REVIEW ARTICLE

ROLE OF VITAMINS IN CARDIOVASCULAR SYSTEM –A REVIEW

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ABSTRACT

Cardiovascular disease (CVD), the leading cause of mortality around the world, among many risk factors has but some are modifiable one of which is lifestyle. The key element in the healthy lifestyle is diet that boosts cardiovascular health, especially few key vitamins which have been found to help the heart and blood vessels working properly. Vitamins, especially those with antioxidant potency, may have a role in the prevention of and therapy for CVD. Antioxidant vitamins such as vitamin C, vitamin E, and carotenoids are able to decrease the rate of oxidative stress, which may have a principal role in the pathogenesis of atherosclerosis and CVD. Vitamin D also contributes to the maintenance of cardiovascular health and can induce cardio protective effects. Although most of the randomized controlled trials on vitamins failed to show the benefit of vitamin supplementation for cardiovascular outcomes, a number of observational and cohort studies, meta-analyses, and stratified analyses of large vitamin trials appeared to show an effect in some aspects of cardiovascular prevention. Moreover, many of the vitamin trials for secondary prevention are biased by use of vitamins and drugs effective for cardiovascular prevention; therefore, the conclusions drawn from them supporting the effectiveness of vitamin substitution for the prevention of CVD may be inappropriate. This review summarizes the available data suggesting the role of few vitamins in cardiovascular health and in the primary prevention of CVD; also, examining the use of new concepts and new study designs to establish the effectiveness of vitamin supplementation in the therapy for and prevention of CVD.

KEYWORDS: Hematomatrocolpos, transverse vaginal septum, imperforate hymens

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INTRODUCTION

Cardiovascular disease (CVD), the leading cause of mortality around the world, is attributed to unhealthy lifestyle and environmental insults. It results in approximately 790,000 deaths annually in the United States, alone and is the leading cause of death of both men and women above the age of 35 among all racial and ethnic groups.[1] Atherosclerosis, besides CAD or MI, constitutes the basis of CVD. It is estimated that 90% of CVD is preventable by elimination of the modifiable risk factors of atherosclerosis – cigarette smoking, hypertension, diabetes, obesity, elevated level of cholesterol and homocysteine (HCY), stress, alcohol, and lack of physical exercise. Thus, CVD can be prevented by maintenance of a healthy lifestyle, including stress management and healthy eating with satisfactory vitamin supply.[2-3]

The deficiency of some vitamins can cause pathological symptoms in the heart and vascular system became known with the deficiency of vitamin B1 resulting in Beriberi. B vitamins (FA, vitamin B6, and vitamin B12) may play a role in central venous pressure (CVP).[4] A suitable and efficient supply of all vitamins is essential to normal life and the normal functions of the cells and organs. Currently, the vitamins which had a recognized major role for years have now been found important for both the prevention and therapy of CVD and other diseases. This group includes antioxidant vitamins (vitamin C, vitamin E, and carotenoids), folic acid (FA), vitamins B6 and B12 from the vitamin B group, vitamin D, and coenzyme Q10.[5]

This review summarizes the available data suggesting the role of few vitamins in strengthening of heart and cardiovascular health and in the primary

prevention of CVD; also, examining the use of new concepts and new study designs to establish the effectiveness of vitamin supplementation in the therapy for and prevention of CVD.

DISCUSSION

Vitamins are capable of improving the function of the heart and vessels has been advocated by a number of publications. However, many contradictions and inconsistent results cause conflicts because of the abundance of data. In vitro studies, animal experiments, clinical trials and examinations suggest the beneficial effects of vitamins in the inhibition of atherogenesis and atherosclerosis progression. [5]

Vitamin C controls signaling pathway

Vitamin C, well known for promoting the production of new blood vessel and reducing cholesterol build-up on artery walls, hence aids in the health of cardiovascular system. Vitamin C, when given to isolated hypoxic cardiomyocytes, was found to decrease ROS and hence improved resistance to cell death by activation of caspas-3 and translocation of cyt-c into the cytoplasm.[6]

Presence of ascorbic acid is required in the synthesis of Carnitine, which is involved in the oxidation of fatty acids. Absence of vitamin C leads to cardiological, metabolic and musculoskeletal problems characterized by various symptoms. Deficiency resulted in decreased energy supplied by heart, nervous system and skeletal muscles.[7] It is anticipated that vitamin C has protective role on stress-induced heart damage and the development of cardiovascular diseases, but its precise role and mechanisms are unclear.[8]

Oudemans-van Straaten[8] describes the comprehensive pathway how vitamin C controls ROS initiated Ischemia/reperfusion-induction and sepsis-induced endothelial dysfunction.

