International Journal of Medical and Health Research
ISSN: 2454-9142
Received: 13-01-2020; Accepted: 14-02-2020; Published: 09-03-2020
www.medicalsciencejournal.com
Volume 6; Issue 03; 2020; Page No. 43-45

To study the co-relationship between glycosylated hemoglobin and serum calcium levels in type 2 diabetes mellitus patients

Dr. Hardeep Singh Deep[1], Dr. Jasmine Kaur[2], Dr. Gurjyot Singh Nanda[3], Dr. Seerat Kaur[4]

[1] Professor MD Medicine Sri Guru Ram Das University of Health Sciences, Amritsar, Punjab, India
[2] Assistant. Professor MD Medicine Sri Guru Ram Das University of Health Sciences, Amritsar, Punjab, India
[3] junior resident Medicine Sri Guru Ram Das University of Health Sciences, Amritsar, Punjab, India
[4] junior resident Radiodiagnosis Sri Guru Ram Das University of Health Sciences, Amritsar, Punjab, India

Abstract
Background: The incidence of type-2 Diabetes Mellitus has increased world-wide making it a major public health problem. Electrolyte and mineral abnormalities are common in patients with type-2 Diabetes Mellitus. Therefore, this study was undertaken to look for the correlation between HbA1c (glycated hemoglobin) and serum calcium levels in patients with type-2 Diabetes Mellitus.
Aim: To study the co-relationship between glycosylated hemoglobin and serum calcium levels in type 2 diabetes mellitus patients.
Materials and Methods: A total of 50 type 2 Diabetic patients and 50 healthy non-Diabetic individuals were included for the study. Both fasting and post prandial blood samples were collected from the two groups and were used for fasting blood sugar, HbA1c, serum calcium, RFT, LFT, CBC, UACR. Unpaired student's t-test was used to compare the results between the diabetic and non-diabetic group.
Results: The results showed a significant decrease in the serum calcium levels ($p < 0.001$) in the type 2 Diabetic patients when compared to the non-Diabetic control group, whereas HbA1c levels were significantly increased in the diabetic group when compared to the non-diabetic group ($p < 0.001$). Also, type 2 Diabetic patients showed a statistically significant negative correlation ($r = -0.513$, P-value= 0.00) between their HbA1c and serum calcium levels.
Conclusion: Type 2 Diabetic patients with poor glycemic control are at increased risk of developing hypocalcemia when compared to those with good glycemic control.

Keywords: Serum calcium, Type 2 diabetes, HbA1c, UACR, BMI

Introduction

Diabetes Mellitus is a global epidemic affecting more than 422 million people world-wide [1]. It has also been predicted that by the year 2025, India will top the list of countries with the largest number of people with Diabetes Mellitus followed by China and United States [2]. Type-2 Diabetes Mellitus is characterized by chronic hyperglycemia with disturbances of carbohydrate, fat and protein metabolism resulting from a relative Insulin deficiency or resistance to the action of Insulin [3].

The long term complications of Diabetes Mellitus includes; development of Diabetic retinopathy, Diabetic nephropathy and Diabetic neuropathy [4]. These complications are far less common and also less severe in people who have well controlled blood glucose levels [5]. The Diabetes control and complications trial (DCCT) and United kingdom prospective Diabetes study have shown that the risk for developing Diabetic complications are directly related to glycemic control which is measured by glycated hemoglobin (HbA1c). Glycated Hemoglobin (HbA1c) is routinely used to measure long term glycemic control in patients with Diabetes Mellitus [6]. Glycated Hemoglobin (HbA1c) is formed within the red blood cells at a rate directly proportional to the blood glucose level and indicates the mean blood glucose levels over the previous 10-12 weeks [7]. HbA1c values are not altered by any recent changes in diet, exercise or drug intake [8]. Skeletal System involvement is yet another complication of Diabetes Mellitus [9]. Patients with Diabetes Mellitus have increased risk of developing skeletal complications like osteoporosis, charcot's arthropathy and Diabetic foot syndrome [10]. Bone and mineral abnormalities observed in patients with type-2 Diabetes Mellitus may be caused by Insulin resistance and hyperglycemia on the bone and bone marrow micro environment and increased concentrations of advanced glycation end products affecting the bone matrix proteins [11]. Calcium is a major mineral of the bones and teeth and also plays a major role as a second messenger in cell-signalling pathway. Calcium is necessary for insulin mediated intracellular processes in insulin responsive tissues such as skeletal muscle and adipose tissue [12]. Changes in serum calcium levels in type-2 Diabetes Mellitus contributes to peripheral Insulin resistance via impaired Insulin signal transduction leading to decreased GLUT-4 activity [13, 14, 15]. Decreased levels of serum calcium in type-2 Diabetes Mellitus patients may be due to hyperglycemia which causes excessive urinary loss of calcium proportional to the degree of glucosuria [16]. In response to urinary calcium loss, parathyroid hormone (PTH) secretion is mildly stimulated to maintain serum calcium concentrations. Bone formation is suppressed in the hyperglycemic state and urinary calcium loss in Diabetes is derived from the bone [17]. The aim of this study is to study the correlation of serum calcium and

