ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Serum Calcium and Vitamin D levels in Type 2 Diabetes Mellitus.

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ABSTRACT

Hyperglycemia has its effect on almost all body systems causing various structural and biochemical changes. From this study it is hypothesized that alterations in calcium flux may adversely affect insulin secretion as it is a calcium dependent process. since vitamin d plays a very important role in calcium homeostasis it is also hypothesized that alterations in vitamin D levels may also affect insulin secretion. This study was done to estimate the serum calcium and vitamin D levels in type 2 Diabetes mellitus patients. Estimation of blood glucose levels in all subjects. Estimation of serum calcium levels in diabetes and non-diabetes. Estimation of vitamin D levels in diabetes and non-diabetes. Compare serum calcium and vitamin D levels in diabetes and non diabetes. Case control study. Diabetes patients (cases)[n=50],non Diabetes patients (controls)[n=50].Plasma glucose levels was estimated by GOD-POD Method. Serum calcium levels were estimated by Arsenazo method. vitamin D was estimated by ELISA Method for all subjects at the central lab of biochemistry, SBMCH, Chennai. Data collected was analyzed by single factor Anova and two way Anova. In both the cases F statistical value was greater than F critical value and p value was less than 0.05 in both the analysis also there was a negative correlation between plasma blood glucose levels and serum calcium levels in Diabetes patients and a weak positive correlation between serum calcium and vitamin D levels in diabetes patients. Thus a correlation was established between the three parameters from this study. Supplementation of calcium along with vitamin D can prove to be a easily affordable and effective strategy in optimizing blood glucose levels in diabetes as well as reduce the risk of occurrence of the disease in non diabetes patients.

Key words: Hyperglycemia, type 2 diabetes mellitus, serum calcium, vitamin D.

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ISSN: 0975-8585

INTRODUCTION

Diabetes is a condition characterized by hyperglycemia that occurs either due to decreased insulin secretion or insulin resistance in body tissues. Hyperglycemia has its effect on almost all body systems through various structural and biochemical changes. The hypothesis of our study is that alterations in calcium flux may adversely affect insulin secretion as it is a calcium dependent process. Vitamin D plays a very important role in calcium homeostasis, hence it is also hypothesized that alterations in vitamin D levels may also affect insulin secretion.

There are various risk factors for diabetes, the most important being obesity. It has long been suggested that weight loss greatly helps in control as well as prevention of diabetes mellitus. But it is difficult to achieve and maintain long term.

Hence there occurs the need to identify easily modifiable risk factors. There is evidence as per studies done by Anastassios G Pittas that calcium and vitamin D levels when altered may affect control of Diabetes [1-10].

MATERIALS AND METHODS

Ours was a case control study where in data was collected from 128 subjects but only 42 non Diabetic and 48 diabetic volunteered to give blood samples for the laboratory investigations. All investigations were carried out at the central lab of Sree Balaji Medical Colege, Chennai.

Plasma blood glucose levels was estimated by GOD-POD method (Reference range-70-110 mg/dl).Serum Calcium by Arsenazo (Reference range-8.9-10.3mg/dl) and vitamin D by ELISA method (Reference range-30-150 ng/ml) was estimated at the central lab.

All the subjects where given a questionaire wherein they were asked to fill details regarding age, body weight, physical activity, smoking status, alcohol usage, drug intake, history of hypertension, asthma, duration of diabetes, symptoms of hypocalcemia such as myalgia, arthralgia, pins and needles sensation, weakness, paresthesias.

Hypertensives, asthmatics, subjects suffering from osteoporosis, osteomalacia, end stage renal failure and pregnancy where excluded from the study.

STATISTICAL ANALYSIS

Anova single factor and Anova two factor analysis was done.

In both the analysis F statistical value was greater than F critical value and P value was less than 0.05 which was statistically significant.

ISSN: 0975-8585

Overall Results of the Study.

DM	Low	Normal	High	Total
PLASMA BLOOD GLUCOSE LEVELS (mg/dl)	2	14	32	48
SERUM CALCIUM LEVELS (mg/dl)	7	41	0	48
VITAMIN D LEVEL (ng/ml)	40	8	0	48
NDM	Low	Normal	High	Total
PLASMA BLOOD GLUCOSE LEVELS (mg/dl)	0	26	17	43
SERUM CALCIUM LEVELS (mg/dl)	1	42	0	43
VITAMIN D LEVEL (ng/ml)	38	5	0	43

Reference Range:

Plasma Blood Glucose Levels (mg/dl)	<70	70-110	>110
Serum Calcium Levels (mg/dl)	<8.6	8.6-10.3	>10.3
Vitamin D Level (ng/ml)	<30	30-150	>150

Anova: Single Factor Diabetics

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
PLASMA BLOOD GLUCOSE LEVELS (mg/dl)	48	7647	159.3125	4573.113032
SERUM CALCIUM LEVELS (mg/dl)	48	452.3	9.422916667	0.612442376
VITAMIN D LEVEL (ng/ml)	48	1002.14	20.87791667	82.72014025

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	668195.8093	2	334097.9046	215.2486675	1.41399E-43	3.060291772
Within Groups	218852.9439	141	1552.148538			
Total	887048.7532	143				

ISSN: 0975-8585

Anova: Two-Factor With Replication

SUMMARY	PLASMA BLOOD GLUCOSE LEVELS (mg/dl)	SERUM CALCIUM LEVELS (mg/dl)	VITAMIN D LEVEL (ng/ml)	Total
DM				
Count	42	42	42	126
Sum	6403	404.4	884.34	7691.74
Average	152.452381	9.628571429	21.05571429	61.04555556
Variance	4443.326945	0.223066202	83.01173728	5717.674321
NDM				
Count	42	42	42	126
Sum	4678	398.7	776.67	5853.37
Average	111.3809524	9.492857143	18.49214286	46.45531746
Variance	1593.607433	0.138240418	86.13344164	2689.136577
Total				
Count	84	84	84	
Sum	11081	803.1	1661.01	
Average	131.9166667	9.560714286	19.77392857	
Variance	3408.896586	0.183136833	85.21641209	

