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Effect of Vitamin D on Blood Pressure in Patients with Type 2 Diabetes Mellitus

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Abstract: *Objective: In Trinidadian Type 2 Diabetes Militias patients, we investigated the connection between calciferol, blood pressure, and type 2 diabetes mellitus. Methods: Experiments have shown a connection between calciferol and elevated blood pressure. ELISA was used to determine the calediol (25(OH)D value, which is a calciferol indicator. A computerized dry chemistry device was utilized to obtain cholesterol readings, while an automated blood pressure scale was utilized to obtain blood pressure readings. Results: Type 2 diabetes mellitus did not affect 25(OH)D levels (p=0.128, n=76). Systolic blood pressure above 135 millimetres Hg was associated with 25-hydroxy calciferol blood levels above 32 ng/mL and plasma amounts above 27 ng/mL. Systolic blood pressure correlated modestly with calciferol levels (rs=0.39, p<0.001). Conclusion: People who had a diastolic blood pressure of 130 mmHg were eight times more likely to have a serum calciferol level that was greater than 27 ng/mL. This had 8.00 odds. (2.3 to 27.4). Cafferol and hypertension study is needed.*

Key Words: Vitamin D, Calciferol, 25(OH)D, Blood Pressure, Diabetes Mellitus

Introduction

A lack of calciferol in the body may make the symptoms of diabetes mellitus type 2 worse (Park et al., 2016). The participation of diabetes mellitus type 2 in the breakdown of calcium and bones is a fact that is widely known and discussed. Although the precise pathophysiology of the illness is unknown, it is known that a number of environmental and physiological factors contribute to its development (Leahy, 2005). It is very important to investigate a number of different physiological components in order to find out what role they play in the development of diabetes type 2. Calciferol is the biochemical factor that has been shown to be of particular importance in this investigation.

Hyperglycemia and insulin resistance are the hallmarks of diabetes mellitus type 2, which is a persistent metabolic condition that can contribute to a variety of complications, including cardiovascular illnesses. (CVD). A well-established risk factor for cardiovascular disease, hypertension is one of the most prevalent complications that occur in conjunction with type 2 diabetes. Patients

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with type 2 diabetes mellitus have a substantially greater proportion of hypertension than individuals who do not have diabetes; therefore, the management of hypertension is a primary therapeutic objective in the treatment of type 2 diabetes. In recent years, there has been a growing interest in the function that vitamin D plays in the modulation of blood pressure in individuals who have type 2 diabetes.

Vitamin D is a fat-soluble vitamin that plays a significant part in the regulation of calcium levels in the body and the preservation of bone health. On the other hand, research has shown that it can also have pleiotropic effects, such as the management of the renin-angiotensin-aldosterone system (RAAS) and the modification of immunological function. Similarly, several studies have documented a negative relationship between vitamin D levels and the risk of hypertension, which points to the possibility that vitamin D plays a part in the modulation of blood pressure. It has been hypothesized that vitamin D may inhibit the RAAS, enhance nitric oxide production, and improve endothelial function, all of which could contribute to its blood pressure-lowering effect in T2DM patients. Nevertheless, the precise mechanism that underlies the relationship between vitamin D and blood pressure is not yet fully understood by researchers. The purpose of this article is to explore the potential therapeutic consequences of the prospective impact of vitamin D on blood pressure in T2DM patients and examine the current findings on the effect of vitamin D on blood pressure in T2DM patients. The effects of vitamin D supplementation on blood pressure in individuals with type 2 diabetes have been investigated in a number of clinical studies, with conflicting findings. Some studies have found that taking vitamin D supplements significantly lowers blood pressure, while other studies have found that these supplements have no impact on blood pressure. Vitamin D supplementation was found to substantially lower systolic blood pressure (SBP) by 2.34 mmHg and diastolic blood pressure (DBP) by 1.48 mmHg, according to the results of a meta-analysis that included 12 randomized controlled studies and 1433 individuals with type 2 diabetes. However, the magnitude of the impact was relatively insignificant, and it is uncertain what the practical implications of this diminution are. In addition, it is not known what the ideal dosage of vitamin D supplementation is or how long it must be taken for T2DM patients to experience a reduction in blood pressure that is considered to be clinically significant. Therefore, additional clinical tests that are well-designed are required to ascertain whether or not vitamin D supplementation is successful as a treatment for reducing blood pressure in T2DM patients and to establish the optimum dosage and duration of supplementation.

