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Research Paper

Study of Association of Calcium with Lipid Profile in Patients of Type 2 Diabetes Mellitus in Population of Udaipur

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Introduction

Many types of metabolic alterations are responsible for altering the metabolism related with the metabolic syndrome. The pathophysiology and the progression of the disease correlate well with the deranged reactions in the diseased states. There are particular roles of different minerals as far as the pathogenesis of the metabolic syndrome is concerned. The progress of the disorder is also correlated with the metabolism of different minerals. [5]. There are many minerals which hold significance and are significant in relation to the metabolic syndrome. These trace elements control the different functions like growth and biological functions[3, 4.]

Classification of Diabetes Mellitus

1. Insulin Dependent Diabetes Mellitus (IDDM):
   It is called as Type 1 diabetes (T1-DM) due to damage of β cells normally resulting in absolute deficiency of insulin.[12]
2. Non Insulin Dependent Diabetes Mellitus (NIDDM):
   It is called Type 2 diabetes (T2DM).It is an effect of deranged metabolisms like obesity along with insulin resistance. In such cases insulin is made at first normally by the pancreas however there is defect in the functioning of this hormone in regulating the blood glucose concentration. The pancreas then unable to make sufficient insulin in order to respond as far as requirement of the body is concerned. [9]
3. Gestational Diabetes Mellitus (GDM):
   This is seen in the period of pregnancy where the onset of the disorder of initial stage of glucose intolerance is very common mainly in the second / third trimester phase of the pregnancy period. The prevalence of such type is approximately 5 percent of pregnant women. Cases showing such type of diabetes present with almost half a chance of suffering from the disease in future mainly type 2 disorder[13].

Type-2 diabetes mellitus (DM) is now one of important global health disease of this century. It is responsible for around ninety percent of all the diagnosed population for the disease. Around one fourth adult persons population has been

diagnosed as diabetic patients recently in our country and the statistics reveal that it would be 3 times after the year 2030. Basically it is said that nearly ½ populations after the age of thirty become more prone to the disorder of diabetes[15,16].

Complications that are associated with the metabolic syndrome are many which involves CVD disorders, nephropathy involvements, retinopathy involvements along with involvement of polyneuropathy[21].

Aims and Objectives

1. Determination of serum levels of the Calcium in Type 2 Diabetes Mellitus patients in population of Udaipur.
2. Evaluation of their association with lipid profile in population of Udaipur.

Review of Literature

If there is a altered metabolism of the mineral calcium then this might lead to peripheral insulin resistance through improper insulin signal transduction resulting in less activity of glucose transporter 4 (GLUT4). In the year 1978 Arquilla ER et al did a research on impact of trace element zinc both in vivo as well as in vitro metabolism of the hormone regulating its metabolism that is insulin. They concluded that the altered concentrations of proper and damaged insulin in the blood are related to bond and hydrolysis in liver with time and not in the kidney[12] In the year 1981 H.P. Roth et al did a study on the impact of nutrition from zinc on metabolism of the hormone insulin. They concluded from their study that to fed controls the deficient in the mineral zinc had unaffected pro insulin contents following stimulation by glucose although they observed less glucose tolerance and less serum insulin along with an increased total insulin-like activity. In the year 1987 D'Ocon C et al gave a research study on healthy group and they concluded negative correlation among the trace element and insulin concentration and also among the latter and Cu concentration with a positive relation between Cu and the other parameter.

Material and Methods

The study was carried out in 100 patients suffering from type 2 diabetes mellitus from December 2023 to July 2024 at Pacific Medical College and Hospital, Udaipur, Rajasthan. 50 healthy subjects who came for medical executive check-up at our hospital were selected for this study.

Inclusion Criteria

Cases – It included 50 clinically proven cases of Type 2 Diabetes Mellitus patients who have visited Biochemistry laboratory of Pacific Hospital from December 2023 July 2024 in the age group of 40-70 yrs. Known patients of hyperlipidemia and subjects who were obese were included in our study

Controls – It included 50 normal healthy age and sex matched subjects who were having no major illness and also not on any treatment or medications.

Exclusion Criteria

Patient who were diagnosed with following diseases or family histories were excluded from our study:

- Eating Disorders
- Minerals (Medication)
- Alcoholism
- Kidney Diseases
- Pregnant Women
- Lactating Mother
- Liver Disorders
- Patients suffering from Diabetic Ketoacidosis
- Patients who were on nutritional supplementations
- Subjects who were suffering from acute complication like mild to severe infections or any kind of major traumas
- Patients who were on anti Lipidemia drugs

Locus of study

All patients who were diagnosed with Type 2 Diabetes Mellitus were the also evaluated for our study by routine biochemical assays and investigations along with some specific laboratory investigations. All laboratory assays were done in the clinical laboratory, in Department of Biochemistry on Auto analyzer and semi Auto analyzer.

