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Hyperhomocystenemia: Current status

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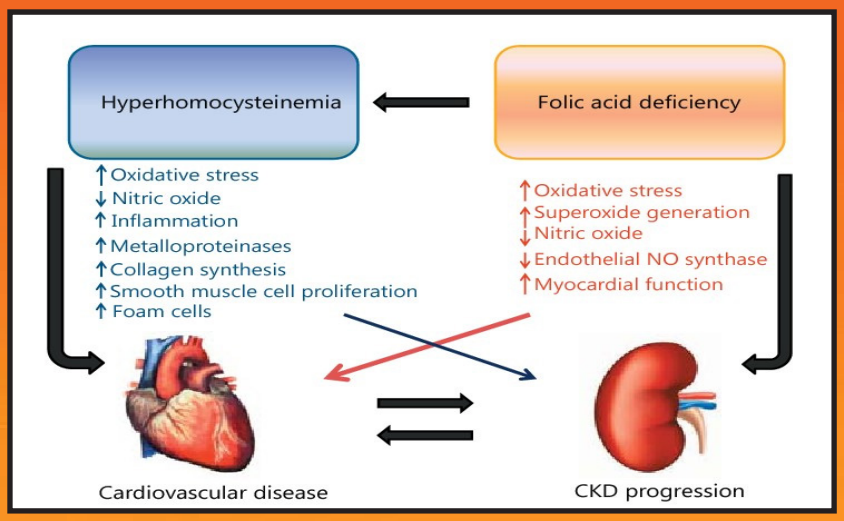

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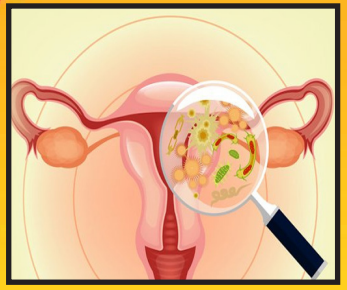

Role of Probiotics in Treatment Among Women with Symptomatic White Discharge

Methylcobalamin: The Bioactive Form of Vitamin B12

SANJAY AGRAWAL, PRIYANKA KASHI

INTRODUCTION

Vitamin B12, commonly known as cobalamin, is a water-soluble vitamin that is required for a variety of physiological functions in the human body. One of its active forms, methylcobalamin, is essential in several metabolic processes, including DNA synthesis, brain function, and red blood cell formation. In this article, we will look at the importance of methylcobalamin, its health advantages, and prospective therapeutic uses, all of which are supported by scientific data[1].

BIOAVAILABILITY AND STRUCTURAL PROPERTIES

Because of the distinctive methyl group (-CH3) bonded to the cobalt atom, methylcobalamin differs structurally from other forms of vitamin B12, such as cyanocobalamin and hydroxocobalamin. Because of this structural change, methylcobalamin has different biochemical characteristics and greater bioavailability, making it the most functional and easily absorbed form of vitamin B12[1].

BIOLOGICAL PURPOSES

1. Methionine Synthesis: Methionine synthase, an enzyme that converts homocysteine to methionine, requires methylcobalamin as a cofactor. Methionine is required for protein synthesis and is involved in various metabolic activities in the body[2].
2. DNA Synthesis: Methylcobalamin is required for the synthesis of DNA, which is required for all cell development and repair. Methylcobalamin deficiency can decrease DNA synthesis, thereby impacting general health[1].
3. Nervous System Function: Methylcobalamin is essential for the healthy functioning of the central nervous system. It helps to build the myelin sheath, which covers and protects nerve fibres. A methylcobalamin shortage can cause neurological symptoms such as numbness, tingling, and cognitive difficulties[1].