Vitamin D insufficiency is quite common in type 2 diabetes patients, and it is particularly prevalent in patients who have poor glycemic control, obesity, and insulin resistance. This is an essential point to keep in mind regarding T2DM patients. In addition, the condition of vitamin D can be affected by a variety of other variables, including age, the pigmentation of the epidermis, and geographic position. As a result, the management of hypertension in T2DM patients may benefit from the evaluation for vitamin D insufficiency and the appropriate supplementation of this nutrient. However, it is also essential to take into account the potential dangers associated with taking vitamin D supplements, such as hypercalcemia and hypercalciuria, both of which have the potential to have a negative impact on the health of the cardiovascular system and the kidneys. When recommending vitamin D supplementation to people with type 2 diabetes, it is, therefore, essential to carefully evaluate the patient's current vitamin D levels as well as their kidney function. In summary, the connection between vitamin D and blood pressure in T2DM individuals is a complicated one that calls for additional research. Vitamin D supplementation may offer some advantages in the management of hypertension in T2DM patients; however, additional research is required to determine the optimum dosage and duration of vitamin D supplementation, in addition to the potential dangers associated with vitamin D supplementation. Through the process of photosynthesis, 7-dihydroxy cholecalciferol is

transformed into cholecalciferol, also known as calciferol3. This happens in the epidermis layer of the skin. When 7-dihydroxy cholecalciferol is exposed to UVB radiation, such as that is emitted by the sun, it undergoes a transformation that results in the formation of calciferol3. The production of calcifediol (25-hydroxy calciferol) begins in the liver, where calciferol3 is hydroxylated (Nayak & Ramnanansingh, 2016). In order to produce calcitriol, it is necessary for the kidneys to perform an additional hydroxylation of calcifediol (25(OH) D) (an active form of calciferol). Calcitriol, which is a derivative of 1, 25-dihydroxycalciferol3, attaches itself to the intracellular calciferol receptor of the cell, which causes the impacts of calciferol3 on metabolism to begin. In this investigation, the levels of calciferol found in the participants will be modelled after 25(OH)D.

Participants in the study are from Pakistan, a country that has weather that is consistently mild and bright throughout the entire year. Participants in the research generally had skin kinds V and VI, according to Fitzpatrick and Fitzpatrick's (1988) categorization system for skin types (brown). It is anticipated that the vast majority of people who take part in the study will be exposed to a sufficient quantity of sunlight, which may result in adequate amounts of 25-hydroxy calciferol in the participants. If a patient spends the majority of their time indoors, their body's ability to produce calciferol3 from sunlight will be diminished; however, they will still be able to consume foods like seafood, eggs, and milk that have been supplemented with calciferol. The levels of 25-hydroxy calciferol that indicate a calciferol deficiency or scarcity are, respectively, 20 and 22-30 ng/mL (Pilz et al., 2009). There is a connection between type 2 diabetes mellitus and hypertension, but the linkage between 25-hydroxy calciferol and blood pressure is unclear (Ke et al., 2015). As a result, a review of the research done on the subject revealed contradictory conclusions.

Materials and Methods

In the Hayatabad Medical Complex in Peshawar, Pakistan, this study was carried out between the months of June 2021 and March 2022. Patients diagnosed with type 2 diabetes mellitus were selected at random from the patient records kept at the institutions where the study was conducted. According to the documents from the hospital, patients diagnosed with type 2 diabetes mellitus had measurements for their fasting blood glucose (FBG) that were lower than 120 mg/dL and numbers for their glycated haemoglobin (HbA1c) that were lower than 6.5%, respectively. Before people who have diabetes mellitus type 2 could take part in the study, they had to go through a screening process.

