ISSN: 0976-3031

International Journal of Recent Scientific Research

Impact factor: 5.114

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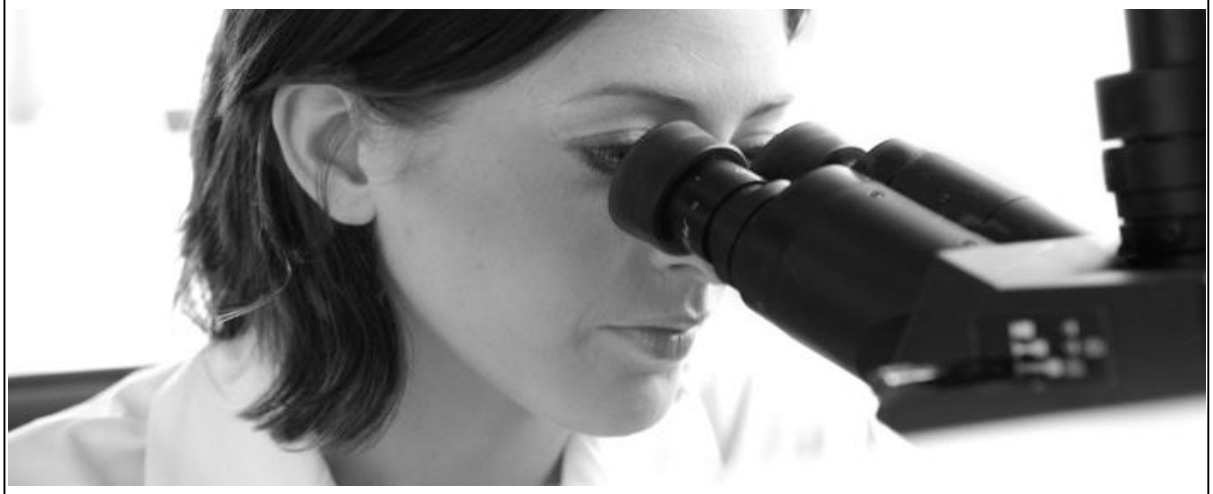

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Volume: 6 Issue: 10

THE PUBLICATION OF
INTERNATIONAL JOURNAL OF RECENT SCIENTIFIC RESEARCH
http://www.recentscientific.com
E-mail: recentscientific@gmail.com

ISSN: 0976-3031

Available Online at http://www.recentscientific.com

International Journal of Recent Scientific Research
Vol. 6, Issue, 10, pp. 6632-6636, October, 2015

International Journal of Recent Scientific Research

RESEARCH ARTICLE

IMPACT OF NEUROTRANSMITTERS ON HEALTH THROUGH EMOTIONS

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ARTICLE INFO

Article History:

Received 05th July, 2015
Received in revised form 08th August, 2015
Accepted 10th September, 2015
Published online 16st October, 2015

Key words:

ABSTRACT

Neurons in order to communicate with each other rely on highly specialized chemicals called neurotransmitters. Neurotransmitters are chemical messengers that coordinate the transmission of signals from one nerve cell (neuron) to the next. Neurotransmission has a great influence over human emotions, behavior, and moods. Neurotransmitters interact with target sites called receptors located throughout the brain and body to regulate a wide variety of processes including emotions, fear, pleasure, joy, anger, mood, memory, cognition, attention, concentration, alertness, energy, appetite, cravings, sleep, and the perception of pain. Disrupted communication between the brain and the body can have serious effects to one's health both physically and mentally. Various aspects of personality can be altered mainly by the three major neurotransmitters - dopamine, serotonin and noradrenaline. Imbalances in dopamine have been found to play a role in schizophrenia. Low levels of serotonin often results in depressed mood and poor sleep patterns among many other symptoms. Norepinephrine alerts the brain of the presence of novel and potentially threatening events in the external environment i.e., alertness and arousal. Depression, anxiety and other mood disorders are thought to be directly related to imbalances with neurotransmitters. Hence, the present article aims to review the role of neurotransmitters on health through human emotions.

