The impact of vitamin D status on arterial functions and carotid intima-media thickness in healthy children.

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Background

Vitamin D deficiency is accepted as an independent risk factor for atherosclerosis. Several studies addressing the possible role of vitamin D deficiency in the pathogenesis of endothelial dysfunction and vascular stiffness. Arterial stiffening is an important cardiovascular risk factor and an independent predictor of all-cause and cardiovascular death. Increased aortic stiffness index (AoSI) or elastic modulus (AoEM) and/or decreased aortic distensibility (AoD) may suggest the widespread nature of the atherosclerotic process.

Carotid intima-media thickness (CIMT) has been utilized as a non-invasive surrogate marker to detect the presence, occurrence, and progression of subclinical cardiovascular disease. Although limited data is available in healthy children regarding the effect of vitamin D on vascular functions.

The aim of this prospective cross-sectional study is to investigate the impact of vitamin D levels on carotid artery, and aortic vascular functions.

Materials and Methods

We enrolled fifty-four healthy children who were admitted to our outpatient clinic between January 2013 and June 2013. Subjects were 3 to 24 months old. We chose subjects for whom vitamin D testing and complete transthoracic echocardiography. Carotid intima-media thickness and aortic/carotid diameter at systole and diastole were measured after conventional echocardiographic examination. Aortic strain, aortic distensibility, aortic stiffness index and aortic elastic modulus were calculated using the current formulas.

We then excluded patient with following features: sepal hypertrophy, valvular disease, hypertension, chronic disease such as diabetes mellitus, chronic renal failure and chronic liver disease, as these finding could influence both vitamin D status and echocardiographic data. We also did not enroll subjects with rickets.

We divided our study population into three groups according to the levels of vitamin D: subjects with \( \geq 30 \text{ ng/ml} \ 25 \text{(OH) D} \) were grouped as sufficient, subjects with 21-29 ng/ml 25(OH) D were grouped as insufficient, and subjects with \( \leq 20 \text{ ng/ml} \ 25 \text{(OH) D} \) were grouped as deficient.

Results

Vitamin D deficiency was observed in 16 patients, and vitamin insufficiency was observed in 16 cases. The vitamin D level was within normal limits in 22 cases. No significant statistical differences were observed among the parameters related with age, sex, weight and serum levels of Ca, P and ALP (p > 0.05). As for the levels of vitamin D there was a significant difference among median values of sufficient group, insufficient group, and deficient group as expected. No statistically significant difference was found in the three groups regarding to the elastic properties of the aortic and carotid arteries. There were no differences between three groups with regard to CIMT.

Discussion

In the present study, we have shown that CIMT and the elastic properties of the aorta and carotid artery did not change at early stages of vitamin D deficiency. To our knowledge, this is the first such study investigating the impact of vitamin D on carotid artery and aortic vascular functions in healthy children.

Vitamin D deficiency is associated with increased CIMT and reported as an independent risk factor for atherosclerosis. Low levels of 25(OH) D are associated with traditional risk factors such as hypertension, obesity, dyslipidemia, and diabetes and regulate atherosclerotic biologic pathways.

Suspected pathogenesis of endothelial dysfunction, vascular stiffness, and atherosclerosis mediated by vitamin D deficiency are proliferation and migration of vascular smooth muscle cell, foam cell formation and accelerated intimal atherosclerosis, increased renin angiotensin-aldosterone system activation, increased bone morphogenic proteins and vascular calcification, increased matrix metalloproteinases and adverse connective tissue matrix remodeling in the vascular wall, increased inflammatory cytokines such as tumor necrosis factor-\( \alpha \) and reduction in T- helper 2 cells, and increased platelet aggregation and thrombogenesis. Vitamin D also improves vessel compliance. The aorta has an elastic structure, and it is generally affected by atherosclerosis.