Glycated Hemoglobin (HbA1c) levels in patients with type-2 Diabetes Mellitus. This is to demonstrate how glycemic control can affect serum calcium levels in type-2 Diabetic patients.

Materials and Methods

Study population

The study population consisted of two groups. Group-1 included type- 2 Diabetic patients (n =50) and Group-2 consisted of healthy non- Diabetic people (n =50). The study was a comparative study.

Inclusion criteria

The whole study size consisted of 100 individuals, attending the department of Medicine at Sri Guru Ram Das Institute of Medical Sciences and Research, Vallah, Sri Amritsar, Punjab, India. 50 diabetic patients labeled as test group and other 50 normal healthy, non- diabetic individuals as control group.

Exclusion criteria

Patients with known history of (cardiovascular disease, respiratory disease, skeletal muscle injury, renal failure, bone and endocrine diseases) and terminally ill patients were excluded from the study.

Parameters studied

Serum Calcium, Glycated Hemoglobin (HbA1c), Fasting Blood Sugar (FBS)

Study method

Ethical committee approval was obtained for the study. Written informed consent was obtained from all the participants of the study. All the participants were clearly explained about the procedure of the study. 5 ml of peripheral venous blood was collected from both the diabetic and non-diabetic group under strict aseptic conditions in the fasting and postprandial state. This sample was divided into two portions. The first part (2ml) was transferred to an EDTA tube and used for HbA1c analysis. HbA1c percentage was analysed by particle enhanced immuno-turbidimetric test method using HbA1c XL System Pack kit. EM-360 Fully automated clinical chemistry analyser was used for HbA1c determination. The second part (3ml) was allowed to clot at 37^0 c for 3 minutes and then centrifuged for 10 minutes. After separation, the serum samples were used for calcium, fasting and post prandial blood glucose determination. Erba Chem 5 plus V2 Semi automated clinical chemistry analyser was used for serum Calcium measurement. Serum Calcium levels were analysed by Arsenazo-III method. Both fasting and post prandial blood glucose levels were determined by enzymatic kit methods.

Statistical method of analysis

Statistical analysis was done using SPSS statistical package version 21. Data was expressed in terms of Mean ± SD. Unpaired student's t test was used to compare the results between the diabetic and non-diabetic group. Pearson's correlation coefficient was used to correlate serum calcium levels with HbA1c levels in type-2 Diabetic patients. Statistically significant variation was considered when p value was less than 0.05.

Results

Table 1: Comparison of mean values of HbA1c and serum Calcium between Diabetic and non-Diabetic group

	Test Group		Control Group		P value
	Mean	SD	Mean	SD	
Serum Ca(mg/dl)	7.651	.741	8.154	.507	0.010
HbA1c	8.863	2.294	5.320	.633	0.000

** Highly Significant ($p < 0.001$) *Significant ($p < 0.05$) Ca – Calcium HbA1c – Glycated Hemoglobin

Table 1 shows that mean values of Serum Calcium were significantly lower in the Diabetic group when compared to the non-Diabetic control group (P-value< 0.001); while mean values of HbA1c, were significantly higher in the Diabetic group (P-value<0.001).