METHYLCOBALAMIN HEALTH ADVANTAGES

1. Red Blood Cell formation: Methylcobalamin is essential for the formation of red blood cells, which helps to avoid anaemia. A healthy consumption of vitamin B12 enables adequate erythrocyte synthesis, minimising weariness and weakness[1].
2. Neurological Health: The relevance of methylcobalamin in nerve function extends to its role in the prevention and treatment of neurological illnesses. Methylcobalamin supplementation may be advantageous in illnesses such as neuropathy, multiple sclerosis, and Alzheimer's disease, according to research[1].
3. Cardiovascular Health: Adequate methylcobalamin levels can assist in lowering blood homocysteine levels. High homocysteine levels are associated with an increased risk of cardiovascular disease. Regular methylcobalamin use may benefit heart health[1].
4. Production of Energy: Methylcobalamin is required for the conversion of carbohydrates into glucose, which the body utilises for energy. Individuals who are deficient in vitamin B12 frequently suffer weariness and weakness as a result of decreased energy production[1].
5. Bone Health: According to some study, vitamin B12, especially its methylcobalamin form, may help with bone health by lowering the risk of osteoporosis[1].

THERAPEUTIC POTENTIAL OF METHYLCOBALAMIN

1. Neuropathy: Methylcobalamin has showed potential in the treatment of neuropathic disorders such as diabetic neuropathy and peripheral neuropathy. It is thought to enhance nerve regeneration and relieve symptoms.
   - Neurotransmitter production: Methylcobalamin participates in the production of neurotransmitters such as serotonin and dopamine. These neurotransmitters are critical in controlling mood, emotions, and general mental health. According to some research, low levels of methylcobalamin may contribute to abnormalities in these neurotransmitters, potentially leading to mood problems.
   - Neuroprotection: Because methylcobalamin has neuroprotective characteristics, it can help protect nerve cells from injury and degeneration. Methylcobalamin may give neuronal protection in situations such as depression, where persistent stress and inflammation can have an influence on brain health.

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- Homocysteine Levels: Elevated homocysteine levels, which can be caused by vitamin B12 deficiency, have been linked to an increased risk of mood disorders, including depression. Methylcobalamin aids in the reduction of homocysteine levels, potentially decreasing this danger[1] .
- Energy Production: Fatigue and poor energy are frequent depressive symptoms. Methylcobalamin helps the body convert carbohydrates into glucose, which it utilises for energy. Maintaining adequate methylcobalamin levels may reduce some of the tiredness associated with depression[1].
- Antidepressant Synergy: One study has looked at the potential synergistic effects of methylcobalamin with antidepressant drugs. Individuals with depression may react well to traditional therapy if probable vitamin B12 deficits are addressed[1].

2. **Depression and Mood Disorders:** Some research has looked at the use of methylcobalamin as an additional therapy for depression and mood disorders. While additional study is needed, preliminary results indicate that it may have a favourable effect on mood. Methylcobalamin plays a crucial role in several biochemical pathways, some of which are directly or indirectly related to mood regulation.

- Karakoc, et al in a study that investigated the effects of methylcobalamin supplementation in patients with major depressive disorder. The researchers found an important role of methylcobalamin in mood regulation[5].
- Reginald et al in a study, investigated the effects of methylcobalamin supplementation in patients with major depressive disorder. Methylcobalamin treatment is imperative in major depressive disorder[6].

3. **Age-Related Cognitive Decline:** Because of its involvement in nerve health, methylcobalamin may help battle age-related cognitive decline and lower the risk of neurodegenerative disorders such as Alzheimer's.

- Support for Brain Function: Vitamin B12, especially methylcobalamin, is essential for the correct functioning of the neurological system. It is important in neurotransmitter synthesis and myelin preservation, which allows for effective nerve signal transmission. Maintaining cognitive ability requires optimal brain function.
- Energy Metabolism: Methylcobalamin aids in the production of energy inside cells, particularly brain cells. A sufficient supply of energy to the brain is essential for its proper functioning. A vitamin B12 shortage can cause tiredness and poor cognitive function[6].

