CSIR NET Life Science Unit 4

Neurotransmitters

The human body functions are controlled by neural cell networks which generate and grow electrochemical signals, they get released and diffuse across synaptic junctions of neurotransmitters. These transmitters mediate the exchange of those signals between the neural cells. A synapse is known as having the presynaptic neuron and a postsynaptic neuron that release and bind neurotransmitters, respectively. In the nervous system, neurotransmitters are essential components. As to understand the work of the brain and identify neurological diseases. Neurotransmitters binding to the receptor in postsynaptic neuron triggers may be short-term changes like postsynaptic potential also known as a change in membrane or change may be longer like activation of the signal cascade. Nerve impulses are necessary for signal propagation, when signal grows they are sent to the central nervous system through efferent and afferent neurons to maintain the coordination in muscles.

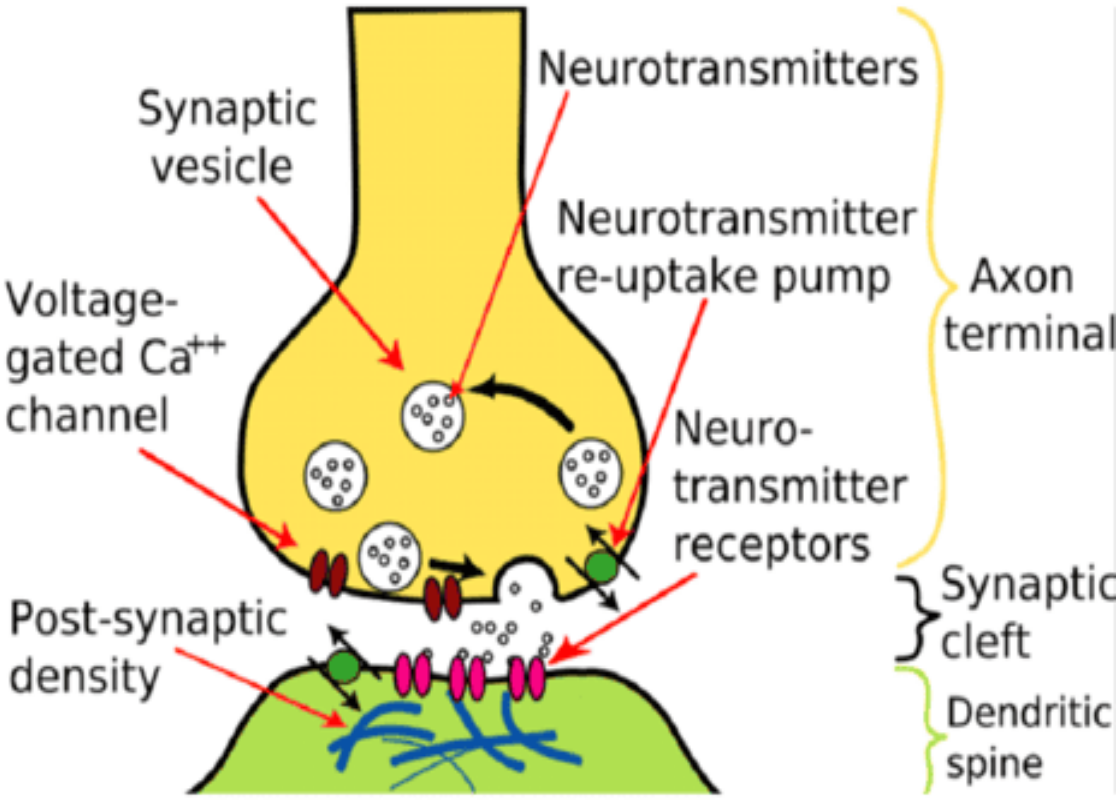
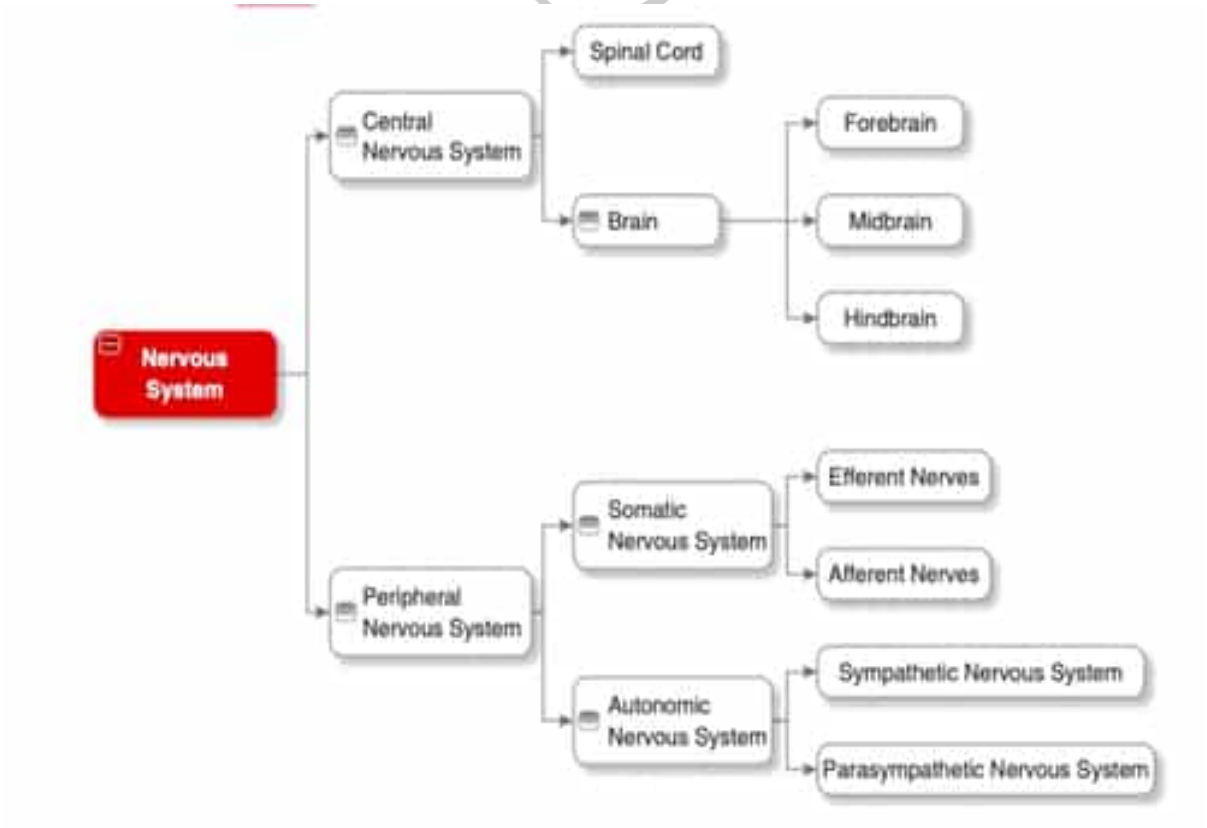