INTRODUCTION

Animal and Human behavior suggests that it is ultimately an expression of events guided by the nervous system. As decision-making neurological processes became increasingly concentrated in the centralized brain over evolutionary time, behavior became essentially an expression of brain's response to information coming to it from inside and outside the body. [12]

Human emotions guide and direct behavior. They dominate us in such a way that there is no solution. If a person has no emotions, he becomes crippled in terms of life. An emotion is a strong feeling associated with some instincts or biological drives. In addition to the above, emotions have some more specific characteristics-they bring psychological and physiological changes. Emotions are short-lived experiences that produce coordinated changes in people's thoughts, actions and physiological responses. During emotions, specific action tendencies infuse both mind and body, simultaneously narrowing individual action urges (flight in fear, attack in anger) by mobilizing appropriate bodily support for those specific actions. [24]

Researchers classified the human emotions into Negative (Fear, Anger, Depression, Anxiety, Envy, Shame etc.) and Positive (Love, Appreciation, Happiness, Hope, Confidence, Patience, Trust etc.) emotions. The primary emotions are anger, fear, pleasure, sadness, and disgust. Positive emotions are often characterized by a relative lack of autonomic reactivity. They broaden the scopes of attention, cognition, and action widening the array of percepts, thoughts and actions presently in mind.[24] The positive emotion of pleasure may facilitate ingestive, exploratory, sexual or novel-seeking behavior[5]. Negative emotions such as anger and fear may promote avoidance or defensive behaviour. They may lead to Change in appetite, Headaches, High blood pressure, Insomnia, Sexual problems, Weight gain or loss, Chest pain. Studies have shown that negative emotions actually weaken your body, while positive emotions strengthen your body. Shame has the most devastating effect, followed by guilt, apathy, grief, fear, anxiety, craving, anger and hate. Negative emotions really do cause disease and illness and premature aging. Powerful emotions such as pain, fear, grief, disappointment, panic, anxiety, anger and longing shock your body like an electrical charge, leaving scars or lesions along your neural pathways [6].
A person suffering from depression for two to three months period can observe psychological and physical changes. The psychological changes that can be noticed are loss of memory,

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interest in life, decision making and problem solving ability. Similarly, physical changes such as loss of appetite, weight, glow in face and general activities also can be observed. Actually it is the mind that suffered from depression, but how these changes occur to the human body can be studied. The aim of the present paper is to understand the role of neurotransmitters in the psychological changes in the human body and their impact on the health.

Neurotransmitters

Neurotransmitter [1] is a chemical substance that acts as a mediator for the transmission of nerve impulse from one neuron to other neuron through a synapse. It is produced in the cell body of the neuron and is transported through axon. At the axon terminal, the neurotransmitter is stored in small packets called vesicles. Under the influence of stimulus, these vesicles open and release the neurotransmitter into synaptic cleft. It binds to the specific receptors on the surface of post synaptic cell and is responsible for the various actions produced. In short, neurotransmitters are the way nerve cells communicate with each other and with other cells in the body. Neurotransmitters are used to relay information about environment to the brain, to analyze the information and to set in motion appropriate bodily responses. [12]

Most neurotransmitters can activate multiple receptor subtypes and receptor classes. If they were allowed to operate over a long period of time, the results would be disastrous for the organism since there would be a constant overload of messages being sent [29]. Approximately 70 neurotransmitters regulate human body functioning and contribute to normal functioning [27]. They function by changing the permeability of the cell membrane to various ions such as sodium and potassium. If an excess of sodium ions flow into the nerve cell, an impulse is generated. If an excess of potassium ions flow out, the impulse is inhibited. Depending upon their function, neurotransmitters are classified into two types. Excitatory neurotransmitters and Inhibitory neurotransmitters.

Excitatory neurotransmitters are responsible for the conduction of impulse from presynaptic neuron to postsynaptic neuron. Neurotransmitter released from presynaptic axon terminal causes some change in resting membrane potential, i.e. slight depolarization by the opening of sodium channels in the postsynaptic membrane and influx of sodium ions from extra cellular fluid. This slight depolarization is called excitation. Common excitatory neurotransmitters are acetylcholine, noradrenaline, glutamate, aspartate, histamine and nitric oxide.

Inhibitory neurotransmitters inhibit the conduction of impulse from the presynaptic neuron to postsynaptic neuron. When it is released from presynaptic axon terminal due to the arrival of action potential, it causes the release of potassium in the post synaptic membrane and efflux of potassium ions which leads to hyper polarization, also called as inhibition. Inhibitory neurotransmitters calm the brain and help create balance in mood. Common inhibitory neurotransmitters are dopamine, gamma amino butyric acid (GABA), glycine and serotonin[1].

The small molecular neurotransmitters that carry the heaviest burden in regulating the brain activity affect behavior. They move across the synapse by simple diffusion and bind to receptors on the post synaptic dendritic tip of the receiving neuron. If an appropriate receptor is present on the post synaptic fiber, several things may happen. Otherwise, nothing happens. If the receiving cell is another neuron, the incoming signal will act either to facilitate or to suppress release of that neuron's own transmitter. If the receiving cell is a muscle cell, it will contract.