Fasting for nine to eleven hours and refraining from taking any prescription prior to having arterial blood samples collected from each participant was a requirement of the test. Before taking venous samples from the participants on the first day of the blood test, the researchers measured their height and weight to get a baseline for comparison. With the assistance of a computerized blood pressure meter, readings for both the systolic and diastolic blood pressures were obtained. A centrifuge with a g-force of two thousand was used to separate the components of blood samples taken from the cardiovascular system. These components were the serum and the plasma. After the investigation, two samples of whole blood and each component of blood were separated and stored at a temperature of seventy degrees Celsius. The enzyme-linked immunosorbent assay (ELISA) technique was utilized in order to determine the levels of plasma 25-hydroxy calciferol. An automated dry chemistry instrument was utilized in order to obtain blood cholesterol readings. Because of hemolysis in their blood samples, four participants in the research were unable to continue with it.

Results

In a general sense, there was no relationship between type 2 diabetes mellitus and 25-hydroxy calciferol, nor was there an association between

type 2 diabetes mellitus and the use of particular anti-hypertensive medications. 25-hydroxy calciferol and diastolic blood pressure were discovered to have a significant correlation with one another. According to the values of 25-hydroxy calciferol that have been adjusted for both age and gender presented in Table 1, there is no discernible difference between the amounts of 25-hydroxy calciferol in males and women. Patients with type 2 diabetes mellitus and individuals were compared (p = 0.384). The systolic blood pressure was divided into two group factors for measurements of 135 millimetres of mercury or greater, which were not displayed in a picture. These readings were considered elevated. The average levels of 25-hydroxy calciferol found in each of these categories were, respectively, 27.6 12.8 ng per millilitre and 38.4 18.4 ng per millilitre. (p 0.001, log-normal conversion of 25-hydroxy calciferol data to normal variation). Between the groups that had a systolic blood pressure of > 135 mm Hg and the group that had a systolic blood pressure of 135 mm Hg, a significant difference was observed in the 25-hydroxy calciferol. (p0.001). There was a small but significant positive relationship between systolic blood pressure and 25-hydroxy calciferol (rs = 0.39, p 0.001).

Table 1. Hydroxy Calciferol Averages that have Been Aged and Gender-adjusted.

Subjects	Sex	Adjusted mean 25(OH)D, ng/mL	95% Cl		p Value
			Lower Bound	Upper Bound	
Controls	Male, n=11	41.4	29.3	52.5	0.474
	Female, n=22	44.6	34.6	52.7	
Patients with TYPE 2 DIABETES MELLITUS	Male, n=11	37.4	24.8	48.7	
	Female, n=30	32.5	25.5	40.0	

Table 2 displays the findings of a generalized linear model (GLM) multivariate study with logarithmic, systolic blood pressure as the dependent variable and sex, 25-hydroxy calciferol (>26 and 26 ng per millilitre), and type 2 diabetes mellitus/controls as fixed variables. The dependent measure ln significantly shifted between the range of 25-hydroxy calciferol levels (>26 to 26 ng/mL)(systolic blood pressure).

Table 2.The Generalized Linear Model (GLM) Analysis of Systolic Blood Pressure.

Source	P value	Size (d)	Measured Output (%)
Updated version	0.007	0.3	87
Type 2 diabetes mellitus/controls	0.045	0.3	50
Sex	0.557	0.2	10
Calciferol>27 in nanogram per dL	0.001	0.1	70

Table 3 displays the OR when 25-hydroxy calciferol and blood pressure were split within separate factors after controlling for age, gender, and the presence of type 2 diabetes mellitus. For 25-hydroxy calciferol levels, Two groups were distinguished by levels of >35 and >30 ng/ml. Data for diastolic blood pressure readings higher than 135 and 145 mm Hg were separated into separate groups. Blood pressure readings were sorted into 5 groups based on whether they were 135/95, 135/105, 140/95, 135/75, or 145/95 mm Hg on the diastolic side.

Table 3. Adjusted Odds Ratios for High Blood Pressure and 25-hydroxy Calciferol.