Fig. Basic process of neurotransmission

A neurotransmitter must meet the following criteria in order to qualify as, a molecule:

- It has to be synthesized and released by the same neuron and it is stoked at the presynaptic terminal.
- The release of neurotransmitters induces a specific behaviour on the postsynaptic neuron.
- Exogenous administration of a neurotransmitter is also capable to generate the same effect.
- A specific mechanism can stop the induced action on the postsynaptic cell.
- The molecule or substance should be packed into a synaptic vesicle and they need to be available in the presynaptic nerve terminal.
- When depolarisation or an action potential occurs on the arrival of at the presynaptic membrane, the substance must be released from the nerve terminal.
- The substance must be available on the postsynaptic membrane on specific receptors.

To date, the neurotransmitter's molecule number exceeds above a hundred, chemical nature of neurotransmitters varies chemically. They are classified as amino acids, monoamines, peptides, purines, and others. All neurotransmitters are necessary for the good functioning of the central and peripheral nervous systems.



Types of Neurotransmitters:

Neurotransmitters are classified in many ways by their chemical composition or their function. Majorly, neurotransmitters are chemically classified into the following types:

A) Amino Acids- in this type Glutamate, Aspartate, D-Serine, Gama-Amino-Butyric acid, and Glycine comes.

B) Monoamines and other Amines- these categories includes dopamine, Epinephrine, Norepinephrine, Histamine, Serotonin, and others.

C)Other- in this category Acetylcholine, Adenosine, Nitric oxide, and anandamides come

