. On the contrary low secretion of dopamine in the body leads to mood swings, unhappy state, being unmotivated and tired. So optimum amount or a balance amount of dopamine secretion is required in the body to remain focused, alert, motivated and happy.

High level of dopamine also leads to problems like addiction, mania and obesity. Imbalance level of dopamine secretion in the brain leads to mental disorders like Schizophrenia. This is because of high secretion of dopamine in certain regions of the brain and low secretion in certain other.

Sometimes this question is generally asked how do dopamine impacts a drug addicts?

Addictive drug or recreational drugs interfere with the nervous system of our body. If taken continuously addictive drugs weakens the nervous

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system impacting the response one gets with reward signal usually when with some dopamine stimulus. To achieve the same the addicts continuously depend on the dose of drug they are edited to a regular interval to get that kick.

Therefore, dopamine is not directly involved in drug users surge in behaviour. But dopamine secretion is such designed after addiction that it gives the urge of going back to the drug intact after a fixed time and to get the desired reward of pleasure.

There certain food that contains high magnesium dose and it is said magnesium is important for appropriate dopamine secretion in the body. So, we need to take good food and nutrients to avoid lack of dopamine secretion in the body. Good intake of almond, green leafy vegetables, banana, beetroots, oranges and green tea are good for dopamine level in the body.

OBJECTIVE OF THE STUDY

Objective of the study is to know the structure of dopamine and various physiological and psychiatric disorder associated with dopamine malfunctioning.

LITERATURE REVIEW

Dopaminergic system is important for mental health of the human body. Many pathological conditions like Schizophrenia, Parkinson disease etc take place because of the dysfunctional dopaminergic transmission in the body. Dopamine receptors help to overcome hallucination and delusion caused during schizophrenia. Dopamine deregulation in the body causes serious health issues in the human body and brain. One of the challenges of scientists, pharma, medical experts and doctors have to find dopaminergic drug which has no adverse effect. A great achievement in the field of dopamine research surfaces a decade ago.⁵

The neurotransmitter is involved in behaviours like food craving, decision making and various executive functions of human beings. Some human beings show the symptom of binge eating, which is also connected with the dopamine regulation deviation in the body.⁶

We very well know that the neurotransmitters are very well with the help of neural transmitters or neural signals from the central and peripheral nervous system. Dopamine is an important neurotransmitter of central nervous system that function in the most of the activities of human behaviour.^{7,8}

Dopamine is synthesized by the precursors of kidney and the brain area of an animal body specifically in humans. The importance of dopamine in human brain lies in its role in the sense of pleasure with the work a human beings do in its day-to-day life. Motor control in humans and lactation in feeding females are all the result of proper functioning of dopamine neurotransmitter.⁹

Discussion the Structure of Dopamine

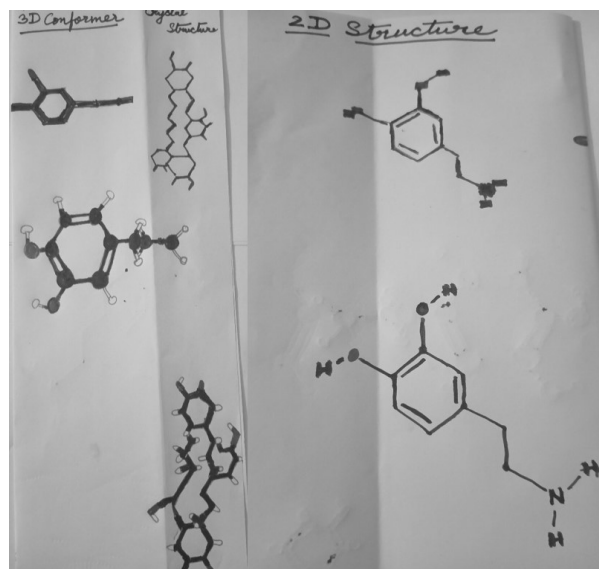


Fig. 1: 2D, 3D and crystal structure of dopamine

Dopamine's chemical structure is $C_8H_{11}NO_2$ and it is a chemical of catechol family and called catecholamine (Fig. 1). Catechol is the family in which position 4 hydrogen is substituted with 2-aminoethyl group.

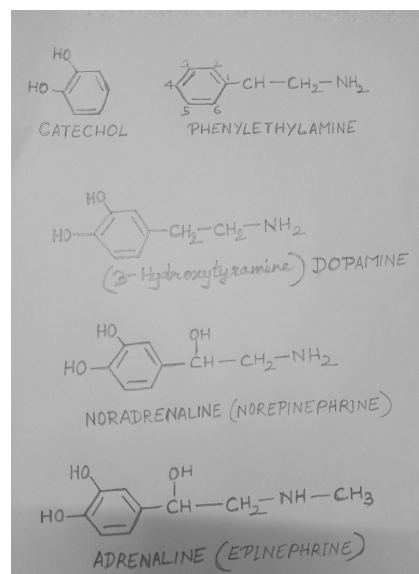


Fig. 2: Structures of main catecholamines

Only dopamine is not the hormone belong to the catechol family but adrenaline (epinephrine) and noradrenaline (norepinephrine) also belong to this family. These are the hormone secreted from adrenal gland (Fig. 2).

