PHYSIOLOGICAL ROLE OF SEROTONIN

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Currently, the coverage of the issues of the functional interaction of vasomotor amines (histamine and serotonin) with immunological regulation factors, as well as the possibility of using these mediators to target metabolic processes in the body, is of significant interest for experimental and theoretical physiology, immunology, and biochemistry.

Keywords: *serotonin, growth factor, stimulation, physiological role.*

Introduction.

Serotonin is a biogenic amine, one of the main neurotransmitters in the CNS, controlling appetite, sleep, mood, and human emotions. The physiological functions of serotonin are extremely diverse. When serotonin levels decrease, the sensitivity of the body's pain system increases, meaning that even the slightest irritation can cause severe pain. Serotonin facilitates motor activity and is involved in the regulation of vascular tone. Along with dopamine, this neurotransmitter is involved in the mechanisms of hypothalamic regulation of the hormonal function of the pituitary gland.

At present, the coverage of the issues of the functional interaction of vasomotor amines (histamine and serotonin) with immunological regulation factors, as well as the possibility of using these mediators to target metabolic processes in the body, is of significant interest for experimental and theoretical physiology, immunology, and biochemistry.

A person's mood largely depends on the amount of serotonin in the body. Part of the serotonin is produced by the brain, but a significant portion is produced by the intestines. According to scientists from the University of Oxford in the UK, our perception of close human relationships depends on the substance called serotonin produced in the brain.

Scientists have concluded that the presence of serotonin in the body prevents the development of mental disorders and stimulates the recovery of those who have mental and nervous disorders. The absence of serotonin in the body can have the opposite effect and cause mental disorders. The evidence for the influence of serotonin on a person's mental state is obvious.

Serotonin (5-hydroxytryptamine) is found in platelets and enterochromaffin cells of the gastrointestinal tract, as well as in mast cells and basophils. The mediator enhances the immediate hypersensitivity

reaction caused by histamine and possibly prolongs its effect. It is assumed that serotonin stimulates the migration of leukocytes through the vascular wall. There is evidence of an increase in the sensitivity of mononuclear cells to chemotaxis factors, as well as the stimulation of chemotaxis factor synthesis by T-lymphocytes.

All of the above provides significant grounds for including these mediators in research work. Moreover, the choice of histamine and serotonin for study is also justified by the fact that these biologically active substances rapidly change their concentration under the influence of various factors, including adverse climatic and professional factors, intense physical work, and depending on social conditions.

The possibility of chemically influencing the closeness of people by increasing serotonin concentration opens new possibilities in the treatment of many mental disorders. It is possible that a serotonin deficiency in the intestines is what determines the development of depression, while its deficiency in the brain is just a consequence, an accompanying symptom. The primary cause may be the low number of brain cells responsible for serotonin production, as well as a lack of receptors capable of receiving the produced serotonin. Alternatively, the deficiency of tryptophan—a necessary amino acid from which serotonin is made—could be the cause. If any of these problems occur, there is a high likelihood of depression and obsessive-compulsive nervous disorders: anxiety, panic, and bouts of unprovoked anger.

Serotonin is a hormone produced in the human body, so serotonin is not present in food products. However, certain foods can help increase serotonin production in the body. The simplest way to increase serotonin levels is to eat sweets. Simple carbohydrates, which promote serotonin production, are abundant in pastries and even plain white bread. However, this method of increasing serotonin levels in the body can lead to an addiction to sweets, which has already been proven by scientists through experiments on laboratory animals. The mechanism of sweet addiction is very simple: you eat sweets, serotonin levels rise sharply, then the sugar is processed, its level in the blood drops, and the body starts demanding more serotonin, meaning more sweets. To ensure that serotonin is produced in sufficient quantities in the body, it is necessary to consume foods containing the amino acid tryptophan, which is the precursor of serotonin in the body. Tryptophan is found in any food rich in animal proteins. Since tryptophan cannot be produced by our body's cells, we must obtain it from food and appropriate supplements. Tryptophan is found in meat, bananas, dates,

sesame seeds, peanuts, and oats. Two types of foods improve mood: those that contain the hormone of joy—serotonin—and those that contain B vitamins, which affect the functioning of nerve cells and stimulate the production of serotonin.

Metabolism of Serotonin and Physiology of Serotonin Receptors.

Serotonin is formed from the amino acid tryptophan by its sequential 5-hydroxylation by the enzyme 5-tryptophan hydroxylase (resulting in 5-hydroxytryptophan, 5-HTP) and then decarboxylation of the resulting 5-hydroxytryptophan by the enzyme tryptophan decarboxylase.

5-Tryptophan hydroxylase is synthesized only in the soma of serotonergic neurons, and hydroxylation occurs in the presence of iron ions and the cofactor pteridine.