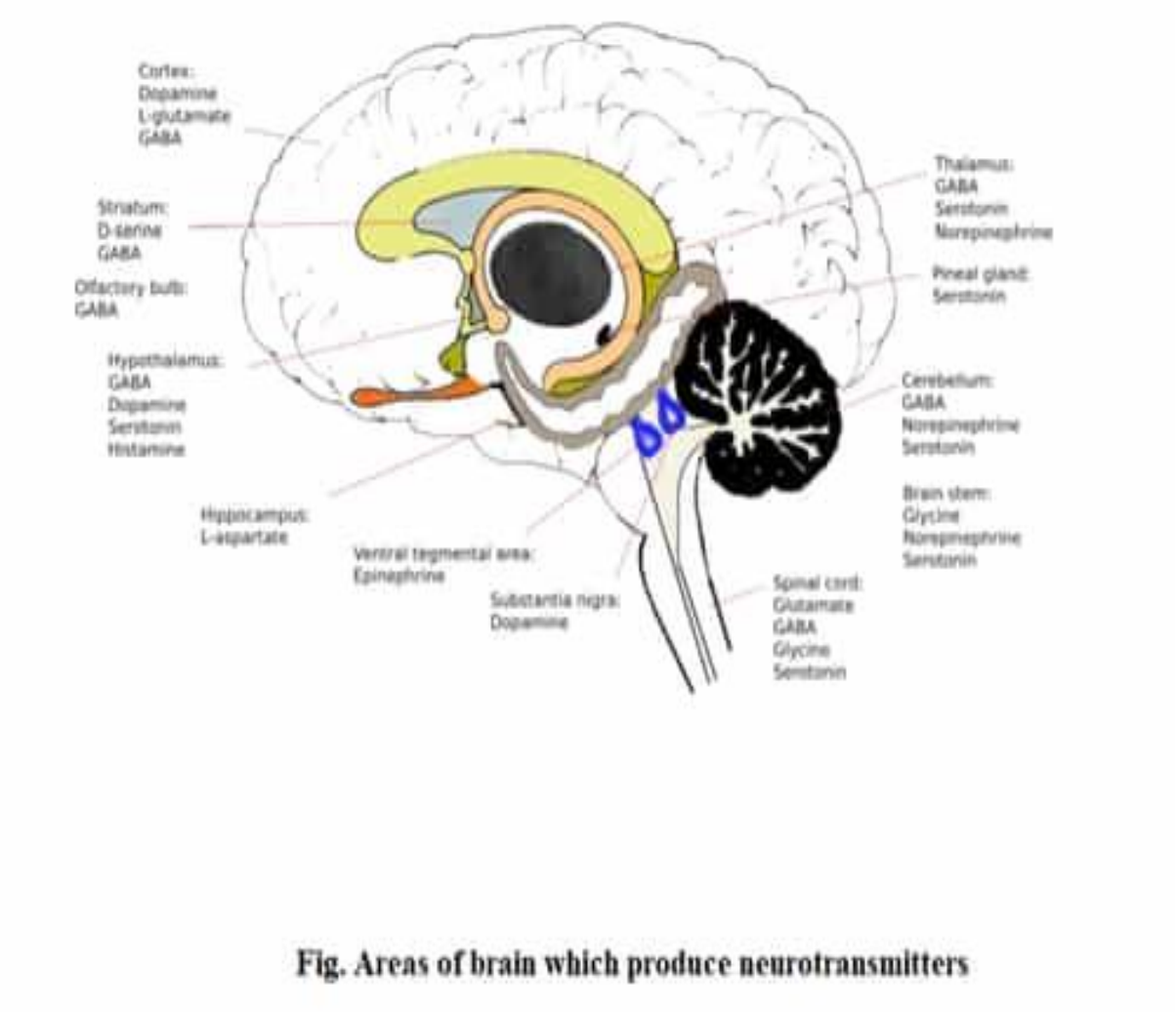


Fig. Areas of brain which produce neurotransmitters

SN.	Name	Localization	Role
1	Glutamate	Widespread in the brain and spinal cord	Involved in learning, memory, vision, epilepsy, schizophrenia, excitotoxicity
2	L-aspartate	Hippocampus	Activate NMDA receptor. Co-neurotransmitter with glutamate
3	GABA	Hypothalamus, cerebellum, spinal cord, olfactory bulb, and retina	Effects augmented by alcohol and antianxiety drugs, epilepsy, convulsions
4	Glycine	The brain stem, spinal cord, and retina	Hyperexcitability, uncontrolled convulsions
5	D-serine	Striatum	Coagonist of NMDA receptor, schizophrenia
6	Dopamine	Hypothalamus substantia nigra of midbrain	Good feeling, Parkinson's disease, and schizophrenia
7	Epinephrine	Tegmental and medulla	Fight-or-flight response
8	Norepinephrine	Locus coeruleus of the midbrain brain stem, limbic system, cerebral cortex, thalamus	Good feeling, depression
9	Serotonin	midbrain, hypothalamus, limbic system, cerebellum, pineal gland, spinal cord	sleep, appetite, nausea, headaches, regulation of mood, schizophrenia,

			anxiety, and depression.
10	Histamine	Hypothalamus Act on G-protein coupled receptors	Involved in Alzheimer's and schizophrenia
11	Acetylcholine	Basal nuclei and cortex, neuromuscular junctions	Prolonged effects lead to tetanic muscle spasms, which is linked to Alzheimer's
12	Substance P	widespread in the brain, hypothalamus, limbic system, pituitary gland and spinal cord	Undefined
13	Natural opiate Neuropeptide Y	Hypothalamus	Increasing food intake, reducing anxiety and pain, affecting the circadian rhythm, and controlling epileptic seizures