Although there is only a single form of each neurotransmitter found in the body, there may be as many as a dozen or more different kinds of protein receptors for each neurotransmitter. Different neurons, in different regions of the brain and carrying out different functions, may express different receptors for the same neurotransmitter. This allows the same neurotransmitter to affect neurons in different ways, depending on the type of receptor they display. Each receptor, when occupied, triggers a different kind of reaction within the receiving neuron. All neurotransmitters play some role in behavior. The neurotransmitters most commonly implicated in behavior modulation are the small molecular transmitters – acetyl choline, norepinephrine, dopamine and serotonin. [12]

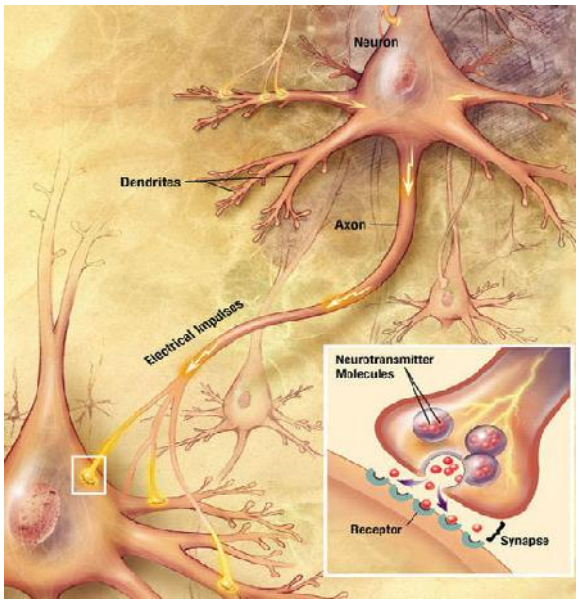
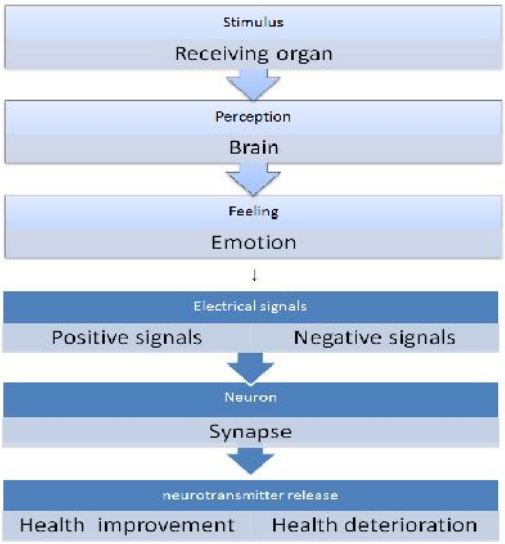


Fig1 Process of neurotransmission [26]

Scheme of neurotransmission



Acetylcholine (ACH)

ACH is responsible for much of the stimulation of muscles, including the muscles of the gastro-intestinal system. It is transmitted within cholinergic pathways that are concentrated mainly in specific regions of the brainstem and are thought to be involved in cognitive functions, especially memory. Severe damage to these pathways is the probable cause of Alzheimer's disease. Outside the brain, acetylcholine is the main neurotransmitter in the parasympathetic nervous system – the system that controls functions such as heart rate, digestion, secretion of saliva and bladder function. It causes emotion, reward perception and longterm depression.[8] I t plays an important role in memory formation[30].

The rapid nature of the synaptic transmission mediated by the nicotinic receptor is consistent with its role at the NMJ and in the ganglion of the ANS. Little is known about the role of the nicotinic receptor in CNS behavior. Clearly, nicotine stimulation is related in some manner to reinforcement as indicated by the prevalence of nicotine addiction among humans.

Muscarinic receptors, in contrast, are important mediators of behavior in the CNS. One example is their role in modulating motor control circuits in the basal ganglia. A second example is their participation in learning and memory. The latter is inferred from two types of observations- muscarinic antagonists are amnesic agents, and deterioration of the cholinergic innervation of the neocortex is associated with memory loss in Alzheimer's disease. [13]

Serotonin

Serotonin has an unusually large number of different receptors present on various cells in the brain; a total of 15 receptors, spread across 7 different structural classes. There are two pre-synaptic receptors that are important to behaviour - the serotonin transporter and a regulatory receptor referred to as the serotonin-1β receptor. [12]

Adequate amounts of serotonin are necessary for a stable mood and to balance any excessive excitatory neurotransmitter firing in the brain. In addition to mood control, serotonin has been linked with a wide variety of functions, including the regulation of sleep, pain perception, body temperature, blood pressure and hormonal activity.

