

The Relationship Between Vitamin D and Complications of Diabetes

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Abstract: Diabetes is a group of systemic endocrine and metabolic diseases characterized by chronic blood glucose increase, which is caused by the deficiency of insulin secretion and utilization. Among them, the proportion of type 2 diabetes patients with vitamin D deficiency is often high. Research shows that vitamin D is closely related to diabetes, so this article analyzes vitamin D and diabetes nephropathy, diabetes retinopathy, diabetes peripheral neuropathy, diabetes cardiovascular complications, diabetes fractures from five aspects, aiming to guide new directions for the prevention and treatment of diabetes, and explore a better treatment plan.

Keywords: Vitamin D; Diabetes; Complication

1. Introduction

In China, the earliest record of diabetes was in the Yellow Emperor's Inquisitions on Internal Medicine in 400 BC, which mentioned the word "diabetes". Diabetes is a group of systemic endocrine metabolic diseases characterized by chronic blood glucose increase, which is caused by insulin secretion and/or utilization defects. The multi system damage caused by long-term metabolic disorders of nutrients, including kidneys, retina, heart, nerves, bones[1], etc., is one of the serious health problems that pose a threat to global public health. At present, there are 828 million adult diabetes patients in the world, and China accounts for about 20%. The largest is India (212 million, accounting for 25.6%), followed by China (148 million, accounting for 17.9%), the United States (42 million), Pakistan (36 million), Indonesia (25 million), and Brazil (22 million) [2]. At present, there are four classifications of diabetes: type 1 diabetes is caused by the destruction of islet B cells, which leads to the absolute lack of insulin. Type 2 diabetes is characterized by insulin resistance accompanied by progressive insulin insufficiency. Other special types of diabetes are diabetes with clear genetic and environmental etiology. Gestational diabetes refers to abnormal glucose metabolism during pregnancy [3]. The proportion of vitamin D deficiency in type 2 diabetes patients is often high [4], which is an independent risk factor in the occurrence and development of diabetes.

2. Relationship between vitamin D and diabetes

The discovery of vitamin D has a history of over 100 years. Vitamin D is a steroid derivative, and it is an essential fat soluble vitamin in the body. 25 hydroxyvitamin D is an intermediate product of vitamin D metabolism and is currently recognized internationally as the preferred gold standard for reflecting the nutritional status of vitamin D[5]. Research shows that, Vit D has a protective effect on islet β cells [6], can maintain the normal secretion of insulin, and improve blood sugar in diabetes patients.

Vitamin D is closely related to diabetes. Lack of vitamin D increases the risk of diabetes by 50%, and also increases the risk of pre diabetes by 62%. Research shows that about 60% -70% of diabetes patients have decreased vitamin D levels. Vitamin D deficiency increases the risk of diabetes[7].

3. Relationship between vitamin D and complications of diabetes

3.1 Vitamin D and diabetes nephropathy

Diabetes nephropathy is a microvascular complication of diabetes, which is mainly caused by microvascular disease or renal arteriosclerosis, leading to changes in the structure and function of the kidney, and ultimately urine protein. Vitamin D has anti-inflammatory properties. Diabetes nephropathy has chronic low level inflammation, and inflammatory factors are active. Vitamin D receptors can inhibit signaling pathways such as nuclear transcription factor kappa B, reduce the release of inflammatory factors, and alleviate the damage caused by inflammation to kidney tissue. Vitamin D is beneficial for the absorption of calcium ions in the intestine, helping parathyroid hormone regulate blood calcium levels in the body, maintain a balanced and normal state of calcium and phosphorus metabolism, and prevent calcium and phosphorus deposition, which can lead to kidney calcification. Vitamin D can inhibit abnormal activation of the renin angiotensin aldosterone system

[8]. RAAS in diabetes nephropathy is activated to increase blood pressure. Vitamin D can inhibit the expression of renin gene, reduce angiotensin II, reduce aldosterone level, lighten the renal burden, and slow down the development of diabetes nephropathy.

