THE SIGNIFICANCE OF COBALT IN MEDICINE

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Abstract. Cobalt is widespread in the natural environment and can be formed as an effect of anthropogenic activity. This element is used in numerous industrial applications and nuclear power plants. Cobalt is an essential trace element for the human body and can occur in organic and inorganic forms. The organic form is a necessary component of vitamin B12 and plays a very important role in forming amino acids and some proteins in nerve cells, and in creating neurotransmitters that are indispensable for correct functioning of the organism. Its excess or deficiency will influence it unfavurably . Salts of cobalt have been applied in medicine in the treatment of anemia, as well as in sport as an attractive alternative to traditional blood doping. Inorganic forms of cobalt present in ion form, are toxic to the human body, and the longer they are stored in the body, the more changes they cause in cells. Cobalt gets into the body in several ways: firstly, with food; secondly by the respiratory system; thirdly, by the skin; and finally, as a component of biomaterials. Cobalt and its alloys are fundamental components in orthopedic implants and have been used for about 40 years. The corrosion of metal is the main problem in the construction of implants. These released metal ions may cause type IV inflammatory and hypersensitivity reactions, and alternations in bone modelling that lead to aseptic loosening and implant failure. The ions of cobalt released from the surface of the implant are absorbed by present macrophages, which are involved in many of the processes associated with phagocytose orthopedic biomaterials particles and release pro-inflammatory mediators such as interleukin-1 (IL-1), interleukin-6 (IL-6), tumor necrosis factor α (TNF-α), and prostaglandin

Keywords: cobalt, human health, trace element, vitamin B12, physiological processes.

Аннотация. Кобальт широко распространен в природной среде и может образовываться в результате антропогенной деятельности. Этот элемент используется в многочисленных промышленных применениях и на атомных

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электростанциях. Кобальт является важным микроэлементом для организма человека и может встречаться в органической и неорганической формах. Органическая форма является необходимым компонентом витамина B12 и играет очень важную роль в образовании аминокислот и некоторых белков в нервных клетках, а также в создании нейротрансмиттеров, которые необходимы для правильного функционирования организма. Его избыток или дефицит будет оказывать на него неблагоприятное влияние. Соли кобальта применяются в медицине для лечения анемии, а также в спорте в качестве привлекательной альтернативы традиционному допингу крови. Неорганические формы кобальта, присутствующие в ионной форме, токсичны для организма человека, и чем дольше они хранятся в организме, тем больше изменений они вызывают в клетках. Кобальт попадает в организм несколькими способами: во-первых, с пищей; во-вторых, через дыхательную систему; в-третьих, через кожу; и, наконец, как компонент биоматериалов. Кобальт и его сплавы являются основными компонентами ортопедических имплантатов и используются уже около 40 лет. Коррозия металла является основной проблемой при изготовлении имплантатов. Высвобождающиеся ионы металла могут вызывать воспалительные реакции IV типа и реакции гиперчувствительности, а также изменения в моделировании кости, которые приводят к асептическому расшатыванию и отказу имплантата. Ионы кобальта, высвобождающиеся с поверхности импланта.

Ключевые слова: кобальт, здоровье человека, микроэлемент, витамин B12, физиологические процессы.

Annotatsiya. Kobalt tabiiy muhitda keng tarqalgan va antropogen faoliyat ta'sirida hosil bo'lishi mumkin. Bu element ko'plab sanoat qo'llanmalarida va atom elektr stansiyalarida qo'llaniladi. Kobalt inson tanasi uchun muhim mikroelement bo'lib, organik va noorganik shakllarda paydo bo'lishi mumkin. Organik shakl B12 vitaminining zarur tarkibiy qismi bo'lib, asab hujayralarida aminokislotalar va ba'zi oqsillarni hosil qilishda hamda organizmning to'g'ri ishlashi uchun ajralmas bo'lgan neyrotransmitterlarni yaratishda juda muhim rol o'ynaydi. Uning ortiqcha yoki yetishmasligi unga salbiy ta'sir qiladi. Kobalt tuzlari tibbiyotda anemiyani davolashda, shuningdek, sportda an'anaviy qon dopingiga jozibador alternativa sifatida qo'llanilgan. Ion shaklida mavjud bo'lgan kobaltning noorganik shakllari inson tanasi uchun zaharli hisoblanadi va ular organizmda qancha uzoq saqlansa, hujayralarda shuncha ko'p o'zgarishlarni keltirib chiqaradi. Kobalt organizmga bir necha yo'llar bilan kiradi: birinchidan, oziq-ovqat bilan; ikkinchidan, nafas olish tizimi orqali; uchinchidan, teri orqali; va nihoyat, biomateriallarning tarkibiy qismi sifatida. Kobalt va uning qotishmalari ortopedik implantlarning asosiy tarkibiy