Table 2: Correlation between HbA1c and serum Calcium levels in Diabetic Group

Variable	Statistics	HB A1c
	Prearson	
Serum CA(mg/dL)	Correlation	-.513**
	P value	0.001

**Correlation is significant at the 0.01 level

Table 2 shows that Serum Calcium levels have a strong negative correlation with HbA1c levels in the Diabetic group (r = -0.513 P value= 0.00).

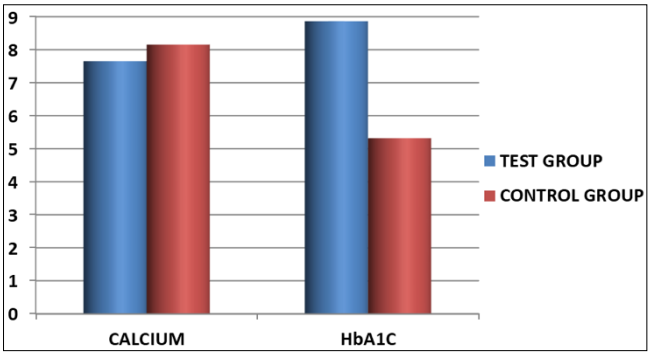

Fig 1: Bar Diagram showing comparison of mean values of HbA1c and serum Calcium between Diabetic and non-Diabetic group

Figure-1. Bar Diagram shows decrease in the mean Serum Calcium levels and increase in mean HbA1c values in the Diabetic group when compared to the non-Diabetic group.

Discussion

In the present study, we have evaluated the levels of serum calcium in type-2 Diabetic patients and its correlation with HbA1c levels. Results in our study have shown that serum calcium levels were significantly decreased ($p < 0.001$) in type-2 Diabetic patients when compared to the non-Diabetic control group. The mean level of HbA1c in patients with type-2 Diabetes Mellitus in our study was (8.86± 2.29) and they were significantly higher ($p < 0.001$) than those of the non-Diabetic controls with mean value (5.32± 0.63) as shown under (table-1 and figure-1). The findings in our study are in accordance with the study done by Najeeb *et al* [18]. Who also showed statistically significant decrease in serum calcium and increase in HbA1c in type 2 Diabetic patients when compared to non-Diabetic controls ($p < 0.001$). Similar

Findings were also observed in another study done by Kanchana N and Saikumar P [19]. However in contrast to our study, Nuha E. Abubaker and Mohammed Nasir [20] had shown that there was no statistically significant difference in serum calcium levels between the Diabetic and non-Diabetic control group ($p > 0.05$). The decrease in serum calcium levels in type 2 Diabetic patients observed in our study may be due to several factors; reduction in Insulin levels with impaired bone formation as a result of decreased osteoblastic activity thus resulting in impaired calcium homeostasis, associated hyperglycemia which increases the calcium and glucose excretion in urine proportional to the degree of glucosuria. The increase in HbA1c levels observed in patients with type-2 Diabetes Mellitus in our study may be due to poor glycemic control. In our study, a statistically significant negative correlation ($r = -0.513$, P-value= 0.00) between HbA1c and serum Calcium levels was observed in the type 2 Diabetic patients as shown under (table-2). These findings are in agreement with the study done by Safaa Abed EL *et al* [21]. Who showed a significant negative correlation ($r = - 0.56$, P-value= 0.00) between HbA1c and serum Calcium levels in the Diabetic Group.

Conclusion

We conclude that, in type 2 Diabetic patients, serum calcium levels are very much affected by poor glycemic control with a significant negative correlation between HbA1c and serum calcium levels. The better the glycemic control, as reflected by HbA1c, the better would be the serum calcium level. Therefore, it can be concluded that, a good glycemic control in type 2 Diabetic patients will contribute in improving the serum calcium level and lessen the associated risk of developing diabetic complications.

