

The Association between Serum Calcium and Vitamin D levels in Relation To Hypertension and Type 2 Diabetes in the Tribal Population of Adilabad District

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Abstract: Recent evidences have shown an association between vitamin D deficiency and hypertension including diabetes mellitus. The exact underlying mechanism is obscure however vitamin D appears to be involved in regulation of the Renin-Angiotensin system and Insulin sensitivity. Methods: This study was conducted in the Departments of General Medicine and Biochemistry, Rajiv Gandhi Institute of Medical Sciences, RIMS, Adilabad. The patients were divided into two groups the study group I (n=30) who were detected with Impaired glucose tolerance and having lower levels of serum calcium and 1-25 Hydroxyvitamin D levels. The control group II (n=30) were the normal age and sex matched controls with normal values of FBS. The study group I was then given tablets of Vitamin D with calcium for 3 months and was asked to report after three months. The control group I was asked to maintain their normal activity and normal diet and report after 3 months for the analysis of parameters. Results: The Fasting blood glucose levels before the study in group I was 115.15 ± 6.5 mg/dl and in group II it was 89.94 ± 8.5 . The mean SBP in group I was 134 ± 12.3 mmHg and in group II it was 118.0 ± 10.2 mmHg. The mean DBP was 84.6 ± 4.6 in group I and mean values were 78.8 ± 4.2 mmHg in group II. The Serum Calcium levels in group I were 8.0 ± 1.5 mg/dl and in group II 8.8 ± 1.7 mg/dl the p values were found to be significant. The 1, 25-hydroxyvitamin D, in group I pmol/L was 78.8 ± 1.8 and in group II it was 83.5 ± 3.5 pmol/L the p values were found to be significant. The Mean FBS values in group I (Test Group) the mean FBS values were decreased by 7.8 ± 4.5 mg/dl in the test group and in control group the values changed by 0.12 ± 3.5 mg/dl. The 1, 25-hydroxyvitamin D levels were increased by 15.5 ± 5.54 pmol/L in the Test Group I and slightly decreased -0.58 ± 1.8 pmol/L. Conclusion: Within the limitations of the present study we found that supplementation with calcium and vitamin D may improve the glucose tolerance and improvement in blood pressure levels in patients with impaired glucose tolerance and elevated blood pressure in this group of population however as the sample size is small and similar studies with large samples are required for confirmation of the same.

Keywords: Serum Calcium, Vitamin D, Hypertension, Type 2 Diabetes.

INTRODUCTION

Studies have shown that dairy consumption of calcium and vitamin D are inversely associated with body weight, hypertension, and glucose homeostasis and type 2 diabetes mellitus [1-3]. Although the underlying mechanisms are unclear, however, calcium and vitamin D are two major components of dairy products have been postulated to be primarily responsible for the beneficial effect of dairy consumption on body weight and insulin sensitivity [4-6]. Intracellular calcium acts on adipocytes to regulate lipid metabolism and insulin-stimulated glucose uptake and the dietary calcium intake may have favorable

effects on body weight [2, 5] hypertension [1] and Coronary Artery Disease CAD [7, 8]. Vitamin D deficiency and cell dysfunction have been reported in healthy and glucose tolerant subjects [4] non-diabetic people [6] and patients with type 2 diabetes [9]. Hypovitaminosis D correlates with beta cell dysfunction and insulin resistance in 126 normoglycemic healthy adults studied with OGTT [10]. Certain studies have also reported an association between the low circulating concentration of vitamin D and the prevalence of diabetes mellitus [9, 11, 12]. Prevalence and severity of Vitamin D deficiency is increased from 2% to 6% in general population of USA [13]. The metabolic

syndrome defined by the clustering of impaired glucose tolerance, hypertension, adiposity, and abnormal lipid profiles is especially important for identification of those at especially high risk for Type 2 diabetes and coronary heart disease. Till date several studies have been conducted on this issue however no interventional study has been conducted therefore this study was designed to examine to what extent levels of calcium and vitamin D are related to the risk of development of hypertension and Diabetes Mellitus in Tribal Population of Adilabad district and what will be effect of vitamin D and calcium supplementation in people with impaired glucose tolerance and high blood pressure levels before and after the therapy.

MATERIALS AND METHODS

This study will be conducted in the Departments of General Medicine and Biochemistry, Rajiv Gandhi Institute of Medical Sciences, RIMS, Adilabad. Institutional Ethical committee permission was obtained for the study. The Inclusion criteria were subjects male and female aged between 30-55 years those belonging to tribal Adilabad District. The details of the study were explained to all the participants in the local language and a written consent was obtained for the study. The patients were divided into two groups the study group I (n=30) who were detected with Impaired glucose tolerance and having lower levels of serum calcium and 1-25 Hydroxyvitamin D levels. The control group I (n=30) were the normal age and sex matched controls with normal values of FBS. Fasting blood samples will be collected in Vacutainer 10ml and serum fasting blood sugar, calcium, vitamin D and lipid profile will be estimated in fully automatic chemistry analyzer 'Beckman Coulter Au 400' subject's blood pressure and BMI were recorded as per standard protocol. The study group I was then given tablets of Vitamin D with calcium for 3 months and was asked to report after three months. The control group II was asked to maintain their normal activity and normal diet and report after 3 months for the analysis of parameters. The data obtained will be analyzed using statistical software.