Activities such as eating, grooming, or simply resting and thinking are accompanied by high levels of brain serotonin. But it is also the main chemical messenger used to wake up the cortex and get it involved in decision making. In this role, serotonin is used largely by neurons found in the so-called "raphae nucleus" of the midbrain region, where possible behavioral responses to various stimuli are first formulated. These neurons in turn become involved in the future processing and interpretation of the incoming messages, and in selecting an appropriate response.

Low levels of 5-HT and metabolites are associated with depression and especially a type of depression that is more likely to lead to suicide. Several studies have shown reduced serotonin in brains of suicide victims as well as a low 5HIAA in CSF of depressed patients who have high incidence of suicide attempts. Recent studies indicate that this type of 5-HT influence may start early in life; low levels of 5HIAA have been found in children and adolescents with disruptive behavioral disorders. Serotonin dysfunction has been associated with obsessive compulsive disorder, aggression, eating disorders, and schizophrenia and migraine headaches. Reduced serotonin may induce insomnia and decreased immune system functioning. [14]

The decreased level of serotonin generated by the action of enzyme monoaminooxidase A is associated with violent behavior and antisocial personality disorder. Increased level of serotonin during early life, caused by decreased activity of this enzyme, seems to be linked with the higher risk of violent behavior and aggression in the adulthood. Abnormalities in serotonin signalling are important in development of schizophrenia. Serotonin directly modifies subjects' moral judgments and behavior by means of enhancing aversion to personally harming others. [21] If there are imbalances in these neurotransmitters, many bodily functions will start to function inappropriately, which can lead to a number of unpleasant or debilitating symptoms. Increased 5-HT neurotransmission facilitates the recognition of fearful faces, whereas its decrease impairs the same performance without a significant change in subjective anxiety [25].

Histamine

Histamine plays role in arousal, phobias, addictions and extreme depression, pain threshold, and regulation of blood pressure [9]

Noradrenaline

NA is involved in a broad range of psychological functions and behaviors. One of the most important is its role in attention and arousal. It regulates anxiety and negative emotional memory reward perception. NA neurons appear to be involved in the regulation of an organism's vigilance. The broad projection of the locus coeruleus (LC) makes it especially well suited to act as a mechanism to alert cortical and thalamic areas to incoming sensory stimuli. The LC is electro-physiologically quiet during low vigilance states such as sleep or in the lack of sensory input. When exposed to a strong stimulus, the LC markedly increases its firing rate, however. The broad influence of the activated LC is to filter weak stimuli and enhance moderate stimuli. This filtering and enhancement by NA is believed to aid in CNS processing of sensory information. In support of this conclusion, the application of NA to cortical neurons reduces responsiveness to weak stimuli, and enhances responses to strong stimuli. α-2 receptors appear to be important for these responses. NA is believed to be involved in the etiology of some unipolar and bipolar affective disorders. [14]

Noradrenaline alerts the brain of the presence of novel and potentially threatening events in the external environment-brain arousal and body arousal. Under activity of

noradrenaline-releasing neurons often accompanies depression. Over production of noradrnaline may generate feelings of anxiety and fearfulness, as if there was a constant threat present in the environment. [12]

Dopamine

The role of DA systems in motivated behavior is of particular importance. It is proposed to mediate a performance activating effect of motivated behavior, as well as conveying internal reward signals. DA is implicated in psychiatric illnesses (especially schizophrenia) and disorders of movement control. [14]Impulsivity usually has a negative connotation because of the harm it can cause not only to the impulsive individual but, through that individual's behavior, to others. Impulsive acts are often preceded by a period of rising tension, which resolves into a sense of relief and well-being once the act is completed. The role of dopamine in impulsive behavior is most likely tied to its involvement in the brain's system for rewarding particular behaviors. Certain elemental types of behavior critical to the survival and reproduction of animals, such as eating food, drinking water or mating, produce a sense of satisfaction or "rightness" that actively reinforces engagement in these behaviors. Inducing these sensations is the job of dopamine. Dopamine involved in rewarding and reinforcing behaviors that reduce stress.