3.2 Vitamin D and diabetes retinopathy

Diabetes retinopathy is a microvascular disease that occurs in the retina of diabetes patients. Diabetic patients have a high sugar content in their blood vessels, which affects capillary cells and causes atrophy and degeneration, leading to impaired and blocked capillary circulation. Vitamin D can improve the chronic inflammatory response of retinal tissue caused by diabetes. The increased expression of inflammatory cytokines will damage the function of retinal blood vessels and nerve cells. Vitamin D can play a protective role in the retina[9]. Secondly, vitamin D can regulate angiogenesis. Long term diabetes endangers retinal ischemia and hypoxia, stimulates vascular endothelium to produce growth factor, and retinopathy promotes the formation of new blood vessels. Vitamin D can inhibit the expression of vascular endothelial growth factor, and then delay the retinopathy. Vitamin D is involved in regulating the process of cell apoptosis. By regulating the expression of retinal nerve apoptosis proteins, inhibiting the apoptosis of retinal nerve cells and vascular endothelial cells, and alleviating retinal lesions.

3.3 Vitamin D and diabetes peripheral neuropathy

Diabetes peripheral neuropathy mainly involves sensory nerve and motor nerve, and leads to pain, numbness, sensory abnormalities and other symptoms[10]. In diabetes patients, oxidative stress is triggered, which damages biological macromolecules of nerve cells, leading to degeneration and necrosis of nerve fibers and peripheral neuropathy[11]. Vitamin D can activate superoxide dismutase and glutathione peroxidase, improve the ability of nerve cells to eliminate reactive oxygen free radicals, reduce the damage of oxidative stress to nerves. Vitamin D is beneficial to the synthesis and release of nerve growth factors, strengthen the regeneration ability of nerve cells, alleviate sensory and motor disorders caused by diabetes peripheral neuropathy, and also participate in regulating the balance of calcium and phosphorus metabolism of the body. The imbalance of calcium and phosphorus will interfere with the transmission of nerve impulses. Vitamin D can maintain the normal transmission of nerve impulses, reduce the neurological disorder caused by abnormal calcium metabolism, and reduce the risk of diabetes peripheral neuropathy.

3.4 Vitamin D and cardiovascular complications of diabetes

Cardiovascular disease in diabetes is one of the common complications of diabetes patients, which involves the heart, cerebrovascular and peripheral blood vessels. Diabetes patients will have vascular endothelial function damage, because the synthesis of vasodilator nitric oxide decreases, blood pressure increases, cardiovascular disease risk will increase. Vitamin D can inhibit the proliferation of vascular smooth muscle cells and improve the cardiovascular complications of diabetes. The anti-inflammatory properties of vitamin D can reduce damage to blood vessel walls and lower the risk of acute cardiovascular disease caused by plaque rupture[12]. It can also maintain the balance of calcium and phosphorus in myocardial cells, ensure the normal electrophysiological activity of the heart, and reduce cardiovascular complications in patients with diabetes.

3.5 Vitamin D and diabetes fracture

Diabetes fracture is a fracture that occurs when diabetes patients suffer from slight external force due to osteoporosis caused by poor blood glucose control, which reduces bone density and bone quality. Active vitamin D can promote the absorption of calcium in the intestine and coordinate with parathyroid hormone to regulate blood calcium levels [13]. Patients in a chronic inflammatory state can affect the normal metabolism of bone cells. Vitamin D can reduce oxidative stress damage to osteoblasts and osteoclasts[14], and regulate the process of bone remodeling. Vitamin D can also affect neuromuscular function and balance, indirectly increasing the risk of fracture in patients with diabetes. It also aggravates neuromuscular dysfunction, leading to poor coordination of patients and easy falls, which is one of the key reasons for diabetes fractures. Therefore, maintaining sufficient vitamin D in diabetes patients is of great significance for improving calcium and phosphorus metabolism, reducing oxidative stress and inflammatory reaction, enhancing bone strength and reducing fracture risk.

4. Conclusion and Prospect

There is a close relationship between vitamin D and diabetes, and a higher concentration of serum 25 (OH) D in the body is significantly related to the reduction of the risk of complications in diabetes patients [15]. However, the diagnostic criteria of vitamin D deficiency, how to supplement, and the optimal dose of vitamin D supplementation still need to be further studied, and the treatment target or combination treatment scheme based on vitamin D should be developed to

improve the prognosis and quality of life of diabetes patients, reduce the disease burden of diabetes and its complications, and explore a better treatment scheme for the prevention and treatment of diabetes worldwide.

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