The BP in Millimetres Hg	OR (95% CI) Adjusted, mm Hg 25(OH)D>30 ng/mL	Calciferol>27 in in Nanograms per ml
systolic blood pressure>120	5.1 (2.1 to 16.6) p=0.008	7.2 (3.1 to 29.5) p=0.003
systolic blood pressure>130	2.6 (0.7 to 6.2) p=0.158	7.3 (2.1 to 25.4) p=0.014
systolic blood pressure/diastolic blood pressure>120/80	7.2 (1.8 to 26.4) p=0.004	5.4 (3.3 to 20.3) p=0.008
systolic blood pressure/ diastolic blood pressure >120/90	5.7 (2.2 to 19.3) p=0.006	6.8 (3.1 to 25.9) p=0.004
systolic blood pressure/ diastolic blood pressure >125/100	4.3 (2.1 to 12.5) p=0.009	6.1 (2.8 to 23.2) p=0.005
systolic blood pressure/ diastolic blood pressure >130/80	3.6 (2.3 to 5.9) p=0.089	8.3 (1.2 to 22.6) p=0.008
systolic blood pressure/ diastolic blood pressure >125/90	3.2 (1.4 to 5.3) p=0.092	6.2 (1.4 to 23.4) p=0.009

Discussion

Studies have connected amounts of 25-hydroxy calciferol that are too low to an increased chance of type 2 diabetes; the vitamin d receptor may be troublesome in the calciferol pathway (Holick et al., 2007; Nayak & Ramnanansingh, 2016). The vitamin d receptor DNA variant may cause minor alterations in the 3-D shape of vitamin D receptors. Because of these relatively minor structural shifts, different people have Vitamin D Receptors that have varying degrees of sensitivity to 1,25-Dihydroxyvitamin D. Different inclinations may be to blame for a person's vulnerability to type 2 diabetes mellitus. Therefore, it is reasonable to infer that type 2 diabetes mellitus is more likely in people with Vitamin D Receptor receptors that have low 1,25(OH)2D sensitivity. More study is therefore required to comprehend the Vitamin D Receptor variants that may influence Vitamin D Receptor variance in relation to type 2 diabetes mellitus. This research does not conclusively establish a link between vitamin D receptors and type 2 diabetes mellitus.

The finding that there was a very modest favourable relationship between 25-hydroxy calciferol and diastolic blood pressure came as a complete surprise to researchers. Since the majority of the studies either demonstrated that there is no connection between the two variables or that there is an association between the two factors, we can conclude that there is no connection between the two variables (Pilz et al., 2009). There are some studies that do corroborate the beneficial relationship that exists between 25-hydroxy calciferol and diastolic blood pressure; however, the majority of these studies only had a few participants in their sample groups (Muray et al., 2003). Surprisingly, individuals with higher systolic blood pressures had a sevenfold increased likelihood of acquiring a vitamin D level that was greater than 27ng/ml if their blood pressure was higher than 135 mm Hg.

Since the completed research did not meet the needs of the anticipated sample size, increasing the number of samples that were collected would be essential in order to arrive at a conclusion that is more accurate and definitive regarding the relationship between 25-hydroxy calciferol and

systolic blood pressure in the population of Trinidad and Tobago. When looking at the 25-hydroxy calciferol groups >30 and 30 ng/mL in relation to ln systolic blood pressure, the findings of the generalized linear model multivariate analysis that are displayed in the second table compensated for the lack of sample quantity ($p = 0.003$, 90% power). In relation to the consumption of a specific medication, the 25-hydroxy calciferol groups were analyzed at a concentration of 25ng/ml.

This research is an exploratory study that will assist researchers in determining sample numbers for further studies with appropriate power for a particular outcome parameter that is of interest to them. It should come as no surprise that it is challenging to establish a connection between diabetes type 2 and the calciferol pathway. In spite of the fact that there is a chance that calciferol plays a part in the progression of the disease, current studies and the findings of the preliminary investigation suggest that 25-hydroxy calciferol is not an appropriate molecular marker or prognostic for type 2 diabetes mellitus. Calciferol may play a role in the progression of the disease. In order to shed more light on a potential connection between Type 2 Diabetes Mellitus and the calciferol axis, additional research into the binding relationship between calciferol and Vitamin D Receptor as well as modifications to Vitamin D Receptor is necessary. This will allow for a greater understanding of the potential nature of the connection.

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