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CLINICAL PHARMACOLOGY OF VITAMINS, COENZYMES AND IRON PREPARATIONS

Ibodullayeva Qurbonoy Rahmatullo qizi
qurbonoyrahmatullayevna@mail.com
Qurbonova Iroda Shuxrat qizi
irodakurbanova0505@gmail.com
Normurodova Nafisa Doniyor qizi
normurodovanafisa0102@gmail.uz
Department of Pharmacology and Clinical Pharmacology, Termiz branch of the Tashkent Medical Academy Research advisor: ass.
Chutboyev Bunyod Rustamovich
buniktta1115@mail.ru
Termiz Branch of Tashkent Medical Academy. Uzbekistan.

Abstract: This article provides information about the functions of vitamins in the body, mechanisms of action, and which vitamins are found in which products. In addition, this article provides detailed information about coenzymes and iron preparations.

Key words: coenzymes, vitamins, iron preparations, Ascorbic acid, thiamine, cyanocobalamin,

FACILITIES

Vitamins are low molecular weight organic substances necessary to ensure biochemical and physiological processes in the body.

Classification of vitamin preparations

• Monocomponent.

- Water soluble.
- Fat soluble.

• Multicomponent.

- Complex of water-soluble vitamins.
- Complex of fat-soluble vitamins.
- Complex of water- and fat-soluble vitamins.
- Vitamin preparations containing macro- and (or) microelements:

■ complexes of vitamins with macroelements;
■ complexes of vitamins with microelements;
■ complexes of vitamins with macro- and microelements.

- Vitamin preparations with components of plant origin.

• Complex of water- and fat-soluble vitamins with components of plant origin.

• A complex of water- and fat-soluble vitamins with microelements and components of plant origin.

• Herbal medicines high in vitamins.

Mechanism of action and main pharmacodynamic effects

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Vitamins are a non-plastic material or energy substrate. They participate in the regulation of biochemical processes. Many vitamins are used in the body to build coenzymes or are ready-made coenzymes and, therefore, carry out the processes of biological catalysis.

It is known that vitamins B12, BC, B6, A, E, K, B5 have a predominant effect on protein metabolism; for carbohydrates - B1, B2, C, B5, A and lipoic acid; on fat - B6, B12, PP, B5, choline, carnitine and lipoic acid.

Vitamins are needed by the body in relatively small quantities. In most cases, they are food elements that are not formed in the body or are synthesized in insufficient quantities.

Molecular mechanisms of absorption of water-soluble vitamins

Recently, the molecular mechanism of absorption and distribution of a number of water-soluble vitamins has been studied. The role of transporters in their absorption and distribution is shown. The regulation of the process at the gene level has been studied.

Ascorbic acid (C). Its absorption sites are found throughout the small intestine. The process is carried out using a Na-ascorbate cotransporter (secondary active transport). The transport of an acid molecule occurs along a Na+ concentration gradient, supported by the work of Na+-K+-ATPase. When 2Na+ moves, one ascorbate anion is absorbed.

Large doses of the vitamin, unlike small amounts of the substance, are not completely absorbed, which may be due to the limited ability of enterocytes to use the transport system.

The Na-ascorbate cotransporter has stereoselectivity: higher affinity was noted for the L-form. Two of its isoforms have been cloned: SVCT1 and SVCT2 (encoded in the SLC23A1 and SLC23A2 genes, respectively).

In older people, lower expression of SVCT was detected, resulting in a deterioration in the ability of cells to capture vitamins.

Control of Na-ascorbate cotransport can be achieved through post-translational modifications and redistribution of SVCT proteins.

Biotin (B8). The Na-dependent multivitamin transporter (SMVT) is involved in the transport of biotin, pantothenic, and lipoic acids with equal affinity. It is assumed that SMVT molecules contain two protein kinase C phosphorylation sites, apparently involved in the regulation of its uptake. The 5'-regulatory segments of the SMVT gene were cloned and studied.

Folic acid (B9). It has been proven that intestinal absorption of folate is regulated by extracellular substrate levels, intracellular protein kinase and developmentally. Dietary deficiency of folic acid leads to a significant increase in its transport through carriers. Recent data suggest the involvement of transcription regulation mechanisms in enhancing the process.

Thiamine (B1). Studies of the molecular nature of the thiamine transport system in the intestine made it possible to clone 2 transporters SLC19A2 and SLC19A3.