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	13411.128	1	13411.128	12.96504225	0.000383813	3.879537574
Columns	774235.911	2	387117.9555	374.2414991	2.40183E-75	3.032511609
Interaction	22151.37579	2	11075.6879	10.70728439	3.47741E-05	3.032511609
Within	254464.0754	246	1034.406811			
Total	1064262.49	251				

ISSN: 0975-8585

Diabetes Correlation	PLASMA BLOOD GLUCOSE LEVELS (mg/dl)	SERUM CALCIUM LEVELS (mg/dl)	VITAMIN D LEVEL (ng/ml)
PLASMA BLOOD GLUCOSE LEVELS (mg/dl)	1		
SERUM CALCIUM LEVELS (mg/dl)	-0.37222133	1	
VITAMIN D LEVEL (ng/ml)	0.137176203	0.036505732	1

Non Diabetes Correlation	PLASMA BLOOD GLUCOSE LEVELS (mg/dl)	SERUM CALCIUM LEVELS (mg/dl)	VITAMIN D LEVEL (ng/ml)
PLASMA BLOOD GLUCOSE LEVELS (mg/dl)	1		
SERUM CALCIUM LEVELS (mg/dl)	0.063946535	1	
VITAMIN D LEVEL (ng/ml)	0.043312159	0.145172537	1

Overall Correlation	PLASMA BLOOD GLUCOSE LEVELS (mg/dl)	SERUM CALCIUM LEVELS (mg/dl)	VITAMIN D LEVEL (ng/ml)
PLASMA BLOOD GLUCOSE LEVELS (mg/dl)	1		
SERUM CALCIUM LEVELS (mg/dl)	-0.284110641	1	
VITAMIN D LEVEL (ng/ml)	0.143594961	0.056808489	1

There was a negative correlation between serum calcium and plasma blood glucose levels,and there was a weak positive correlation between serum calcium and vitamin D levels.

DISCUSSION

Diabetes is a very common disease in India with the number of diabetes cases is increasing every year at an alarming rate. There arises a need for implementing cost effective and effective measures to prevent as well as control the disease.

Insulin secretion is a calcium dependent process. When blood glucose levels increase the glucose is transported inside with help of GLUT-4 transporters. This glucose is converted to glucose-6-phosphate with aid of glucokinase. This is further oxidized to yield increased ATP which causes closure of potassium channels and hence depolarization of the cell membrane depolarisation

causes a increase of calcium flux through calcium channels which causes docking of vesicles containing insulin to fuse with the cell membrane. Insulin is then secreted by exocytosis.

Calcium is important for insulin mediated intracellular processes in insulin responsive tissues such as adipose tissue and skeletal muscle with a very narrow range necessary for optimal insulin action. Furthermore, calcium is necessary for insulin receptor phosphorylation and proper signal transduction and thus optimal GLUT-4 transporter activity.

Role of Vitamin D In Insulin Secretion

Synthesis of vitamin D

When exposed to sunlight Previtamin D is converted to vitamin D3 (cholecalciferol). Cholecalciferol is converted to 25-hydroxy cholecalciferol in the liver with help of 25-hydroxylase. 25-hydroxy cholecalciferol is converted to 1,25-dihydroxy cholecalciferol with help of 1-alpha hydroxylase enzyme. This 1,25-dihydroxy cholecalciferol causes increased calcium absorption from intestine.

Vitamin D contributes to normalization of extracellular calcium ensuring normal calcium flux through cell membrane. Studies done have also shown to prove that there is a vitamin D response element in the human insulin gene promoter. Also 1 alpha hydroxylase is expressed by beta cells of pancreas thus playing a important role in formation of active form of vitamin D.

RESULTS AND CONCLUSION

There appears to be a correlation between plasma blood glucose, serum calcium, vitamin D levels in Diabetics. Supplementation of calcium along with vitamin D can prove to be a very cost effective and beneficial factor in modifying the risk of diabetes along with playing a very crucial role in better glycemic control.

REFERENCES

[1] Mathieu C, Gysemans C. Diabetol 2006; 22(3): 187-93.
[2] Bikle DD, Siiteri PK, Ryzen E, Haddad JG. J Clin Endocrinol Metab 1985; 61: 969-75.
[3] Maesstro S, Bajo MS, Davila N, Calle C. Cell Biochemistry and function. 2002; 3: 227-32.
[4] Thacher TD,Clarke BL. Mayo Clin Proc 2011; 86: 50-60.
[5] Parker J, Hashmi O, Dutton D, Mavrodaris A, Stranges S, Kandala NB, et al. Maturitas 2010; 65: 225- 236.
[6] Pittas AJ, Lau J, Hu FB, Dawson-Hughes B. J Clin Endocrinol Metab 2007; 92(6): 2017-29.
[7] Johnson JA, Grande JP, Roche PC, Kumar R. American J Physiol 1994; 267 (3), E356-E360.
[8] Bland R, Markovic, Hills CE, et al. J Steroid Biochem Mol Biol 2004; 89-90:121-25.
[9] Bourlon PM, Billaudel B, Faure Dussert AJ. Endocrinol 1999; 160: 87-90.
[10] Mathieu C, Gysemans C, Giulietti A, Bouillon R. Diabetologia 2006; 49 (1): 217-18.