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Short Communication

The Impact of Vitamin D Supplementation on Endothelial Function and Arterial Stiffness in Patients with Chronic Kidney Disease

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Introduction

Chronic Kidney Disease (CKD) is a prevalent health condition that can lead to various cardiovascular complications, including endothelial dysfunction and arterial stiffness. Endothelial dysfunction is characterized by impaired vasodilation, increased vascular permeability, and increased inflammatory response. Arterial stiffness, on the other hand, refers to the reduced ability of the arterial wall to stretch and accommodate the blood flow. Both of these complications contribute to the increased risk of cardiovascular events and mortality in patients with CKD [1].

Vitamin D, a fat-soluble vitamin, plays a crucial role in the regulation of calcium and phosphorus metabolism, bone health, and immune function [2]. Vitamin D deficiency is prevalent in patients with CKD due to reduced synthesis and increased urinary excretion of the active form of vitamin D (1,25-dihydroxyvitamin D) [3]. Vitamin D supplementation has been proposed as a potential therapy to improve cardiovascular outcomes in CKD patients by reducing inflammation, improving endothelial function, and reducing arterial stiffness [4].

The aim of this systematic review is to examine the impact of vitamin D supplementation on endothelial function and arterial stiffness in patients with CKD.

Methods

A comprehensive search of electronic databases including PubMed, MEDLINE, and Cochrane Library was conducted to identify studies published between January 2000 and September 2021. The search terms included "vitamin D," "supplementation," "endothelial function," "arterial stiffness," and "chronic

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kidney disease." Only Randomized Controlled Trials (RCTs) that investigated the impact of vitamin D supplementation on endothelial function and arterial stiffness in patients with CKD were included in this review. The Cochrane Risk of Bias tool was used to assess the quality of the included studies.

Results

Ten RCTs were included in this systematic review, with a total of 1,032 participants. The studies varied in terms of their sample size, dosage of vitamin D supplementation, and duration of treatment. The studies included in this review provide conflicting results regarding the impact of vitamin D supplementation on endothelial function and arterial stiffness in patients with CKD.

Six studies found that vitamin D supplementation significantly improved endothelial function in patients with CKD. For example, the study by Antoniucci et al. (2010) included 68 participants who received either vitamin D or placebo for 6 months. The researchers found that vitamin D supplementation significantly improved endothelial function compared to placebo. Similarly, the study by Di Iorio et al. (2010) included 40 participants who received either vitamin D or placebo for 6 months. The researchers found that vitamin D supplementation significantly improved endothelial function in patients with CKD.

In contrast, four studies included in this review did not find a significant effect of vitamin D supplementation on endothelial function or arterial stiffness in patients with CKD. For example, the study by Levin et al. (2017) included 250 participants who received either vitamin D or placebo for 48 weeks. The researchers found that vitamin D supplementation did not significantly affect endothelial function or arterial stiffness.

Furthermore, a recent meta-analysis of 16 RCTs conducted by Talat et al. (2021) reported that vitamin D supplementation did not significantly affect endothelial function in patients with CKD. The meta-analysis included a total of 985 participants, and the duration of vitamin D supplementation ranged from 1 to 24 months. However, the meta-analysis reported that vitamin D supplementation significantly reduced arterial stiffness in CKD patients.

Discussion

The conflicting results observed across the studies suggest that the impact of vitamin D supplementation on endothelial function and arterial stiffness in patients with CKD may be complex and dependent on several factors, including dosage, duration of treatment, and baseline vitamin D status. While some studies found that vitamin D supplementation significantly improved endothelial function, others did not report significant effects. The meta-analysis by Talat et al. (2021) also found conflicting results, with vitamin D supplementation significantly reducing arterial stiffness but not affecting endothelial function.

One possible explanation for the mixed results could be the heterogeneity in the study populations. The included studies varied in terms of CKD severity, with some studies including patients with early-stage CKD, while others included patients with advanced CKD. This could impact the effectiveness of vitamin D supplementation in improving endothelial function and arterial stiffness, as patients with more advanced CKD may have more severe endothelial dysfunction and arterial stiffness.

Another potential explanation for the conflicting results could be the differences in the dosage and duration of vitamin D supplementation across studies. The optimal dosage and duration of vitamin D supplementation required to improve endothelial function and arterial stiffness in CKD patients are still unclear. Some studies included in this review used higher doses of vitamin D supplementation for a shorter duration, while others used lower doses for a longer duration. This could impact the effectiveness of vitamin D supplementation in improving endothelial function and arterial stiffness.

The impact of vitamin D supplementation on endothelial function and arterial stiffness may also be influenced by baseline vitamin D status. Patients with CKD often have vitamin D deficiency, and the severity of vitamin D deficiency could affect the response to vitamin D supplementation. The study by Wimalawansa et al. (2015) found that patients with lower baseline vitamin D levels had a more significant improvement in endothelial function with vitamin D supplementation.

Limitations of this systematic review include the small number of studies included and the heterogeneity of the included studies in terms of dosage and duration of vitamin D supplementation, as well as the CKD severity of the study populations. Furthermore, the studies included in this review did not report consistent measurements of endothelial function and arterial stiffness, making it challenging to compare the results across studies.

Conclusion

In conclusion, this systematic review found conflicting results regarding the impact of vitamin D supplementation on endothelial function and arterial stiffness in patients with CKD. While some studies found that vitamin D supplementation significantly improved endothelial function, others did not report significant effects. The meta-analysis by Talat et al. (2021) found conflicting results, with vitamin D supplementation significantly reducing arterial stiffness but not affecting endothelial function. Further well-designed RCTs with standardized measurements of endothelial function and arterial stiffness are needed to determine the optimal dosage and duration of vitamin D supplementation required to improve cardiovascular outcomes in CKD patients. Future studies should also investigate the role of baseline vitamin D status in the response to vitamin D supplementation in patients with CKD.

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