

Original Research Article

Study of serum Zinc status among type 2 diabetes mellitus patients

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ABSTRACT

Background: Both microvascular and macrovascular complications in diabetes are related to oxidative stress. Zinc which has antioxidant property, delays diabetic complications. The present study was conducted with the objective to study the relationship between serum Zinc level and HbA1C level in newly diagnosed type 2 diabetes mellitus and to compare serum Zinc level with its risk factors.

Methods: The present study was a cross sectional study, conducted on 100 patients attending the outpatient department at Rajiv Gandhi Government General Hospital and Madras Medical College, Chennai during the period from May 2015 to October 2015. Of them 50 were newly diagnosed type 2 diabetics and considered as diabetic group and other 50 were considered as controls, who attended the master health check-up. All patients were subjected to thorough general and systemic examination. Under strict aseptic precautions blood sample was collected from all the patients and the serum was investigated for creatinine, urea, zinc, HbA1c, cholesterol, triglycerides and fasting blood glucose. The data obtained were analysed using Microsoft excel software. Correlation was found out in SPSS by using regression equation.

Results: The body mass index (BMI) and mean systolic blood pressure (SBP) was significantly higher ($p < 0.001$) in diabetic group as compared to controls. Serum levels of HbA1C and fasting blood glucose (FBG) levels were found to be significantly higher in diabetic group than in controls ($p < 0.001$). Serum zinc levels were significantly higher in control group ($p < 0.001$). Mean zinc value decreases with increase in HbA1c, FBG, BMI, SBP, DBP, triglycerides and cholesterol and the difference was statistically significant (p value < 0.01). The relation between Pearson correlation coefficient for zinc and the above parameters were higher in diabetics than controls.

Conclusions: Lower serum zinc levels were found to be responsible for the development of macrovascular complications in type-2 diabetics. Hence there is a need for zinc supplementation in diabetic patients to prevent long term complications associated with it.

Keywords: Complications, Serum zinc, Type 2 diabetes mellitus

INTRODUCTION

Diabetes mellitus is the most prevalent disease worldwide. Type 2 diabetes is the most common type that affects millions of individuals every year across the globe.¹ According to the data published by International Diabetes Federation in their 5th edition of Diabetes Atlas, people living with diabetes is expected to rise from 366

million in 2011 to 552 million by 2030.² It is identified that zinc plays an important role in synthesis, storage and secretion of insulin in response to carbohydrate intake and plays an important role in energy production. It also maintains the structural integrity of insulin.^{3,4} The decreased zinc concentration in blood, affects the ability of the islet cells of pancreas to produce and secrete insulin that may lead to the development of insulin resistance responsible for incidence of type 2 diabetes.⁵

Oxidative stress plays an important role in the development of diabetic complications. Zinc not only has an antioxidative effect, but also constitutes a key constituent of many antioxidants. It inhibits the damage associated with lipid peroxidation and prevents the formation of free radicals.⁶ These findings recommend that zinc deficiency may be related with the development of diabetic complications.

Glycated hemoglobin percentage (HbA1C%) is one parameter which provides index of blood glucose control in collective sense. It is a reliable indicator of long-term hyperglycemia and the measurement of HbA1C% helps in identifying the risk of developing diabetic complications.⁷

The present study was performed with the primary objective to study the relationship between serum zinc level and HbA1C level in newly diagnosed type 2 diabetes mellitus patients. The secondary objectives of the study were to compare obesity, dyslipidemia, hypertension in diabetes and control, and to compare correlation of serum zinc level with the same risk factors.

METHODS

This was a cross-sectional study conducted over a period of six months from May 2015 to October 2015 at the Institute of Internal medicine, Rajiv Gandhi Government General Hospital and Madras Medical College, Chennai. After getting approval from Institutional ethics committee, 100 patients attending the outpatient patient department of our institute were included in the study. Of them, 50 were newly diagnosed type 2 diabetics attending OP and considered as diabetic group and other 50 were considered as controls who attended the master health checkup. An informed consent was collected from all the participants. A complete history of the patients was collected using a predefined proforma.

All patients were subjected to thorough general and systemic examinations. Under strict aseptic conditions blood sample was collected from all the patients and the serum was investigated for creatinine, urea, zinc, HbA1c, cholesterol, triglycerides and fasting blood glucose. Urine samples were collected and urine proteins were determined by turbidimetric method using 3% sulphosalicylic acid.