14	Adenosine triphosphate	Basal nuclei, dorsal root ganglion	Involved in pain sensation Carbone monoxide C O brain, neuromuscular and neuromuscular synapses regulate vasopressin neuronal activity
15	Nitric oxide N O brain	spinal cord and adrenal gland	Relaxing factor, involved in myocardial infarction

16	Hydrogen sulfide	Hippocampus, Hypothalamus	Involved in the regulation of vascular tone, myocardial contractility

Regulators:

Some drugs are targeting neurotransmitters as they approach and change their whole system, for example, cocaine acts on dopamine and blocks its reuptake and puts it back into the presynaptic neuron, and leave the neurotransmitter molecule in the synaptic gap for a long time. So when the dopamine remains in the synapse for longer neurotransmitters continue their binding to the postsynaptic neurons which elicit a particular type of emotional response. Prolonging or accessing the amount of dopamine in the synaptic region may lead to the downregulation of some postsynaptic responses.

- A drug is known as Prozac acts as a selective serotonin reuptake inhibitor; this drug blocks the reuptake of serotonin by the action of presynaptic cells. This act increases the amount of serotonin in synapses which allows their long time to remain so the potential of natural serotonin release is affected.
- A drug AMPT prevents tyrosine conversion to L-Dopamine;
- Respiring prevents the storage of dopamine into a vesicle, and
- Deprenyl drugs inhibit monoamine oxidase activities so the level of dopamine is increased.
- Some disease also affects neurotransmitters like Parkinson's disease in which failure of dopaminergic cells occurs in deep brain nuclei.