Methodology of collection of samples:

Step 1:

Informed consent was taken from all individuals as participation

Step 2:

Fasting blood sample was collected by vein puncture by an aseptic technique.

Step 3:

Unique ID number was given to every individual participating in study with same ID on the sample also

Step 4:

After sample collection, samples were then centrifuged in centrifuge at 3000 RPM for ten minutes

Step 5:

Serum was separated

Step 6:

Analyzed for following assays:

1) Serum calcium
2) Serum total cholesterol
3) Serum triglyceride
4) Serum high density lipoprotein

Observations and Results

For Male and Female of Control Group

Table: 1 Mean ± SD Values of Element in Control (Male and Female)

Elements	Male (N1= 30) Mean ± SD	Female (N2 = 20) Mean ± SD
Calcium	9.38 ± 0.44	9.26 ± 0.41

Table: 2 Significance of Various Elements in Control (Male and Female)

Element	t-value	p-value	Significance
Calcium	0.107	.398	NS

Table: 3 Mean ± SD Values of Element in Patients (Male and Female)

Element	Male (N = 30) Mean ± SD	Female (N = 20) Mean ± SD
Serum Calcium	7.61 ± 0.270	7.62 ± 0.251

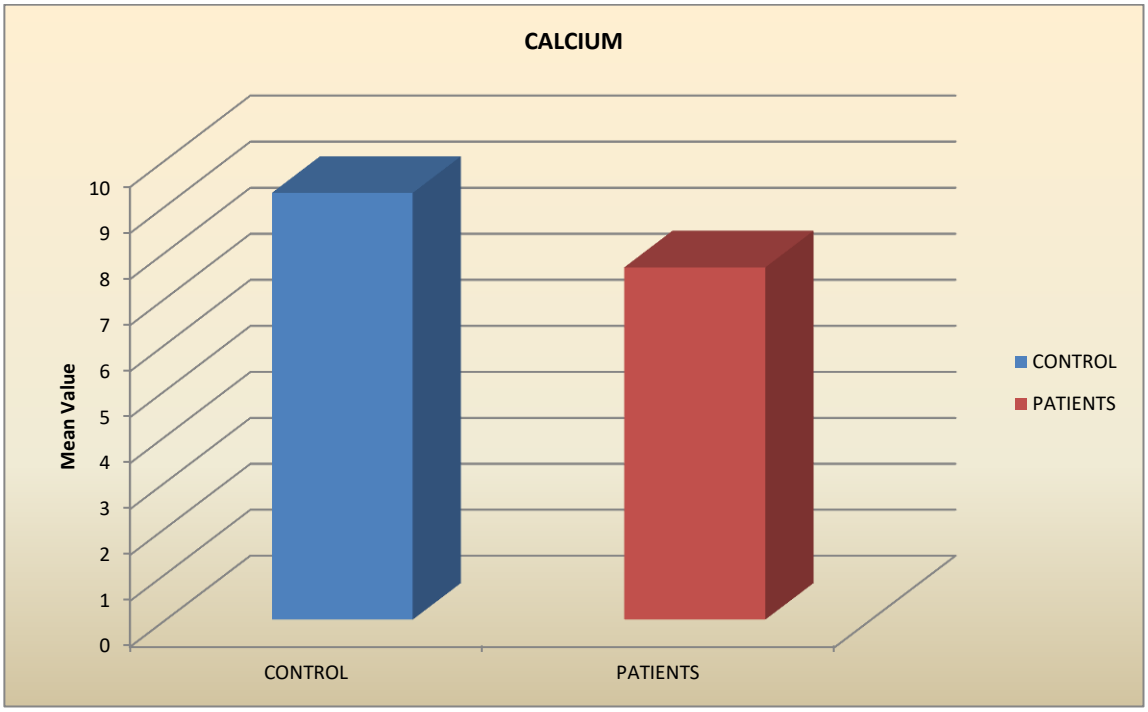
For Control and Patients

Table: 4 Mean ± SD Values of Element in Control and Patients

Element	Control (N = 50) Mean ± SD	Patients (N = 50) Mean ± SD
Calcium	9.28 ± 0.410	7.552 ± 0.28

Table: 5 Significance of Element in Control and Patients

Marker	t- value	p- value	Significance
Calcium	21.26	P<0.05	S



Discussion

In the study the level of serum calcium in healthy controls and Type 2 Diabetes Mellitus group patients in mean and SD is 9.2 ± 0.4 mg/dL and 7.6 ± 0.25 mg/dL respectively.