RESULTS

In the present study there were a total number of 60 patients included based on the inclusion and exclusion criteria, and they were equally divided into two groups of 30 each and The group I was the test group of patients with Impaired glucose tolerance and Group II was the normal control group having age and sex matched control subjects. There were 21 male and 9 female subjects in the Group I and 20 male and 10 female was included in the group II. The Mean age of Group I was 43.5 ± 3.5 years and in group II the mean age 36.5 ± 3.0 years. The Fasting blood glucose levels before the study in group I was 115.15 ± 6.5 mg/dl and in group II it was 89.94 ± 8.5 the p values were found to be significant. Similarly the HbA1c% levels in group I was $5.2 \pm 2.3\%$ and in group II it was $4.5 \pm 1.2\%$. The

BMI was calculated the mean BMI in group I was 28.5 ± 3.2 Kg/m² and 25.4 ± 1.6 Kg/m² the p values were found $< 0.05^*$ and significant. The mean SBP in group I was 134 ± 12.3 mmHg and in group II it was 118.0 ± 10.2 mmHg the p values were not found to be significant. The mean DBP was 84.6 ± 4.6 in group I and mean values were 78.8 ± 4.2 mmHg in group II. The MAP values were 98.6 ± 6.4 mmHg and 91.2 ± 4.2 mmHg in group I and group II respectively. The C reactive protein levels in group I was 3.5 ± 2.1 mg/L and 2.5 ± 1.5 mg/L in group II. The Total Cholesterol levels in group I was 195.5 ± 10.5 mg/dl and in group II was 186.5 ± 8.5 mg/dl. The mean Serum Triglyceride Levels in group I were 166.5 ± 5.9 mg/dl and the mean group II 148.5 ± 3.8 mg/dl. The Serum Calcium levels in group I were 8.0 ± 1.5 mg/dl and in group II 8.8 ± 1.7 mg/dl the p values were found to be significant. The 1, 25-hydroxyvitamin D, in group I pmol/L was 78.8 ± 1.8 and in group II it was 83.5 ± 3.5 pmol/L the p values were found to be significant Shown in table-1.

The values of parameters were measured in both the groups after three months of therapy to the test group. The Mean FBS values in group I (Test Group) the mean FBS values were decreased by 7.8 ± 4.5 mg/dl in the test group and in control group the values changed by 0.12 ± 3.5 mg/dl the p values were found to be significant. The 1, 25-hydroxyvitamin D levels were increased by 15.5 ± 5.54 pmol/L in the Test Group I and slightly decreased - 0.58 ± 1.8 pmol/L the p values were found to be significant. The BMI changes in both the group I and Group II were not changed significantly. The CRP levels were increased by 0.59 ± 0.6 mg/L in Group I and in Group II increased by 0.45 ± 0.3 mg/L the p values were found to be insignificant and SBP decreased by -6.8 ± 3.6 mmHg in group I and changed by 0.15 ± 0.2 mmHg in group II the p values were found to be significant. The DBP values were decreased by -2.6 ± 1.6 mmHg and Group II were increased by 0.11 ± 0.2 mmHg and the p values were found to be insignificant.

DISCUSSION

This study has been taken to provide additional information regarding the association and dietary calcium and vitamin D intake and risk of development of hypertension and diabetes mellitus in middle-aged individuals. Although weight loss is considered as one of the standard intervention for delaying the onset and development of hypertension and diabetes mellitus however, it is difficult to achieve and maintain on the long-term basis. Therefore identification of weight independent easily modifiable risk factor is urgently needed to attenuate the increasing incidence of type 2 in the tribal population. Several epidemiologic studies have suggested low levels of Vitamin D are associated with impaired glucose metabolism [14]. The serum 25 (OH) D levels are inversely associated with HbA1c

especially at a concentration of less than 65 nmol/L [15].