References

1. World Health Organisation, Global Report of Diabetes.WHO,Geneva2016,http:// www.who.int/about/licensing/copyright form/index html.
2. Mehta, Kashyap AS, Das S. Diabetes Mellitus in India; The modern scourge. MJAFI. 2009; 65(1):50-54.
3. Susman JL, Helseth LD. reducing the complications of type-2 Diabetes. A patient centered approach. Am Fam Physician. 1997; 56:471-480.
4. Alberti KG, Zimmet PZ. WHO consultation. Definitions, diagnosis and complications. Diabetic Med. 1998; 15:529-533.
5. Litwack G. Human Biochemistry and Disease. Elsevier's science and technology. 4'Th ed. London: Elsevier, 2008, 131-146.
6. Randie R, William L. A review of variant hemoglobins interfering with hemoglobin A1C measurement. Journal of Diabetes Science and Technology. 2009; 3:446-450.
7. Nathan DM, Singer DE, Hurxthal K, Goodson JD. The clinical information value of the glycosylated haemoglobin assay. Eng J Med, 1994; 310:345.
8. Gandhi M, Venkateshwari R, Swaminathan S. A study on the association between plasma glucose, glycosylated haemoglobin and macro metals calcium and magnesium in Diabetes Mellitus. Experimental Sciences. 2013; 4(1):16-21.
9. Hough FS. Alterations in bone and mineral metabolism in Diabetes Mellitus. Samt Journal. 1987; 72:116-119.
10. Lorenz C, Carolin C, Shiv K Singh, Herald Dobnig. Osteoporosis in patients with Diabetes Mellitus. Journal of Bone and Mineral Research. 2007; 22:1317-1328.
11. Mohammed MK, Abdrabo A. Evaluation of serum bone minerals level in Type-2 Diabetic Sudanese patients. Sudanese Journal of public health. 2013; 8:25-28.
12. Ojuka EO. Role of calcium and AMP Kinase in the regulation of mitochondrial biogenesis and GLUT 4 levels in muscle. Proc Nutr Soc. 2004; 63:275-278.
13. Draznin B, Susman K Kaom. The existence of an optimal range of cytosolic free calcium for insulin stimulated glucose transport in adipocytes. J Biol Chem. 1987; 268:14385-14388.
14. Williams PF, Caterson ID. High Insulin binding and Insulin receptor-effector coupling. Pub med J. 1990; 11:547-556.
15. Zemel MB. Nutritional and Endocrine modulation of intracellular calcium. Mol Cell Biochem. 1998; 188:129-136.
16. Sultan E, Taha I, Saber LM. Altered bone metabolic markers in Type-2 Diabetes Mellitus: Impact of glycemic control. J of Taibah university medical sciences. 2008; 2:104-116.
17. Nagasaka S, Murakami T, Uchikawa T, Ishikawa SE. Effect of glycemic control on calcium and phosphorous handling and parathyroid hormone level in patients with Non- Insulin dependent Diabetes Mellitus.Endocrine Journal. 1995; 42(43):377-383.
18. Najeeb Q, Aziz R, Hamid S. To evaluate the levels of glycated haemoglobin, serum calcium, magnesium, phosphate, uric acid and microalbuminuria in patients with newly diagnosed type 2 Diabetes Mellitus. International Journal of Research in Medical Sciences. 2014; 2(4):1462-1465.
19. Kanchana N, Saikumar P. Serum calcium levels in type 2 Diabetes Mellitus. IOSR Journal of Dental and Medical Sciences. 2014; 13:1-3.
20. Nuha E Abubaker, Mohammed Nasir M. Serum total calcium, magnesium, potassium and pH in Sudanese patients with type 2 Diabetes Mellitus. International Journal of Advanced Research. 2017; 5(3):86-91.
21. Safaa Abed EL Rahman, Wigdan Abdel Rahman Elsheikh, Nazik Ibrahim Abdel Rahman, Nabiela M. Elbagir. Serum Calcium Levels in Correlation with Glycated Hemoglobin in Type 2 Diabetic Sudanese Patients. Advances in Diabetes and metabolism. 2016; 4(4):59-61.