The statistical analysis done via paired t-test showed that serum calcium level was low in patients of type 2 diabetes mellitus and was statistically significant - $P<0.05$.

Calcium is an essential mineral and this element is needed in large amounts that are it is a macro mineral. The Ca^{2+} ion is an electrolyte and is important to the health and development of the muscular system, circulatory system and also digestive system

It becomes indispensable for the development and growth of that is building up of bone

It supports forming along with physiologically important functions of blood cells

Regulation of the contraction of muscles is with the help of this mineral

Nerve conduction is another function done by calcium

It also helps in clotting of blood[19].

The risk factor for type 2 DM:

Vitamin D insufficiency

Vitamin D and calcium insufficiency might negatively influence glycemic states and combined supplementation of these both nutrients might be important and holds advantage in regulation of glucose metabolism.

Calcium is also important and an essential element in insulin-mediated intracellular mechanisms tissues of insulin-responsiveness like skeletal muscles along with adipose tissue and any change with respect to its concentration might contribute lead to peripheral insulin resistance through improper insulin signal transduction which results in less and decreased glucose transporter 4 (GLUT4) action[3].

Decreased concentrations of serum calcium in type-2 Diabetes Mellitus individuals might be due to hyperglycaemic state that results in extra and increased loss of the mineral in urine that is proportional to the amount of glucosuria. Further in response to this condition of urinary loss of calcium the parathyroid hormone (PTH) secretion gets slightly activated in order to maintain serum calcium concentrations in normal range Bone formation also gets decreased and is suppressed because of this state and urinary calcium excretion in Diabetes is mobilized and is driven from the bone[6].

The study was previously conducted by Amare Desalegn Wolidel et al in 2017 on the topic of association of trace metal elements with lipid profiles in type 2 diabetes mellitus and this exhibited a negative correlation between the trace metal elements like Zn+2, Mg+2, Cr+3, Ca+2 and Fe+3 along with lipid profile parameters like cholesterol triglycerides and other parameters among type 2 diabetes mellitus group patients. There was an association of the element calcium with TG[1]

A link between serum calcium and metabolic syndrome disorders was hypothesized that states that less concentration of total calcium seems to be correlated with metabolic syndrome along with less insulin and a deranged lipid profile[7].

The level of serum calcium declined concomitantly along with increasing lipid profile specially VLDL and high glucose level in type 2 diabetes mellitus patients and useful for correlation with lipid profile parameters and DM.

Conclusion

The present study was conducted on 100 subjects. 50 controls and 50 patients included came to PMCH in order to investigate the association of Serum Trace Element and Lipid Profile in Type 2 Diabetic patients. This study concluded that:

- Diabetic patients sound to be less educated than non-diabetics.
- Diabetic patients seem to be poorer than non-diabetics.
- Diabetic patients are two-fold smokers than non-diabetics.
- Diabetic patients are less physically active than the non-diabetics.
- Diabetic patients are heavier and more obese than non-diabetics.
- In short term diabetic control, more than half of diabetic patients are poorly controlled.
- In long term diabetic control, more than two thirds of diabetic patients are poorly controlled.
- Diabetic patients are less frequently removing fat from meat than non-diabetics.
- Diabetic patients don‘t drink whole fat milk at all while non-diabetics rarely do.
- Diabetic patients drink skimmed milk more frequently than non-diabetics.
- Diabetic patients are more frequently eating whole grain bread than non-diabetics. And also they are less frequently eating refined bread than non-diabetics.
- Diabetic patients consume almonds, cashew, hazelnuts and pistachio less frequently than non-diabetics.
- Diabetic patients have decreased serum Calcium level than non- diabetic controls
- Diabetic patients have less serum glucose level than non- diabetic control.
- Diabetic patients have increased serum VLDL level than non- diabetic controls.
- Diabetic patients have decreased serum HDL level than non- diabetic controls.
- The result of the study suggested that there is a correlation between trace element (Calcium) and lipid profile in type 2 diabetes mellitus patients as the theory suggested that when there is increased in serum glucose level this cause increased in serum VLDL level and decreased in serum Calcium level and also decreased in Serum HDL level of lipid profile.
- The decreased in serum calcium level illustrate the increased in serum VLDL level that cause decreased in insulin secretion form pancreas which cause increased in serum glucose level that regulate the type 2 diabetes mellitus.

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