
Estimation of serum calcium and parathyroid hormone (PTH) levels in diabetic patients in correlation with age and duration of disease

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ABSTRACT

Background: A potentially important role for calcium in the development of diabetes has been implicated. This study aims to assess serum calcium (Ca) and parathyroid hormone (PTH) levels in diabetic patients and the correlation between calcium and PTH with the duration of the disease and age of the patients.

Material & Method: This study included 30 patients who had type 2 diabetes who attended outpatients' clinic of Baghdad Teaching Hospital from June 2009 to July 2009. Those patients were varying in their ages (30-70 years) and duration of disease (1-22 years) compared with 20 apparently healthy controls (non diabetic), with the same range of age. Ca estimation was done by atomic absorption method, while PTH level was estimated by ELISA kit.

Results: In this study there was a significant decrease in serum PTH and a significant increase in serum calcium ($p<0.0001$) of the patients compared with the controls. Also there was a strong direct correlation between patients' Ca & PTH levels ($r=0.3$), while a strong inverse correlation was found between patients' age and their calcium level ($r=-0.46$)

Conclusion: There was a decrease in parathyroid hormone level, and increased calcium level in serum diabetic patients.

Key words: Diabetes, Calcium, PTH.

Introduction:

Diabetes is the fifth leading cause of death in modern countries and it is also a major cause of significant morbidity.⁽¹⁾ Identification of environmental and easily modified risk factors is urgently needed to prevent development of diabetes.⁽²⁾

One of the important calcium containing hormones is insulin which is secreted by the B-cells of the pancreas, and plasma calcium plays an important role in insulin secretion in these cells. Therefore, if extracellular calcium is removed or decreased insulin secretion is also blocked or reduced.⁽³⁾

A potentially important role for calcium status in the development of diabetes is suggested since calcium intake was found to be lower in patients with diabetes compared to controls,⁽⁴⁾ Low calcium intake found to be inversely associated with incident type 2 diabetes.^(5,6,7,8)

There is accumulating evidence to suggest that altered calcium homeostasis may play a role in the development of type 2 diabetes, based on animal studies calcium has been suspected as modifiers of diabetes risk.⁽⁹⁾

Changes in calcium level in primary insulin target tissues may contribute to peripheral insulin resistance.^(10,11)

Calcium insufficiency may negatively influence glucose level, supplementation with calcium may be beneficial in optimizing glucose metabolism.⁽¹²⁾

Parathyroid hormone can increase intracellular calcium concentration in key insulin target

tissues,^(13,14) and moderate increase in free intracellular calcium compromise the efficiency of insulin,⁽¹⁵⁾ therefore primary and secondary hyperparathyroidism are characterized by decrease in insulin sensitivity.⁽¹⁶⁾

Diabetic patients should be evaluated for hyperparathyroidism because of the higher incidence of diabetes in patients with primary hyperparathyroidism, and it is estimated that primary hyperparathyroidism in diabetic patients is approximately 3 fold higher than the general population.⁽¹⁷⁾

Patients & Methods:

Thirty diabetic patients were enrolled in this study; they were attending the outpatients clinic of Baghdad Teaching Hospital from June 2009 to July 2009. The range of patients age was (30-70 years) and the range of duration of the disease was (1-22 years) compared with 20 apparently healthy controls (non diabetic), with the same range of age.

Calcium was estimated by atomic absorption method, while PTH level was estimated by ELISA kit.

Data were analyzed by Microsoft Excel 2007 software. The results were expressed as mean $\pm$ standard deviation. The differences were considered significant at $p<0.05$.

Results:

This study revealed highly significant elevation in the calcium level and highly significant decrease in PTH level between controls and patients (table 1).

Table (1): Calcium & PTH levels in sera of Control subjects & Diabetic patients

	No.	Calcium (mg/dl)	PTH (pg/ml)
Controls	20	8.6±2.7	109.04±73.95
Patients	30	14.8±6.1	24.83±23.10
p-value		0.0001	0.0001

Direct correlation ($r=0.323$) between calcium and PTH in diabetic patients was revealed in this study as shown in the figure below.