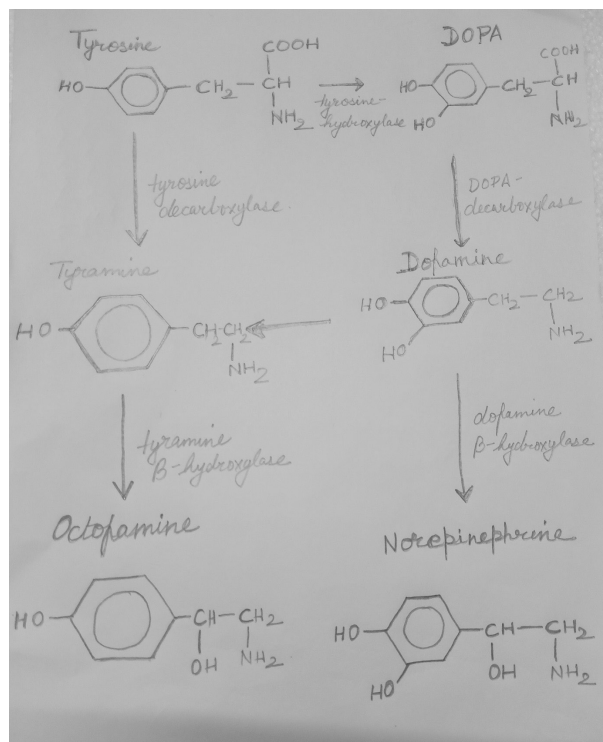


Fig. 3: Representation of biosynthetic pathways and chemical relationships

Fig. 3 represent the biosynthetic pathways and chemical relationships between all the neurotransmitter hormones and enzymes involved in these pathways. Octopamine, norepinephrine, dopamine, and tyramine are all synthesized by tyrosine.

Most of the moving animals are found to have behavioural pattern impacted via neurotransmitters. In mammals body motions are dependent on dopamine. Most of their locomotory action depends on dopamine. In search of food reward animals move from one place to other as much as they can. Some of the experiments have shown that mammals have reflect strong response to dopamine both for primary rewards like food and water and temporary rewards like motivation etc.¹⁻³

In diseases like Parkinson's disease (PD) is loss of nigral dopaminergic neurons.

Anomalous motor behaviour has been shown to robustly correlate with measures of communicative function, suggesting an involvement of the

physiology and psychological studies. The nanomaterials are metals, metal oxides, electrodes, cathodes, anodes, polymers, carbon oxides etc. Electromagnetic material or in other words electronic devices made of nanomaterials help in easy detection of function of neurotransmitters like

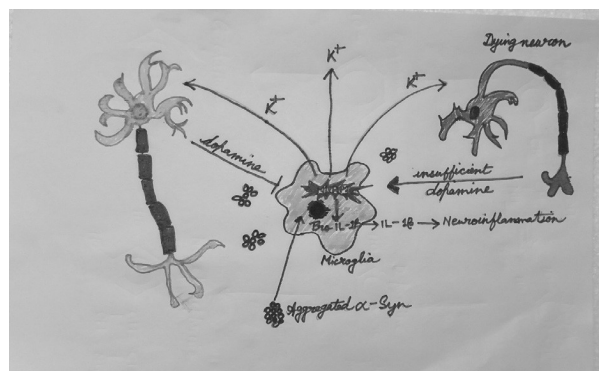


Fig. 4: A sketch diagram of dopamine in Parkinson's disease

sensorimotor system in impaired communication. At the neural level this is supported by the evidence that communicative and motor behaviours have all been linked to different areas within the basal ganglia via a series of parallel (yet overlapping) projections from and to frontal cortical regions.⁴

DISCUSSION

A diseased condition called binge eating disorder (BED) and bulimia nervosa (BN) is characterised by eating in huge amount uncontrollably. Enhanced food craving and decreased decision-making capacity are some of the effects of this diseased caused to the human body.⁷

Hedonic hunger is associated with the sense of lack of energy and people start eating uncontrollably to attain a desired level of pleasure of eating. Such situation leads to other health hazards condition like overweight, obesity and life style diseases associated with weight gain.

In human body termination of dopamine function occurs because of clearance of dopamine singling in the body. This can be impacted by many chemicals, physical and physicalistic conditions.

The detection of dopamine in real behaviour in human is very important area of research. Electronic or electromagnetic biosensors are used to detect function of dopamine, dopamine regulation on human behaviour. Nanomaterial modified materials electronic devices are used to detect dopamine regulation and receptions in human and animal bodies to study its effect on behaviour,

dopamine in the human or animal bodies.⁸

Generally, dopamine is stored in the adrenal gland and dopaminergic vesicles. Dopamine is also an important neurotransmitter not only for brain but also for eye and retina. According to IUPAC (International Union of Pure and Applied Chemistry that names the chemical molecules), the name (ID) of dopamine is as follows: IUPAC ID: 4-(2-aminoethyl) benzene-1,2-diol⁹

CONCLUSION

The study has helped us conclude that the development of new DNA recombinant technology has helped us easily identify DNA receptors subtypes. The technology of use of targeted mutagenic agent helps us identify ligand of receptor dopamine. Presently with all available DNA technologies we are able to identify dopamine receptors area and its function in the brain areas. The structural details and receptor areas of dopamine has been explained in this study. Even the potential function of each receptor sites of dopamine has also been discussed at large in this study article. Even the disease cause both with the hypo and hyper secretion and receptor malfunction has been mentioned in this study. Behavioural studies show that human behaviour is very well dependant on dopamine secretion.

Through our study we have also found out that dopamine has been also involved in the food behaviour of human beings. Binge eating is a symptom of a nervous disease called bulimia nervosa which is generally connected with other serious health issues. In these patients, suffer from strong desire of food at certain trigger situation when they find themselves lacking dopamine spike in the body and the body crave for the same. However, the exact physiological marker to define binge eating is still lacking among the scientists.

Almost all studies in our review of studies have indicated the role of dopamine level, regulation of dopamine and its receptor in the behaviour of human being related to psychiatric condition and behaviour work.

Conclusively we can definitely say that dopamine is an amino acid that brings happiness.

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