CALCIUM AND DIABETES MELLITUS TYPE TWO A PROSPECTIVE STUDY DONE ON PEOPLE WITH TYPE 2 DIABETES IN DIWANIYA TEACHING HOSPITAL

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Abstract

Background: Disturbance in mineral metabolism in diabetes is well-known for the last three decades. Calcium ion plays an important role in glycemic control by affecting the biosynthesis and release of insulin from the Beta cells of the pancreas.

Objective: To examine the level of serum calcium in patients with diabetes type 2 of different ages in Diwaniya city.

Methods: Seventy patients with diabetes type 2 of different ages and both sexes with a mean age of ±SD 56.23 ± 8.25 years and seventy healthy controls of both sexes with a mean age of ± SD of 36.2 ± 14.3 years were examined for serum calcium and glucose levels.
level in the fasting state and postprandial serum glucose level was done. Main outcome measures were serum calcium (SCAL), serum glucose (SGL), serum cholesterol, and serum triglyceride level in fasting state.

**Results**: Serum calcium level was significantly lower in patients with type 2 diabetes as compared to normal healthy control persons with normal blood sugar. Hypocalcaemia was seen in 43% of our patients with type 2 diabetes.

**Conclusion**: Hypocalcaemia is significantly associated with uncontrolled hyperglycemia in patients with type 2 diabetes and should be looked for and corrected to have a better control of the blood sugar.

Key words: Type 2 diabetes mellitus, calcium, glucose, hypocalcaemia, hyperglycemia, hypercholesterolemia, hypertriglyceridemia.

**Introduction**

The incidence of diabetes type 2 is increasing at an alarming rate both nationally and worldwide with more than one million cases per year diagnosed in the US alone. Although our current methods of treating diabetes has improved but prevention is preferable {1}.

High intake of calcium and vitamin D, particularly from supplements may lower the risk of diabetes by 33% and over a billion people are vitamin D deficient. {2}

A growing body of evidence on clinical and animal studies has linked insufficient level of vitamin D and calcium to a variety of human diseases such as osteoporosis, cancer and autoimmune diseases. {3,4}

Based on basic and animal studies, vitamin D and calcium have been suspected as modifiers of diabetes risk. Vitamin D insufficiency has long been suspected as a risk factor for type 1 diabetes based on animal and human observational studies. More recently there is accumulating evidence to suggest that altered vitamin D and calcium homeostasis may also play a role in the development of type 2 diabetes {5}.

An estimated 19 million people are affected by diabetes in Europe equal to four percent of the population and this figure is liable to increase to 28 million in 2030 {2}.

In the United States there are 20 million people with diabetes, equal to seven percent of the population. The total costs are thought to be as much as 132$ billion with $92 billion results from direct cost of medications, according to 2002 American diabetic association figures {2}.

The purpose of this study was to prospectively evaluate the association between calcium level in the blood and type 2 diabetes in comparison with normal healthy volunteers in a group of people of different age and in both sexes in Diwaniya city.

**Patients and methods**

Seventy patients with type 2 diabetes of both sexes with a mean ±SD age of 56.23± 8.25 years who were attending the consultation department of Diwaniya Teaching hospital in Diwaniya city from August till September 2008 and seventy healthy nondiabetic control with a mean age ± SD of 36.2 ±14.3 years, were included in this study. No participant taking any minerals was included and diabetic patients with diarrhea, albuminuria and hypoalbuminemia were excluded from the study as serum calcium was correlated with normal serum albumin in our selected diabetic patients.

The median range of the SGL and SCAL in control and type 2 diabetes is presented in table (1). The proportion of patients with hypocalcaemia in our study was 43% table (2).
Table 1 Median range for the SGL and SCal in healthy controls and type 2 diabetes

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>diabetic</th>
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<tbody>
<tr>
<td>Sugar</td>
<td>89.93(mg/dl)</td>
<td>277.57(mg/dl)</td>
</tr>
<tr>
<td>Ca</td>
<td>9.61(mg/dl)</td>
<td>8.09(mg/dl)</td>
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Venous blood samples were taken in the fasting state at 9 am, and post prandial glucose level was measured after 2 hours, blood collected in sterile unused glass test tubes and allowed to clot for 2 hours at room temperature. After centrifugation, the serum was removed. Glucose measured by spectrophotometric enzymatic end point method\(^6\). Serum calcium level was analyzed by dye colorimetric method, which uses O-cresolflalein complexone at alkaline pH. The intensity of the crnomophore formed is proportional to the concentration of total calcium in the sample\(^7\). The kit purchased for the analysis of the data was from linear chemicals Barcelona (Spain). The accepted level of significance was at \(P <0.001\).

\(P <0.001\).

**Results**

The normal referral values for serum calcium, serum glucose, serum cholesterol, serum triglyceride were as follows respectively, 8.1-10.3mg/dl, 80-110mg/dl, <200mg/dl, and 150-200mg/dl respectively.

