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Mini Review

Sunlight and Vitamin D Linking Bones to Blood Vessels Via Mirroring Through Calcium Transit

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Sunlight induces vitamin D (VitD) synthesis and strengthens bones via nitric oxide (NO), simultaneously it cleans blood vessels (improving endothelial function) and this is supported by calcium transit within the human systems. During winters (low ultraviolet index season) and even in summers (polar locations) humans lack adequate sunlight exposure thus mirroring osteoporosis (T score <2.5) and hypertension (SBP>140mm of Hg / DBP>90 mm of Hg) in general population. VitD is a hormone from the biochemical point of view because it is mostly synthesized in the skin under the direct action of natural UVR B. 7-dehydrocholestrol undergoes conversion in to Previtamin D which undergoes thermal isomerization within hours to form cholecalciferol. The hydroxylation in liver to form 25 hydroxycholecalciferol (25 OH D). In the kidney a second hydroxylation takes place to form 1,25dihydroxycholecalceferol (1,25 OH D) this goes to other tissues as endocrine function. Second hydroxylation can also take place in other tissues as well for paracrine and autocrine function. Diet also can have small amount the active form. Supplements also deliver it as per the prescription of Daily allowance recommendation [1].

Figure 1: VitD synthesis and parameters mirrored with various body components.

Vitamin D (VitD) can affect a large spectrum of disease [2], sunlight can have even a larger spectrum that it affects. Sunlight deficiency has been identified as an important factor for two bone diseases - rickets and osteocalcin, now the current understanding of the sunlight induced and VitD mediated health factors and diseases produced by their deficiency is very vast and the previous findings were only a "tip of the ice berg" as said by Holick [3]. Skeletal and vascular health factors are associated with each other [5] and mediated by VitD concentrations in blood, and ultraviolet band of sunlight being the primary source of this. About >90% of world's population may be having sob-optimal VitD levels < 30ng/ml.

Vitamin D (VitD) is a mediator of vascular health, as checked by flow mediated dilation of brachial artery (FMD) [5]. Analysis for FMD can be done to check endothelial functioning. Association of atherosclerosis and bone loss is reported by [5,6]. That can be the rationale for FMD testing in osteoporosis and hypertension. Living bone constantly remodels as per the various stimulants like weight bearing and VitD levels. The Calcium release or absorption by bone is dependent upon them also along with parathormone and calcitonin levels. During the osteoporosis the calcium is released from the bones [8]. The blood vessels also can take up the calcium and an adverse reaction leading to atherosclerosis can begin. This bone artery association with implications is discussed by [5,7,9]. Loss of bone mass may also be associated with calcific plaques [10,11]. Further based on risk factors of coronary heart disease screening for the bone mineral density is already been proposed and discussed in the literature [12], there are various similar reports [13-20].

Supplementations by bisphosphonate are also shown to be associated with atherosclerosis in younger age group in MESA study

[21]. VitD is known to control calcium and is also reported to have role in cardiovascular diseases, also VitD levels are recognized as a therapeutic target for hypertension and bone health. Increase in serum VitD concentration has been reported by various investigators in many populations using artificial sources of ultraviolet radiation (UVR) like Cystic fibrosis, healthy women, geriatric and psoriatic patients with fair skin type I and II [22-26]. Limited investigation are seen in skin type IV and V using TL01 [27].

VitD Level achieved by uninhibited sun exposure is 60 ng/ml [28]. Various clinical targets for 25 OH D only are - namely optimal level ≥ 30 ng/ml deficient state of ≤ 20ng/ml and sub-optimal range of 21 - 29 ng / ml are given [3]. As specific health outcome may also require specific target level of VitD the linking levels are presently unknoen for osteoporosis and hypertension.

The various forms of Vit D are described with 1, 25 di hydroxy OHD being the most therapeutically active form may have different therapeutic target levels and so may be there for other forms. Specifically, other forms may also be found to have a therapeutic target and all the Vit D spectrum molecules may have different targets as well. Certain molecules like lometrexol and tach sterol which are considered to be inactive may have an unexplored biochemical role. They may be a part of the link.

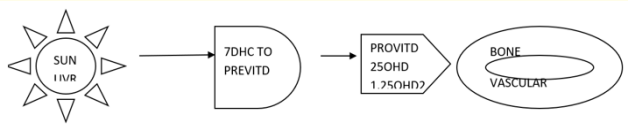

Figure 2: The Photobiosynthesis Of Pre Vitd From 7dhc And Its Effect On Bone And Vascular Health.

Despite all this evidence Cochrane review could only find definite favorable improvement for postmenopausal women in the review for vitamin D supplementation; certain adverse effects like increased nephrolithiasis and increased serum calcium levels have also been quoted [29]. Recently in a review covering 29,000 participants calcium supplementation has been related to more of stroke and myocardial infarction and this risk still remains even after adding VitD, they have also mentioned better prognosis for a group only receiving sunlight as a therapy [30]. During winters the level of UV Index falls and this need to be investigated if during the winter VitD levels are very low [31]. Aristocratic nature of modern humans where there is limited outdoor exposure non-weight bearing bones like distal radius are particularly prone for this. The risk may be more in winters in far off location from the equator [32]. Thus, we shall use the photobiology of VitD for bone and vascular health [33].

Conclusion

Optimal Vitamin D levels via natural exposure can link the homeostatic health of bone and blood vessels in modern human beings.

Conflict of Interest

None.

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