Thiamine-dependent megaloblastic anemia (Rogers syndrome) is a disease with an autosomal recessive type of inheritance, its clinical manifestations: megaloblastic anemia, sensorineural tightness ear infections and diabetes mellitus. It is currently believed that its cause is a genetic defect in the thiamine transporter SLC19A2.

The discovery of a large number of vitamin transporters allows scientific research to be carried out in the search for their mutations; explain and correct the cause of some hereditary conditions of reduced absorption of vitamins; study various types of interaction of vitamins, macro- and microelements in the body.

Pharmacokinetics of vitamins

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Vitamin B1 (thiamine) is well absorbed in the intestines. Penetrates into the intestinal epithelial cell with the help of a carrier (active transport), and at high concentrations - by diffusion. A certain amount of vitamin circulates from epithelial cells into the cavity of the small intestine and back. After 15 minutes, thiamine is detected in the blood plasma, and after 30 minutes - in the tissues. The vitamin accumulates in the brain, heart, kidneys, adrenal glands, liver, and skeletal muscles. About 50% of the total amount is contained in muscle tissue. Its maximum concentration when taken orally as a single drug or as part of vitamin complexes is noted after approximately 1.5 hours (see Table 23-3), its values are almost equal in both cases. When taking thiamine at the same dose as part of a vitamin-mineral complex, the maximum concentration is significantly lower. Similar data were obtained for AUC-thiamine. In the liver, vitamin B1 is converted into active metabolites - diphospho- and triphosphothiamin. Elimination of thiamine is carried out due to metabolism in the liver at an average rate of 1 mg/day. The half-life of endogenous thiamine is 9-18 days; when administered as part of vitamin preparations, it is 4-5.5 hours (see Table 23-3).

ACTIVATORS AND CORRECTORS OF METABOLISM

The pharmacological properties and therapeutic effectiveness of drugs in this group are determined mainly by the biological role of nucleotides, phosphates, amino acids and other substrates, activators, and regulators of metabolic reactions. Some of them have a pronounced antioxidant effect, others improve metabolism and energy supply to tissues, restore trophism and stimulate regeneration processes, reduce hypoxia, and activate metabolism in tissues (Appendix 5).

However, it should be noted that the effectiveness of such drugs in various diseases of internal organs, and in particular coronary artery disease, has been demonstrated only in small studies. Therefore, their use is often considered to be a treatment with unproven effectiveness.

Metabolic drugs for systemic use can also include biogenic stimulants: ginseng, pantocrine, Eleutherococcus rhizomes and roots, aloe vera leaves, humisol*, royal jelly (apilak*), melatonin, etc.

Adenosine phosphate

Adenosine phosphate (AMP) is a component of the adenyl system; its biological role:

• activation under anaerobic conditions of a number of Krebs cycle enzymes, increased ATP resynthesis with simultaneous inhibition of glycolysis;

• as a purine nucleotide, it promotes the synthesis of nucleic acids and, consequently, the synthesis of proteins;

• is part of the most important respiratory coenzymes that transport electrons and protons in the initial links of the tissue respiration chain (NAD, NADP and FAD);

• energy supply for synthesis processes - a precursor of high-energy compounds (the formation of ADP and ATP occurs during the phosphorylation of AMP);

• participates in the regulation of carbohydrate metabolism.

It is able to penetrate cells. Entering the body, adenosine phosphate (phosphadene*) cannot immediately join the high-energy pool - it is first metabolized to adenosine. The latter has biological activity - dilation of arterial capillaries occurs, which entails activation of metabolism due to increased oxygen flow and increased ATP synthesis. In addition, adenosine can be included in the synthesis of macroergs.

At the same time, with a sufficient amount of ATP in the cell, adenosine phosphate is converted not into adenosine, but into inosine monophosphate, which is metabolized differently. Based on the totality of its properties, adenosine can be classified as an anabolic substance.

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Indications for use. The drug is used to improve peripheral blood circulation, as well as to restore anabolic processes and microcirculation in acute and chronic myocardial diseases.

Method of administration and dose. Prescribed per os in tablets in a single dose of 25-50 mg, with a daily dose of up to 300 mg. Course duration is 15-30 days (if necessary, treatment is repeated at intervals of 5-7 days).

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