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qismlari bo'lib, taxminan 40 yildan beri qo'llanilmoqda. Metallning korroziyasi implantlar konstruktsiyasidagi asosiy muammo hisoblanadi. Bu ajralib chiqadigan metall ionlari IV turdagi yallig'lanish va yuqori sezuvchanlik reaksiyalariga, shuningdek, suyak modellashtirishda aseptik bo'shashish va implantning ishdan chiqishiga olib keladigan o'zgarishlarga olib kelishi mumkin. Implant yuzasidan ajralib chiqadigan kobalt ionlari mavjud makrofaglar tomonidan so'riladi, ular ortopedik biomateriallar zarralarini fagotsitozlash va interleykin-1 (IL-1), interleykin-6 (IL-6), o'sma nekroz omili α (TNF-α) va prostaglandin kabi yallig'lanishga qarshi mediatorlarni chiqarish bilan bog'liq ko'plab jarayonlarda ishtirok etadi.

Kalit so'zlar : kobalt, inson salomatligi, mikroelement, B12 vitamini, fiziologik jarayonlar .

INTRODUCTION.

Cobalt is an essential trace element that is cumulated predominantly in liver, kidneys, pancreas, heart, skeletal muscle, and bones. In the blood stream Co (II) exists in complex with albumin. 5,12% of total circulating cobalt in the bloodstream may be present in ionized free form [1]. Possibly, ionized cobalt may exert toxic properties. It is supposed that this mechanism takes place in sportsmen treated with erythropoietin . The majority of cobalt in the organism is present in the structure of vitamin B12 [2]. Cobalt is an essential metal for B12, which is involved in various methyl transfer reactions. Complex system of dietary vitamin intake includes transport proteins like hap to in, Castle intrinsic factor and trans cobalt a mine . The average cobalt content in human body is around 15 mg. Its abundance in the human body by mass is 0.021 μg/g . Liver, kidney, spleen are rich in cobalt. The toxic dose for humans is 500 mg. Optimal daily intake of cobalt is above 0.3 mg, the resorption is 20%. Cobalt is excreted with urine (0.2 mg), feces (0.1 mg), sweat (0.004 mg); the half time is 30–40 years [5]. Elevated content of protein and iron in the diet slows cobalt absorption in the gastrointestinal tract; in contrast, copper and zinc enhance this process. An excess of cobalt can lead to disturbance of iodine metabolism in the thyroid gland.

Cobalt and its vital role in human health: Implications for Growth, Cardiovascular Function, and Development. While cobalt plays a crucial role, the human body typically contains only about 2 mg of it. Vitamin B12 (cobalamin) molecules are integral to various biological processes, particularly in the transfer of methyl groups, such a sin DNA. The average recommended daily intake for an individual is typically a few micrograms (mcg). The entire cobalamin molecule must be obtained from the dietary sources. In the digestive tract, specific proteins have the capability to selectively absorb vitamin B12 from food, and carrier

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proteins are involved in its distribution. Typically, the vitamin is as sociated with a gastric factor. In the ileum, a specific receptor complex is formed by two proteins, namely, an ionless and cubilin . An imbalance of trace elements, including cobalt, in children's bodies can lead to delays in physical, mental, and sexual development, decreased immunity, and the onset of chronic diseases. In the maintenance of the structure and function of the entire cardiovascular system, a critical role is attributed to approximately 25 to 45% of all macro- and microelements that are integral components of protein molecules, hormones, and enzymes. Even minor fluctuations in the levels of these microelements cantrigger the development of cardiovascular diseases.Thephysiologicall yactive form of cobalt is vitamin B12, and a deficiency of cobalt in the body essentially translates to a deficiency of vitamin B12, characterized by symptoms such as megaloblastic anemia. Cobalt directly participates in numerous processes associated with growth, development, and the proper functioning of the cardiovascular and other systems, rendering the investigation of thishighlypertinentissue.Studieshaverevealedreduced cobalt levels in the hair of 89% of examined girls aged 7–8 years experiencing health problems.Cobaltdeficiencyinthebodydetrimentallyaffectslungcapacityandgrowth. Maintaininganadequatecobaltlevelinthebodyplaysacrucialroleininfluencingheart rate and diastolic blood pressure.

