Meditation and Neurotransmitters: A Literature Review

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Abstract:

Neurotransmitters are signaling molecules of crucial importance for the proper functioning of the nervous and other systems. Quantification of neurotransmitters is particularly difficult due to their very low concentrations in biological matrices and co-existence with many other biochemical molecules. Meditation beginners showed increased activity in areas involved in the cognitive regulation of nociceptive processing and areas. These endogenous chemicals are integral in shaping everyday life and functions.

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Material and method –

Neurotransmitters are synthesized in neurons using precursor molecules like amino acids, and their release involves a process where the presynaptic neuron releases the neurotransmitter into the synaptic cleft, which then binds to receptors on the postsynaptic membrane. Methods for detecting and measuring neurotransmitters include microdialysis, HPLC, and positron emission tomography (PET). Neurotransmitter release is mainly determined by the classical microanalysis technique, which is generally coupled to high-performance liquid chromatography (HPLC). Detection of neurotransmitters can be done by fluorescence, optical density, electrochemistry or other detection systems more sophisticated.

Type of neurotransmitters -Neurotransmitters are categorized based on their chemical structure and function.

1.Amino Acids:

- Glutamate: The primary excitatory neurotransmitter in the brain.
- GABA (Gamma-aminobutyric acid): The primary inhibitory neurotransmitter in the brain.
- Glycine: An inhibitory neurotransmitter, particularly in the spinal cord.

2. Monoamines:

- Dopamine: Involved in reward, motivation, and movement.
- Serotonin: Involved in mood, sleep, appetite, and other functions.
- Norepinephrine (Noradrenaline): Involved in alertness, mood, and stress response.
- Epinephrine (Adrenaline): Involved in the fight-or-flight response.
- Histamine: Involved in wakefulness, appetite, and allergic reactions.

3. Peptides:

- Endorphins: Natural pain relievers.
- Oxytocin: Involved in social bonding and childbirth.

4. Other Neurotransmitters:

- Acetylcholine: Involved in muscle movement, memory, and attention.
- Adenosine: Involved in sleep regulation.
- Nitric Oxide: A gasotransmitter involved in various functions, including vasodilation.

Function of neurotransmitters –

Neurotransmitters are chemical messengers that your body can't function without. Their job is to carry chemical signals ("messages") from one neuron (nerve cell) to the next target cell. The next target cell can be another nerve cell, a muscle cell or a gland.

Neurotransmitters are the body's chemical messengers that transmit signals between nerve cells (neurons), or from neurons to muscles or glands. They play a crucial role in various bodily functions, including movement, sensation, and heart rate regulation. Neurotransmitters can be excitatory, promoting action potential generation, or inhibitory, preventing it.

Role in Bodily Functions-

Neurotransmitters influence a wide range of bodily functions, including:

- Movement: They facilitate muscle contraction and coordination.
- Sensation: They enable the brain to process sensory information.
- Mood and Emotion: They play a role in regulating emotions like pleasure, fear, and anxiety.
- Cognitive Functions: They are involved in processes like memory, learning, and concentration.
- Other Functions: They also influence sleep, appetite, and hormone release.

Role in chemistry –

Neurotransmitters are essential chemical messengers in the nervous system, facilitating communication between neurons and other cells. They play a crucial role in various physiological and psychological functions, including movement, sensation, and emotion. In terms of their chemistry, neurotransmitters are molecules synthesized within neurons and released to transmit signals across synapses, where they bind to specific receptors on target cells. Neurotransmitters can be divided into three categories: amino acids, amines, and peptides .The amino acids and amines mediate fast synaptic transmission (sub-millisecond to millisecond) in the CNS. Acetylcholine mediates fast synaptic transmission at all neuromuscular junctions.

Relation between meditation and neurotransmitters –

Meditation is linked to changes in neurotransmitter levels, particularly an increase in serotonin and dopamine. These changes can have a positive impact on mood, stress levels, and overall well-being. Levels of dopamine (the neurotransmitter of pleasure), serotonin (the neurotransmitter of happiness), and GABA (the neurotransmitter of calmness) all rise in response to meditation. And in people who practice on a daily basis, they send signals more routinely. Meditation can influence neurotransmitters, particularly those related to mood, stress, and cognition. Studies suggest increases in serotonin, dopamine, GABA, and BDNF, which may contribute to improved emotional regulation, stress resilience, and cognitive function.

Various Neurotransmitters are released during meditation –

During meditation, several neurotransmitters are released, including dopamine, serotonin, GABA, and potentially others like endorphins and oxytocin. These

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neurotransmitters play key roles in regulating mood, promoting relaxation, and influencing the brain's reward system. Here's a more detailed look at some of the neurotransmitters involved:

- Dopamine: Meditation may lead to increased dopamine release, which is linked to pleasure, motivation, and the brain's reward system.
- Serotonin: Serotonin, often associated with happiness and well-being, has been shown to increase during meditation.
- GABA:GABA is an inhibitory neurotransmitter that promotes relaxation and can help reduce anxiety. Increased GABA levels during meditation are thought to contribute to a sense of calm.
- Endorphins: Endorphins, which have pain-relieving and mood-enhancing effects, are also released during meditation, contributing to feelings of relaxation and contentment.
- Oxytocin: Meditation may also stimulate the release of oxytocin, a hormone associated with social bonding, trust, and positive emotions.

While these are some of the most commonly cited neurotransmitters, other neurotransmitters and neuropeptides may also be affected by meditation, contributing to the overall experience and benefits.

Result –

Neurotransmitters are chemical messengers that transmit signals between nerve cells (neurons) and other cells, like muscles and glands. They result in a variety of effects, including regulating bodily functions like heart rate, breathing, and sleep, as well as influencing psychological functions like mood, pleasure, and learning. Neurotransmitters are released from synaptic vesicles in presynaptic neurons in response to neural activity, diffuse across the synaptic cleft, and bind specific receptors in order to bring about changes in postsynaptic neurons.

Conclusion –

Neurotransmitters are essential for maintaining a functioning brain, coordinating various functions and activities. Imbalances or malfunctions in neurotransmitter systems can lead to various neurological and psychiatric disorders. In summary, neurotransmitters are the fundamental building blocks of communication in the nervous system, playing a crucial role in both normal brain function and the development of various disorders.

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