Serum calcium was low in 43% of the patient group studied with a \((P<0.001)\) compared with the healthy controls (table 2 and 3) while serum glucose, serum cholesterol, and serum triglycerides were all elevated as compared to the control (table 4 and 5). Hypercholesterolemia was found in 50% of patients, while hypertriglyceridemia was found in 58.57% of the patients. Hyperglycemia was found in 95.7%. There was a significant inverse correlation between the level of cholesterol, triglyceride and hypocalcaemia, patients with high serum cholesterol and triglyceride had lower serum calcium levels, with a reverse relationship and \(r\) value of 0.089 for serum cholesterol and 0.219 for the triglyceride level.
Table (2) shows the mean value for SCAL in both control and diabetic.

Table (3) shows the percentage of patients with hypocalcaemia.
Table (4) shows the percentage of patients with hyperglycemia and hypocalcaemia compared to control.

Table (5) shows the mean levels of glucose, cholesterol, and triglyceride in Diabetic and control.
Discussion

There is evidence to suggest that altered vitamin D and calcium homeostasis may play a role in the development of type 2 diabetes \([8,9]\). Both vitamin D and calcium intake are inversely associated with development of type 2 diabetes, and the effect of the two nutrients appears to be additive or synergistic. For both vitamins D intake and calcium from supplements rather than diet were associated with a lower risk of type 2 diabetes \([8, 9, 10, 11]\).

Although the evidence to date suggests that vitamin D and calcium deficiency influences post prandial glycemia and insulin response while supplementation may be beneficial in regulating these processes, the exact mechanisms by which vitamin D and calcium may promote B cell function, or ameliorate insulin resistance is incomplete \([8,9]\).

The mechanism by which vitamin D affect the risk of diabetes is not known. Both insulin resistance and impaired B cell function has been reported with vitamin D deficiency \([13,23]\). The mechanism by which calcium intake may alter diabetes risk are speculative. Abnormal regulation of intracellular calcium affecting both insulin sensitivity and release has been suggested as a possible mechanism to explain the association between calcium insufficiency and the risk of diabetes\([14,15]\).

The main mechanism of vitamin D is to enhance absorption of calcium from the intestine. Therefore insufficient calcium results from insufficient vitamin D from low intake or from low calcium intake. This hypothesis is supported by data indicating that calcium is essential in normalizing glucose intolerance in vivo\([16]\). The additive effect of calcium and vitamin D intake suggests that increased vitamin D intake may potentiate the effect of calcium intake, but it does not rule out a direct effect of vitamin D independent of its role in calcium homeostasis. Indeed, in vitro animal studies suggests that the effect of vitamin D on B-cell appears to direct and independent of plasma calcium concentration \([17]\).

In this study we found the proportion of patients with type 2 diabetes who have hypocalcaemia was 43%, and the hypocalcemia correlated significantly with the height of both serum cholesterol and triglyceride level, the higher the level of either of them the lower the calcium level was in the serum. Our finding was consistent with other studies which showed that hypocalcaemia was associated with both the development of metabolic syndrome and type 2 diabetes.

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The limitation of our study is the small number of patients taken and the period for follow up, as we need a prolonged period following the consumption of adequate amount of both vitamin D and calcium to see the response of the patients and the control of their blood glucose.

Currently recommended intakes for calcium are 1,200 mg/day for adults aged >50 years and for vitamin D are 400 IU/day for those aged 51-70 years and 600 IU/day for those aged >70 years \([21]\). However, there is growing consensus that vitamin D intakes above the current recommendations may be associated with better health outcomes.

In relation to calcium intake for type 2 diabetes, the evidence suggests that intakes above 600 mg/day are desirable but intakes above 1200 mg may be optimal \([22]\).
Conclusion
Serum calcium plays an important role in the regulation of glucose level in the blood particularly post-prandial glucose level, hence serum calcium should be measured in patients with type 2 diabetes who have uncontrolled hyperglycemia, and oral supplementation of both vitamin D and calcium from sources other than diet is recommended.

References
1- Source: Journal of Clinical Endocrinology & Metabolism June 2007, Volume 92, Number 6, Pages 2017-2029. doi:10.1210/jc.2007-0298
"The Role of Vitamin D and Calcium in type 2 diabetes. A systematic Review and Meta-Analysis"
Authors: A.G. Pittas, J. Lau, F. Hu, B. Dawson-Hughes
2- NUTRA USA Ingredients.com
5- Mathieu C, Badenhoop K. Vitamin D and type 1 diabetes mellitus: state of the art. Trends Endocrinol Metab. 2005;16:261–266
12- Cade C, Norman AW: Vitamin D3 improves impaired glucose tolerance and insulin secretion in the vitamin D-deficient rat in vivo. Endocrinology 119:84–90, 1986

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17- Cade C, Norman AW: Vitamin D3 improves impaired glucose tolerance and insulin secretion in the vitamin D-deficient rat in vivo. Endocrinology 119:84–90, 1986