Cobalt Exposure and its Multifaceted Health Implications: **Dose-Response relationships, systemic toxicity, and cancer associations** Cobalt and its compounds are widely distributed in nature and are associated with numerous anthropogenic activities. Sources of cobalt exposure can be categorized into four conditions: occupational, environmental, dietary, and medical. The highest systemic cobalt concentrations are typically observed with oral cobalt supplementation and internal exposure from metal-on-metal hip implants.

The resulting systemic health consequen cesmanifestasa complexclinical syndrome, primarilyen compassing neurological issues (e.g., hearing and visual impairment), cardiovascular complications, and endocrine deficits. Recently, a bio kinetic model has been introduced to elucidate the dose-response relationship and the effects of chronic exposure. According to this model ,health effects are improbable at blood cobalt concentrations below 300µg/L(or)100 µg/L with a safety factor of 3) in healthy individuals. Hematological and endocrine dysfunction are identified as the principal health endpoints in the model, and it further suggests that chronic exposure within acceptable doses does not pose a substantial health risk.

Essential elements play a crucial role in the regulation of carcinogenesis. In a study investigating the association between essential elements and kidney tumors,

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comprising 72 healthy individuals and 100 patients with kidney tumors, it was found that levels ofcobalt, chromium, iron, manganese, nickel, and zincwere markedl ylowerinpatients with kidney tumors. The Kaplan-Meier curve analysis demonstrated that patients with reduced levels of cobalt ,selenium ,and zinc experienced lower progression-free survival rates.

Adverse health effects resulting from cobalt exposure, including conditions like cardiomyopathy and impairments in vision or hearing, have been reported at peak blood cobalt concentrations typically exceeding 700μg/L (over a duration of 8–40 weeks). In humans, reversible hypothyroidism has been observed at cobalt levels around 300 μg/Land higher ,along with instances of policy them .Them echanism behind systemic toxicity is directly linked to the interaction of free Co(II)ions with various receptors ,ion channels, and biomolecules. Notably, these effects are generally reversible. Certain deviationsfromthetypicaldose-responsepatternincobalttoxicitymaybeattributedto rare medical conditions that reduce the system of Co(II) ions to blood proteins. Based on the available information, in most individuals with ostensibly elevated serum cobalt levels, such as users of dietary supplements and patients with him plants, over 90% of the cobalt is bound to albumin, which possesses significant excess capacity for binding Co (II) ions. Given the existing data, it may be advisable to monitor implant patients for signs of hypothyroidism and polycythemia, particularly when their blood or serum cobalt concentrations exceed 100μg/L.

Cobalt in Foods

The trace element is widely distributed in the environment .Its good food sources of cobalt.

- Fish
- Nuts
- Broccoli
- Cereals

Cheese	0.18 %
chocolate	0.05 %
rice	0.01 %
egg	0.005 %
bred	0.006 %
fish	0.007
meat	0.008
Fruit	0.009

The effect of cobalt on the pregnant mother and the fetus. Cobalt plays a key role in vitamin B12 metabolism as an essential trace element. Still, too much

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exposure during pregnancy could bring risks to the mother and her developing fetus. People get cobalt from food through vitamin B12, and the usual daily amount stays pretty low at less than one to two milligrams. That level seems safe enough for most folks. Things change when exposure goes way higher than normal from things like work environments or polluted water or even implants that release metal. Those situations can turn harmful pretty quickly. When cobalt levels rise, it manages to pass through the placenta and build up in the fetus's tissues. That buildup raises chances for developmental problems. For the mother, high amounts might cause oxidative stress and mess with how iron works in the body. It could lead to anemia, which cuts down on oxygen getting to the baby. Cobalt in excess also impacts thyroid hormones, and those matter a lot for the fetus's brain growth. If a pregnant woman takes in or breathes too much cobalt, she might feel tired or short of breath or deal with low thyroid function or worse anemia .The fetus faces its own troubles from extra cobalt, like lower birth weight or slowed growth inside the womb. It links to more chances of being born too early as well. Studies on animals show that big doses of cobalt lead to bone issues in the young, higher rates of losing the pregnancy, and possible problems with nerve and brain development later on. Small amounts from nutrition remain safe and even needed. That said, steering clear of extra exposure from the environment or job during pregnancy helps keep health risks low for both the mother and the child.

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