Inclusion criteria

Study confirmed cases of newly diagnosed type 2 diabetes mellitus in the age group 40 to 60, control group with no known comorbidities. Patients and Controls with hypertension and obesity were included in the study

Exclusion criteria

Study patients who is taking zinc supplementation or drugs that interfere with zinc absorption, patients with chronic disease and pregnancy, diabetic related

complications and patients on oral hypoglycemics or insulin.

Statistical analysis

The data was performed by using Microsoft excel software. A 'P' value of less than or equal to 0.05 was considered statistically significant. Correlation was found out in SPSS by using regression equation.

RESULTS

In this study, 100 patients are included in which 50 are diabetics and 50 are controls. In both groups majority people are in the age group 41 to 50. Equal ratio of male and females (1:1) was seen in diabetic group whereas in control group females outnumbered the males (Table 1).

Table 1: Age and sex wise distribution of study participants.

| Characteristics | Diabetes | Control |
|-----------------|----------|---------|
| Age | | |
| 41-50 years | 33 | 29 |
| 51-60 years | 17 | 21 |
| Sex | | |
| Male | 25 | 23 |
| Female | 25 | 27 |

The body mass index (BMI) and mean systolic blood pressure (SBP) was significantly higher ($p < 0.001$) in diabetic group as compared to controls, while there is no significant difference ($p > 0.05$) in the mean diastolic blood pressure (DBP) in diabetic group when compared to control group.

Table 2: Comparison of demographic variables between the study groups.

| Variables | Diabetes | | Control | | P value |
|-----------|----------|-------|---------|-------|---------|
| | Mean | SD | Mean | SD | |
| BMI | 32.48 | 3.37 | 29.35 | 3.36 | <0.001 |
| SBP | 132.60 | 11.97 | 125.68 | 11.54 | <0.004 |
| DBP | 82.52 | 7.89 | 79.88 | 6.76 | <0.076 |

Table 3 presents the correlation of serum parameters between diabetic and control groups. It was observed that serum levels of HbA1C and fasting blood glucose (FBG) levels were found to be significantly higher in diabetic group than in controls ($p < 0.001$). Serum zinc levels were significantly higher in control group ($p < 0.001$). Serum urea, creatinine, triglycerides and cholesterol levels were found to be higher in diabetic group compared to controls but the difference was not significant statistically ($p > 0.05$). Mean zinc value decreases with increase in HbA1c, FBG, BMI, SBP, DBP, triglycerides and cholesterol and the difference was statistically significant (p value <0.01). The relation between Pearson correlation coefficient for zinc and the above parameters were higher in diabetics than controls (Table 4).

Table 3: Correlation of serum biochemical parameters between diabetic and control groups.

| Variables | Diabetes | | Control | | P value |
|--------------|----------|-------|---------|-------|---------|
| | Mean | SD | Mean | SD | |
| HbA1C | 8.57 | 1.51 | 5.41 | 0.38 | <0.001 |
| FBG | 189.40 | 51.14 | 92.04 | 12.55 | <0.001 |
| Urea | 32.90 | 8.08 | 30.48 | 7.90 | <0.133 |
| Creatinine | 0.82 | 0.20 | 0.78 | 0.20 | <0.341 |
| Zinc | 58.31 | 17.23 | 75.65 | 18.05 | <0.001 |
| Triglyceride | 196.58 | 53.30 | 173.04 | 52.27 | <0.028 |
| Cholesterol | 225.76 | 51.90 | 202.96 | 50.11 | <0.028 |

Table 4: Correlation of zinc with various parameters in diabetes and control.