1 Jak2/Stat1/IRF1 signaling pathway is inhibited by vitamin C by reducing the production of superoxide and hydrogen peroxide and peroxynitrite (OONO–)
2. it prevent endothelial nitric oxide (eNO) depletion and eNOS uncoupling by inhibiting tetrahydro-biopterin (BH4) oxidation, the cofactor of endothelial nitric oxide synthase (eNOS) and thereby protects against oxidative stress induced pathological vasoconstriction and loss of endothelial barrier
3. prevents abundant production of nitric oxide (NO) that generates OONO– in the presence of O2 – . Ascorbate inhibits inducible nitric oxide synthase (iNOS) mRNA and iNOS expression,
4. prevents Bax activation and inhibits myocardial apoptosis which decreases the ability of BCl-2 to inhibit cytochrome-C release from the mitochondria into the cytoplasm and subsequent caspase-3 activation, which initiates apoptosis. The combination with vitamin E is synergistic.
6. Ascorbate inhibits microcirculatory flow impairment by inhibiting tumor necrosis factor-induced intracellular adhesion molecule (ICAM) expression, which triggers leukocyte stickiness and sludging.[8]

What is vitamin D doing for heart?

Vitamin D, besides bone mineralization and calcium homeostasis,[9] has recently been found highly active in cardiovascular health as well as many other health conditions.[10,11] There are several mechanisms by which vitamin D may be associated with atherosclerosis and CV disease events. Vitamin D deficiency may predispose to hypertension via elevation of PTH and disturbed calcium homeostasis.[12-14]. Furthermore, it has been linked to insulin resistance, systemic inflammation, and regulation of the renin–angiotensin system.[15-17] Many tissues possess vitamin D receptor,[18-20] including the myocardium, endothelium, and macrophage, and it has been proposed that vitamin D influences cardiovascular health via autocrine and paracrine activity.

Vitamin D deficiency predisposes to up-regulation of the RAAS: Among the known risk factors of Cardio Vascular diseases, is the up-regulation of the Renin Angiotensen System and hypertrophy of both smooth muscle cells and the left ventricle.21 Vitamin D3 regulates blood pressure by inhibiting the RAAS, lowering the blood pressure. However, a single dose of 100,000 IU vitamin D2 reduced systolic blood pressure by 14 mm Hg regulating endothelial cell-dependent vasodilation.[22] While working on association with cardiovascular diseases studies have found highly significant association ($p<0.0001$) of vitamin D deficiency with coronary artery disease, myocardial infarction, heart failure, stroke and incident death.[23] Many trials and follow-up studies have found out that administration of a daily of 300 IU to 2,000 IU of vitamin D reduces the relative risk for all-cause mortality by 7%.[24]

Vitamin E

Vitamin E (y-tocopherol), one of fat soluble vitamin possesses important biological occasion as cell proliferation, improvement of endothelial cell. It function as lipid-soluble antioxidants, capable of preventing lipid peroxidation. Naturally occurring forms of vitamin E include tocopherols and tocotrienols.[25] The most studied forms are natural a-tocopherol and the esters a-tocopheryl acetate and a-tocopheryl succinate. The Cambridge Heart Antioxidant Study (CHAOS) in 2000 patients with coronary atherosclerosis demonstrated that vitamin E supplementation (400–800 IU/day) over 2 years significantly reduced incidences of cardiovascular death and myocardial infarction.[26] Recently, through metabolomics studies, it was discovered that a-tocopheryl nicotinate occurs endogenously in the heart and that its level is dramatically decreased in heart failure, indicating the possible biological importance of this vitamin E ester.

lino et al. [27] conducted a controlled, double-blind trial of a-tocopheryl nicotinate (EN) versus the placebo for the relief of subjectively assessed symptoms in patients with hypertension and cerebral atherosclerosis. They observed in EN group a significant general improvement (p<0.005) which included numbness of limbs (p=0.032), dizziness (p=0.054), stiff neck (p<0.10), heavy feeling of head (p<0.10), and insomnia (p=0.025), compared to placebo group. Since not much about vitamin E nicotinate is available in the literature, therefore few published reports were evaluated, specifically with respect to a-tocopheryl nicotinate with an emphasis on the differences from natural a-tocopherol or a-tocopheryl acetate.