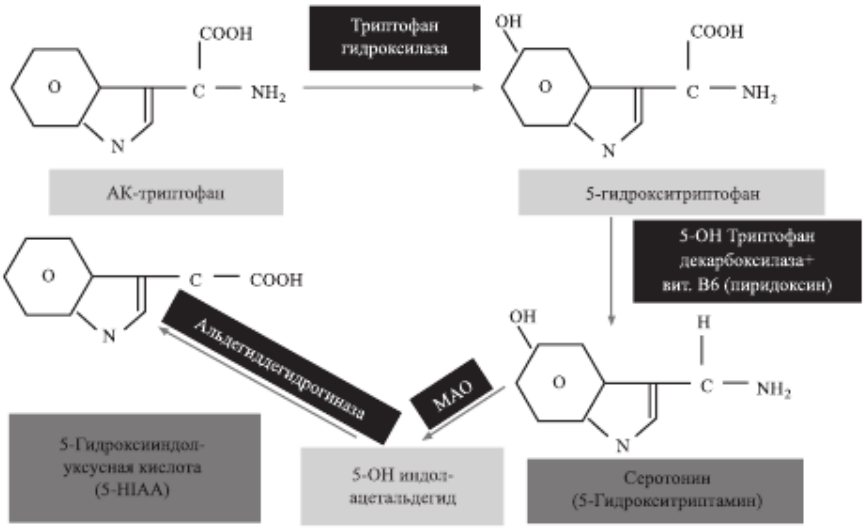
Biosynthesis and Metabolism of Serotonin

Serotonin Receptors.

Serotonin receptors are represented by both metabotropic and ionotropic receptors. There are seven types of such receptors, 5-HT 1–7, with 5-HT 3 being ionotropic and the rest metabotropic, seven-domain, G-protein-coupled receptors. The similarity of metabotropic 5-HT receptors with norepinephrine receptors has been established. The 5-HT 1 type has several subtypes: 1A–E, which can be both pre- and postsynaptic, inhibiting adenylate cyclase; 5-HT 4 and 7 stimulate it; 5-HT 2, with several subtypes (2A–C, which can only be postsynaptic), activate inositol triphosphate. The 5-HT 5A subtype also inhibits adenylate cyclase.

Endogenous ligands have been found for some receptor types besides serotonin. These include, for example, 5HT-modulin (Leu-Ser-Ala-Leu), the ligand for 1B and 1D presynaptic receptors, an inducer of anxiety and stress.

Metabolism and Catabolism of Serotonin.



Under the action of monoamine oxidase (MAO), serotonin is converted into 5-hydroxyindoleacetaldehyde, which, in turn, can reversibly convert into 5-hydroxytryptophol under the action of alcohol dehydrogenase.

Irreversibly, 5-hydroxyindoleacetaldehyde is converted by acetaldehyde dehydrogenase into 5-hydroxyindoleacetic acid, which is then excreted in urine and feces.

Serotonin is the precursor to melatonin, which is formed under the action of the pineal enzyme arylalkylamine-N-acetyltransferase (AANAT) in the pineal gland.

Serotonin plays an important role in regulating gastrointestinal tract motility, hydrochloric acid secretion, chloride transport in the duodenal epithelium, and bicarbonate secretion.

In addition, serotonin is a vasoactive agent, a pro-aggregant, and a potent immunomodulator. 5-HT can regulate processes such as leukocyte migration, phagocytosis, and cytokine secretion in leukocytes. In the duodenum, under the influence of peptic factors (acid, bile, enzymes), there is an increase in serotonin production, providing an acute secretory effect and enhanced motility. At the same time, the role of 5-HT in the pathogenesis of ulcerogenesis and complications of gastric and duodenal ulcer disease remains poorly understood. Analysis of the mechanisms of this phenomenon is complicated by the multifactorial regulation of serotonin synthesis and secretion, the wide range of target cells, and the numerous receptors for 5-HT, coupled with the blood coagulation system and the implementation of the body's acute inflammatory response to injury.

The targets of serotonin in the gastrointestinal tract are:

- The epithelial covering – enterocytes that express 5-HT receptors on the basolateral surface;

- Nerve endings of extramural nerves that provide sensory information transmission to the CNS. Enhanced stimulation of these is associated with sensations of nausea and discomfort;

- Projections of intramural nerve afferents in the mucosa (IPANs), forming direct connections with EC cells, ensuring the inclusion of protective reflexes;

- Afferents of the submucosal intramural plexus that initiate peristalsis and the secretory reflex. Serotonin irritation of primary afferents causes activation of internal neurons and stimulation of the peristaltic reflex;

- Afferents of intramural neurons in the muscular layer, which initiate pronounced contractions. Serotonin secreted by neurons of the

intermuscular plexus regulates fast and slow excitatory transmission and is involved in the regulation of gastrointestinal motility;

- Cholinergic neurons (bodies and efferents) primarily of the intermuscular plexus.

Conclusion.

Serotonin receptor stimulation leads to the enhancement of neuromuscular cholinergic transmission; smooth muscle cells of the mucosal muscular layer and the muscular coat; smooth muscle cells of the blood vessels in the mucosa and submucosa, which realize the vasoactive properties of serotonin; leukocytes of peripheral blood, and cells that form gut-associated lymphoid tissue (GALT). Due to this diversity of targets, serotonin in the gastrointestinal tract functions not only as a neurotransmitter but also as a paracrine messenger, determining intertissue and intercellular cooperation in the mucosa, as well as the implementation of compensatory-adaptive responses.

Some authors consider serotonin a growth factor since it enhances cell proliferation in intestinal crypts. During ontogeny, serotonin stimulates the development of intramural neurons, and in the postnatal period, it increases the survival and plasticity of neurons through the stimulation of 5-HT4 receptors. It is important to note that serotonin is present in neurons and EC cells at the earliest stages of gastrointestinal tract development

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