| Parameters | Values | No. of diabetics | Mean zinc values | Correlation coefficient | | P value | |
|--------------------------|-----------|------------------|------------------|-------------------------|---------|----------|---------|
| | | | | Diabetes | Control | Diabetes | Control |
| HbA1c | <8 | 24 | 60.27 | | | | |
| | 8 - 10 | 20 | 55.80 | -0.543 | -0.120 | <0.001 | <0.408 |
| | >10 | 6 | 39.30 | | | | |
| Fasting blood glucose | ≤200 | 26 | 66.65 | -0.553 | -0.084 | <0.001 | <0.563 |
| | 201-300 | 18 | 53.8 | | | | |
| | >300 | 6 | 40.8 | | | | |
| Body mass index | 20 - 30 | 15 | 65.48 | -0.492 | -0.161 | <0.001 | <0.264 |
| | 30 - 35 | 24 | 59.9 | | | | |
| | 35 - 40 | 11 | 45.33 | | | | |
| Systolic blood pressure | ≤ 120 | 8 | 69.12 | -0.351 | -0.103 | <0.012 | <0.477 |
| | 121 - 140 | 31 | 58.29 | | | | |
| | >140 | 11 | 51.8 | | | | |
| Diastolic blood pressure | ≤ 80 | 24 | 64.5 | -0.422 | -0.146 | <0.02 | <0.311 |
| | 80 - 90 | 19 | 53.2 | | | | |
| | >90 | 7 | 50.7 | | | | |
| Triglyceride | ≤150 | 13 | 68.07 | -0.451 | -0.045 | <0.001 | <0.756 |
| | 151- 250 | 28 | 58.38 | | | | |
| | >250 | 9 | 42.48 | | | | |
| Cholesterol | ≤ 200 | 18 | 64.75 | -0.422 | -0.046 | <0.001 | <0.749 |
| | 201- 250 | 14 | 63.77 | | | | |
| | >250 | 18 | 45 | | | | |

DISCUSSION

In this study 100 patients (50 diabetics and 50 controls) were subjected to history, examination and investigations after getting their consent. Only newly diagnosed type 2 DM without complications attending medicine department were included as cases in the study.

In this study, mean serum zinc values was found to be significantly lower in all diabetics compared to controls. This was in accordance with the findings of McNair et al, in his study serum zinc was inversely related to glycemic status of diabetes.⁸ Garg et al, also reported similar findings in diabetes.⁹ Williams et al, observed 17% decrease in zinc concentration in diabetes while comparing with controls. In this study Pearson correlation coefficient of Zinc and HbA1c in diabetes was -0.543 which established strong negative correlation and

statistically significant (p value <0.001) whereas correlation coefficient of control for these two parameters was -0.120 and not significant (p value 0.408). Tripathy et al, in his study showed negative correlation between Zinc and HbA1c with 'r' value of -0.408.11

In this study mean fasting blood sugar was significantly higher in diabetic than control and Pearson correlation coefficient of zinc and FBS showed significant negative correlation in diabetes (-0.553) compared to control (-0.084). Our study showed serum zinc deficiency occurs with increase in glycemic status. Similar observation is done by Al-Marouf et al in his study conducted on 101 type-2 diabetic patients and found that glycemic status was improved on zinc supplementation.¹²

BMI was observed to be significantly higher in diabetes than control. Our study showed obesity was associated

with type 2 DM. Association between diabetes and obesity was shown by many studies. Mokdad et al, in his study showed strong association between DM and BMI using data from Behavioral Risk Factor Surveillance System.¹³ Our study also showed negative correlation between BMI and zinc in diabetes.

Triglyceride and cholesterol levels were significantly higher in diabetes than control in our study which shows association between dyslipidemia and type 2 DM. Insulin resistance in DM is a well-known reason for dyslipidemia. Zinc had negative correlation with triglyceride and cholesterol in diabetes in our study. Similar findings were also noted by Seet et al.¹⁴ However, there were only limited studies available about zinc and dyslipidemia and furthermore studies are needed to confirm this relationship.

In this study, systolic blood pressure was significantly higher in diabetes than control whereas diastolic blood pressure was not statistically significant. Negative correlation was seen between zinc and systolic/diastolic blood pressure in diabetes. This result is in accordance with Al-Dohan et al.¹⁵

CONCLUSION

This study suggested that zinc has strong negative correlation with HbA1c, FBG, obesity, hypertension and dyslipidemia in type-2 diabetics. So, detecting zinc deficiency in diabetes earlier helps in preventing complications and also controlling glycemic status. Supplementation of zinc in type-2 diabetics is recommended in early stages of diabetes to prevent the incidence of both micro and macrovascular complications. Large scale studies are needed to conduct and support zinc supplementation in type 2 DM to control blood glucose.

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Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee

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