Vitamin K

Vitamin K promotes clotting and is involved in the activation of important proteins in blood coagulation, prothrombin (II), factor VII, factor IX, and factor X, as well as protein C and S. Deficiency of these factors can result in defective clotting and a bleeding disorder. Vitamin K, since its discovery has only been known for the role of supporting coagulation.[28] However, currently known forms of vitamin K after grouping into three categories: vitamin K1 (Phytomenadione or phytomenadione), vitamin K2 (menaoquinones), and vitamin K3 (menadione), among which only vitamin K1 is recognized as a true vitamin, which is essential for human and animal well-being and present in fresh green vegetables such as broccoli, cabbage, lettuce, and spinach. Vitamins K1 and K3 are fat-soluble, whereas vitamin K2 is water-soluble.

Technically, Vitamins K2 and K3 can be derived as metabolites of vitamin K1 in various tissues or the gastrointestinal tract in animals or humans. It has been shown that vitamin K2 modulates the genetic expression of collagen type 1 and osteocalcin which leads to increased produciton of these proteins by osteoblasts[28]. Its reducing effect on osteoblasts' apoptosis and stimulating effect on other bone blastic proteins, such as osteoprotegerin and osteopontin, have been reported. Vascular calcification, regardless of its anatomical site, is a strong risk factor for cardiovascular death.[29] Vasculature calcification leads to arterial stiffening, elevated systolic pressure, and increased cardiac workload.[30] Schurgers LJ states in his study that a high vitamin K diet is able to reverse aortic calcification after warfarin treatment in rats.[31]

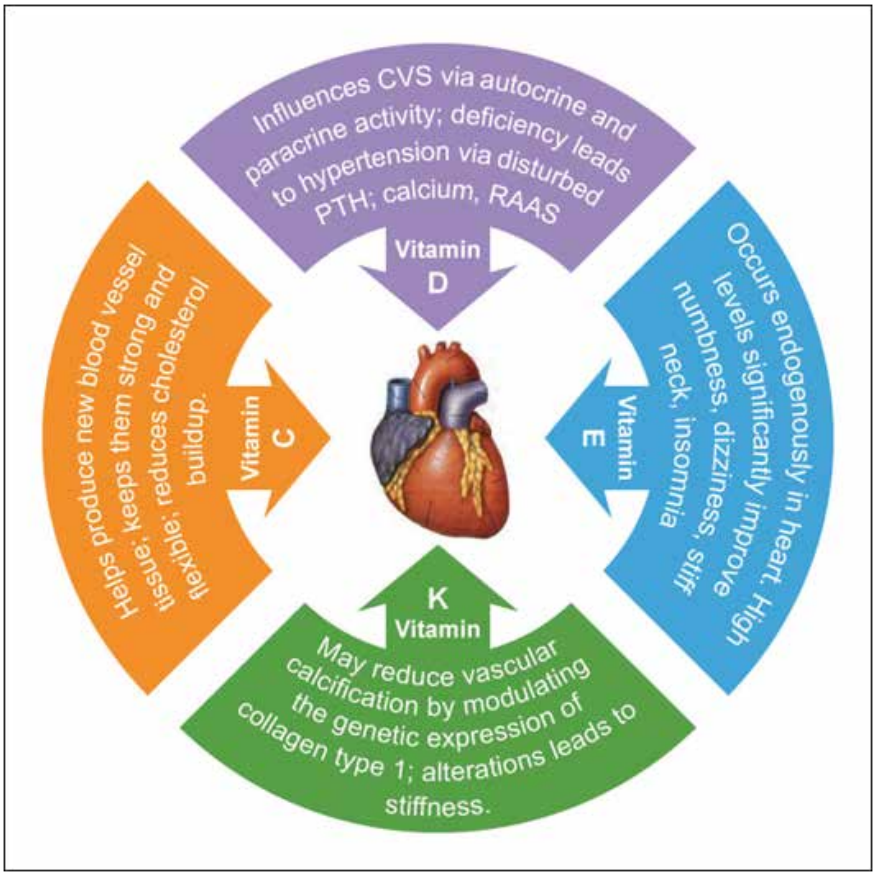

Figure 1: The Influence of Vitamins on Cardiovascular Health

CONCLUSION

In spite of the fact that vitamin supplementation cannot be expected to result in a major decrease of hard cardiovascular endpoints (heart infarct and stroke), it does not mean that vitamin substitutions have no benefit in cardiovascular prevention, especially in primary prevention. There is abundant data from numerous studies suggesting the role of vitamins in primary – and even in secondary, eg, stroke – prevention. Considering vitamin supplementation, it should be emphasized that the principal aim is primary prevention, which means the prevention of the first occurrence of MI, stroke, major cardiac event, or death of cardiac origin. This review concludes that vitamin C, vitamin E, vitamin D, and also β carotene have beneficial effects on cardiovascular health and prevention of CVD. Whether the combined use of these vitamins is more effective than the use of individual vitamins is a question to be addressed in future research.

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