BIOAVAILABILITY OF METHYLCOBALAMIN:

- The bioavailability of several cobalamin (vitamin B12) forms, including Methylcobalamin, is discussed in the study carried out by Obeid, R., Fedosov, and it suggested that methylcobalamin is necessarily superior to other forms in preventing or treating cobalamin insufficiency.
- The researchers (Watanabe, F., et al) did a thorough literature analysis to discover plant foods containing vitamin B12 or its analogues (compounds having similar structures to vitamin B12) that may have potential bioavailability. The explanation is as follows:

1. Cyanocobalamin is a form of vitamin B12 that is widely found in dietary supplements. When you take cyanocobalamin (inactive form) the body can convert it into two distinct forms that aid in crucial tasks:
2. Methylcobalamin: Think of it as a supplement that helps your body produce a chemical called methionine. Methionine acts as a building block in the body, allowing it to form many crucial components such as proteins and chemicals in the brain. Methylcobalamin aids in the synthesis of methionine.
3. 5'-Deoxyadenosylcobalamin: It acts as a tool which the body can use to convert one type of material into another. This modification is required for the body to utilise specific types of lipids and to cope with particular amino acids (the building blocks of proteins)[3].

METHYLCOBALAMIN SOURCES

Meat, fish, eggs, and dairy products are all good sources of methylcobalamin. Individuals with dietary limitations, such as vegetarians, are at risk of deficiency. Supplementation is indicated in such circumstances to ensure appropriate consumption. Methylcobalamin supplements come in a variety of formats, including oral pills, sublingual drops, and injections, making them useful to people with varying preferences and requirements.

COMPARISON BETWEEN METHYLCOBALAMIN AND CYANOCOBALAMIN:

Chemical Formulation:

- Methylcobalamin is a naturally occurring vitamin B12 form. A methyl group (CH3) is linked to the cobalt centre.
- Cyanocobalamin is a synthetic vitamin B12 in which a cyanide molecule is linked to the cobalt centre[1].

BIOAVAILABILITY:

- Methylcobalamin produces better bioavailability than cyanocobalamin. This implies that the body may utilise methylcobalamin more quickly without having to convert it to another form.

- Cyanocobalamin produces lesser bioavailability because it must be converted in the body to active forms such as methylcobalamin and adenosylcobalamin[3].

CONVERSION:

- Methylcobalamin is the active form of vitamin B12, which means it is easily absorbed by the body and utilised in a variety of metabolic reactions.
- Cyanocobalamin: Before it can be utilised efficiently, the body must convert cyanocobalamin into its active forms, which include methylcobalamin and adenosylcobalamin[1].

SOURCE:

- Methylcobalamin is present in animal-derived foods such as meat, fish, and dairy products.
- Cyanocobalamin is commonly found in supplements and fortified meals[1].

SAFETY:

- Methylcobalamin is generally thought to be safe, with minimal possible negative effects. Some people may be allergic to it, but this is uncommon.
- When taken as indicated in supplements and fortified meals, cyanocobalamin is safe. It does, however, contain a trace of cyanide, which is normally removed by the body without causing harm. Exceedingly high dosages might still result in cyanide poisoning.

CONCLUSION

Methylcobalamin, the active form of vitamin B12, is critical in a variety of biological activities critical to human health. Its roles are broad and critical, ranging from DNA synthesis to neuron activity.

Maintaining appropriate methylcobalamin levels through diet or supplementation can improve general health, minimise deficiency-related problems, and perhaps provide therapeutic advantages for a variety of medical diseases.

So, even if cyanocobalamin is consumed, the body can convert it into useful forms for important functions like protein synthesis, brain function, and fat management[6].

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The hepatic clearance of insulin plays a critical role in the bioavailability of insulin, as liver is the first organ to clear the endogenously secreted insulin from the portal circulation. Insulin that is not extracted from the circulation by the liver then reaches the rest of the body where it can exert it s effects to lower blood glucose. Under normal physiological conditions, 80% of endogenously secreted insulin is cleared by the liver (~50% at first pass); ~15% is cleared by the kidney; and ~5% by muscle and adipose tissue. There is a positive correlation between insulin clearance and insulin sensitivity. Moreover, a hypothesis has emerged that diminished insulin clearance may exacerbate insulin resistance via hyperinsulinemia – mediated desensitization and therefore represents an independent risk factor for diabetes.

Studies strongly suggest that impairment of insulin clearance may cause insulin resistance as a consequence of hyperinsulinemia. Moreover, epidemiological studies have suggested that in obese subjects reduced insulin clearance is more relevant to compensate for peripheral insulin resistance rather than the increase in insulin secretion, and a weight loss of about ~10% of initial body weight increases insulin clearance and further augments to restore insulin sensitivity.

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