Dopamine interacts with multiple post synaptic receptors and is assumed to promote slightly different responses in the neuron it serves. Depressed individuals nearly always have low levels of serotonin in their central nervous systems. It is not surprising that impaired dopamine function could contribute to depression. [12] Although the roles of dopamine in human emotion still remain unclear, studies that had been conducted on this aspect had shown that dopamine is responsible in the relay of positive and negative emotions. The processing of negative emotions is said to be linked to the release of dopamine in the amygdale, prefrontal and medial temporal areas of the brain. In the central nervous system, high concentrations of dopamine are linked to love alongside attention, motivation and goal-directed behavior. In addition, the ability to focus, remember, cherish of a beloved indicates that dopamine is involved in this phenomenon (Fisher, 2000).Increased levels of dopamine had indeed been linked to undivided attention. High concentrations of dopamine in the brain had also been associated with euphoria, loss of appetite, hyperactivity, increased mental activity, less likely to feel fatigue, the lack of need to sleep, 'hyperactive fear-like state, anxiety and panic. [17] Dopamine is a neurotransmitter involved in decision- making. [18] It could be hypothesized that alteration of emotional responses in elderly subjects is mostly related to concomitant impairment of DA neurone activity. [19] Intense pleasure experienced when listening to music is associated with dopamine activity in the mesolimbic reward system, including both dorsal and ventral striatum [23]

Gaba

GABA is involved in sedation, anxiety, and muscle relaxation and tonic inhibition. It acts at inhibitory synapses in the brain by binding to specific transmembrane receptors in the plasma membrane of both pre and post synaptic neuronal processes causing cell cycle arrest in the S phase, limiting growth. [8]

Diseases Associated with GABA include focal epilepsy, which is decreased local GABA-mediated inhibition. Many facets of epilepsy can be elicited experimentally by blocking GABA receptors with the toxin picrotoxin. The decrease in GABA inhibition permits cells to fire synchronously, thus producing massive local excitation and initiation of a seizure. Some finding suggests that some initial imbalance in the GABAergic system may underlie aspects of this disorder. [16]

Glutamate [16]

The neurotransmitter glutamate is highly toxic to neurons when present for extended periods. One of the best understood clinical conditions involving glutamate is neuronal injury following stroke or trauma. Derangements in glutamate metabolism or receptor activation have been implicated in a wide variety of pathologic conditions such as Alzheimer's and Huntington's chorea.

Combined Effects [11]

Together Serotonin, Noradrenaline and Dopamine are involved in control of many mental states, sometimes acting on their own and other times acting together. Important features they share include cognitive function, mood, emotion, motivation, appetite, aggression, anxiety. Abnormality in their neurotransmitter activity results in many brain disorders like parkinson's disease, schizophrenia, migraine, anxiety disorders and depressive psychosis. Norepinephrine and serotonoin have been implicated to play an important role in sleep.

CONCLUSION

There are different types of neurotransmitters in the brain and each of them have their own effect on the human body. Most people have heard of several common neurotransmitters, including serotonin, dopamine, norepinephrine and epinephrine and are familiar with at least some of their functions in regards to mood and sleep. Many people do not know that neurotransmitter imbalances can dramatically affect many other aspects of your health and can cause or exacerbate the following conditions: Depression, Anxiety, Migraine, Insomnia, Craving, Mood swings, Poor memory, weight loss, Poor mental focus, Poor concentration, Fibromyalgia, Parkinson's Disease, ADD/ADHD, Obsessive thoughts or Compulsion. [22]

Neurotransmission affects the physiological system, cognition, mood, or behaviour. It plays a major role in everyday life and functioning. Increased 5-HT levels might offer therapeutic benefit for impulse control disorders.[4] Dopamine is a neurotransmitter involved in goal-directed behavior such as pleasure seeking, movement control, emotional response, and addictive behavior. On the one hand, Dopamine is implicated in motivation and reinforcement, for instance, it is a focus of drugs of abuse and self-stimulation. On the other it is a facilitator of vigorous action. In principle, these two axes of behavior might be independent, but they appear instead to be

closely coupled through the action of Dopamine. Acetylcholine is linked to synaptic plasticity in the hippocampus and seems to play an important role in learning and short-term memory via the cholinergic system. Each neurotransmitter can directly or indirectly influence neurons in a specific portion of the brain, thereby affecting behavior.

Society with good humans drives toward healthy and peaceful society unrest in the society question the purpose of life. However, we need a scientific answer for the question - why the humans need to lead good life with positive emotions? The emotions and neurotransmitters give the answer for this. Persons with positive emotions experiencing the release of health promoting neurotransmitters and those with negative emotions have the release of health deteriorating neurotransmitters. So, it can be concluded that humans have to live with positive emotions for sound health, which leads to peaceful life.

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How to cite this article:

Annapurna Uppala *et al*.2015, Impact of Neurotransmitters on Health Through Emotions. *Int J Recent Sci Res.* 6(10), pp. 6632-6636.

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International Journal of Recent Scientific Research

ISSN 0976-3031