Table-1: The baseline parameters in two groups before the start of the study

Variable	Test Group I [Impaired Fasting Blood Glucose]	Control Group II [Normal Fasting Blood Glucose]	P values
Number of patients	30	30	--
M/F	21/9	20/10	>0.1
Age (Years)	43.5 ± 3.5	36.5 ± 3.0	>0.3
FBS mg/dl	115.15 ± 6.5	89.94 ± 8.5	<0.03*
HbA1c%	5.2 ± 2.3	4.5 ± 1.2	>0.1
BMI Kg/m ²	28.5 ± 3.2	25.4 ± 1.6	<0.05*
SBP mmHg	134 ± 12.3	118.0 ± 10.2	>0.13
DBP mmHg	84.6 ± 4.6	78.8 ± 4.2	>0.23
MAP mmHg	98.6 ± 6.4	91.2 ± 4.2	>0.56
CRP mg/L	3.5 ± 2.1	2.5 ± 1.5	>0.1
T Cholesterol mg/dl	195.5 ± 10.5	186.5 ± 8.5	>0.3
Triglycerides mg/dl	166.5 ± 5.9	148.5 ± 3.8	>0.4
Serum Calcium mg/dl	8.0 ± 1.5	8.8 ± 1.7	<0.05*
1,25-hydroxyvitamin D, pmol/L	78.8 ± 1.8	83.5 ± 3.5	<0.01*

* Significant

Table-2: Effects of combined calcium and vitamin D supplementation on the parameters of impaired fasting blood glucose patients

Parameter	Test Group I [Impaired Fasting Blood Glucose]	Control group II [Normal Fasting Blood Glucose]	P values
FBS mg/dl	- 7.8 ± 4.5	0.12 ± 3.5	< 0.01*
1,25-hydroxyvitamin D, pmol/L	15.5 ± 5.54	- 0.58 ± 1.8	< 0.05*
BMI Kg/m ²	0.05 ± 0.08	0.03 ± 0.15	> 0.1
CRP mg/L	- 0.59 ± 0.6	0.45 ± 0.3	> 0.1
SBP mmHg	- 6.8 ± 3.6	0.15 ± 0.2	< 0.05*
DBP mmHg	- 2.6 ± 1.6	0.11 ± 0.2	> 0.1

* Significant

In the present study we found that lower levels of vitamin D were associated with impaired glucose tolerance in the test group I. In this study we found fasting blood sugar decreased by -7.8 mg/dl in group I as compared to normal control group II after intervention and no significant change in HbA1c in both groups. Studies have investigated the association between vitamin D and hypertension and metabolic syndrome including Diabetes mellitus. The third national health and nutritional examination (NHANES III) population Ullah *et al.*, have shown a clear inverse association between levels of 25(OH)D and blood pressure independently of numerous potentially confounding variables [16]. Wood AD *et al.*, found in 305 healthy women aged 60-70 years who received randomly 400 to 1000 IU of vitamin D3 or placebo daily for one year to evaluate the effects of the vitamin of lipid profile, insulin resistance, inflammatory biomarkers and blood pressure observed minor changes in the levels of apolipoprotein [17]. There are some quantitative studies on the effect of treatment with calcium and vitamin D supplements on the glycemic

control of patients with type 2 diabetes. Noda M *et al.* found that calcium and vitamin D supplementation although the metabolism of calcium and vitamin D are related to each other [18]. Pittas *et al.*, indicated that the supplementations of vitamin D and calcium improved the glycemic profile of people with normal glucose tolerance for three years [19]. Some studies have shown that abnormal regulation of intracellular calcium affecting both insulin sensitivity and insulin release has been suggested as a potential mechanism for association between calcium deficiency and risk of Type 2 Diabetes [20, 21]. In this study we found the mean decrease in SBP was 6.8mmHg and mean decrease in DBP by 2.6mmHg in the test group I after supplementation of vitamin D and calcium. It has been shown that person with higher vitamin D levels tend to have lower blood pressure and are generally less likely to develop hypertension [16] taking vitamin D supplementation may help in lowering of the blood pressure [22]. Vitamin D will not make hypertension worse as long as it is taken in appropriate dose. In this study we found a slight decrease in CRP levels in the test group after

supplementation of vitamin D and calcium. It is in agreement with study done by Pittas et al who found decreased CRP levels in patients after supplementation of vitamin D and calcium [19]. Systemic inflammation is one of the factors linked to insulin resistance and elevated cytokines may also play role in beta cell dysfunction by triggering beta cell apoptosis. Vitamin D may improve insulin sensitivity and promote beta cell survival by directly modulating the generation and effect of cytokines [23]. Although the limitation of the present study was sample size is small but this study definitely shows that there is improvement in blood sugar and blood pressure profile in patients with supplementation of calcium and vitamin D in patients with low vitamin D and calcium.

CONCLUSION

Within the limitations of the present study we found that supplementation with calcium and vitamin D may improve the glucose tolerance and improvement in blood pressure levels in patients with impaired glucose tolerance and elevated blood pressure in this group of population however as the sample size is small and similar studies with large samples are required for confirmation of the same.

Conflict of Interest: None

Source of support: Nil

Ethical Permission: Obtained

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