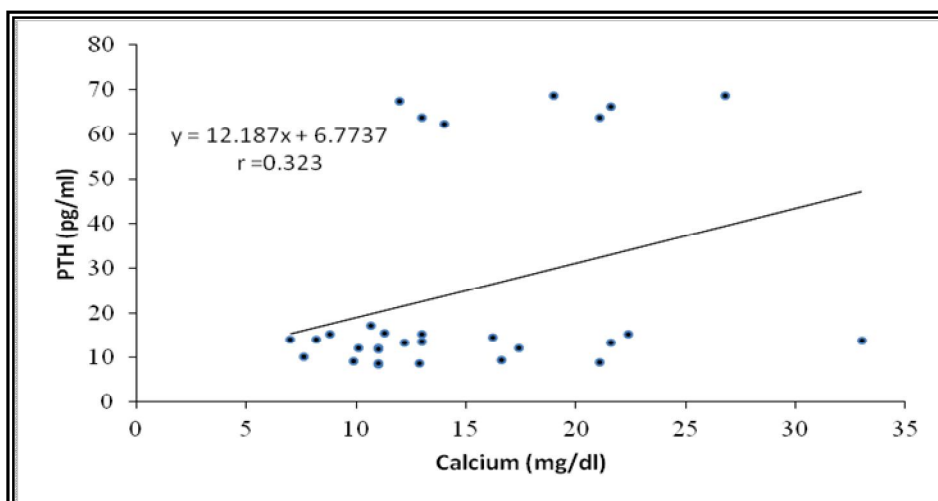


Fig. (1): Correlation of Calcium level with PTH level in serum of diabetic patients.

Patients' age and duration of disease were also studied and it was found that calcium and patients' age have shown a strong inverse correlation ($r=-0.46$), while the others [calcium & duration of

disease ($r= 0.12$), PTH & patients' age ($r= -0.17$), and PTH & duration of disease ($r= 0.12$)] had no significance correlations (table 2).

Table (2): Correlations of patients' age and duration of disease with Ca & PTH levels

	No.	Patients' Age	Duration of Disease
Calcium(mg/dl)	30	-0.46	0.12
PTH (pg/ml)	30	-0.17	0.12

Table (3) shows the correlations of (calcium & PTH), (calcium & age) and (PTH & age) among groups with the duration of the disease. It revealed a strong direct correlation ($r=0.7$) between calcium & PTH in

(≥ 10 yrs) group, while there was a strong inverse correlation ($r= -0.64$) between calcium & age and an inverse correlation ($r= -0.36$) in the (3yrs-9years) group.

Table (3): Correlations of Ca & PTH levels, Ca & age, and PTH & age with the duration of disease

Duration of disease	No.	Calcium & PTH	Calcium & Age	PTH & Age
<3 yrs	11	0.27	-0.20	-0.15
3yrs-9yrs	11	0.14	-0.64*	-0.36
≥ 10 yrs	8	0.70	-0.46	-0.01

*significant at 0.05 level

Discussion:

Alteration of calcium homeostasis have been reported previously to correlate with the abnormality

of fasting serum glucose, insulin level and, B-cell function.⁽⁹⁾

In this study there was a significant increase in serum calcium level in diabetic patients compared

with the control subjects. Joseph Leve *et al.*⁽¹⁸⁾ proposed that regulation of calcium balance is important in the secretory function of pancreatic islets and that impaired response to glucose in diabetes mellitus is the result of defective cellular calcium metabolism, therefore calcium is essential in normalizing glucose intolerance.

M. Akmal *et al.*⁽¹⁹⁾ found that subject with low calcium level had lowest concentration of glucose and least insulin resistance, and subjects with high calcium level had highest concentration of glucose and insulin resistance.

Another study has found that serum total calcium concentrations were increased in geriatric diabetics as compared with non-diabetic controls.⁽²⁰⁾

Streptozotocin-induced diabetes mellitus rats are hypocalcaemic after overnight fast, probably from intestinal calcium malabsorption as the primary cause in untreated diabetes.⁽²¹⁾ PTH secretion is impaired in patients with poorly controlled diabetes mellitus.⁽²²⁾

Poorly controlled diabetics tend to present lower calcium ion levels, and deficient PTH secretion.⁽²³⁾ Low serum ionized calcium concentrations were observed in insulin dependent diabetic patients, and the etiology and pathogenesis of decreased serum calcium ion in insulin-dependent human diabetes mellitus remain unknown.⁽²⁴⁾ Another study has found that there is no difference in serum calcium levels in diabetic patients compared with the healthy controls.⁽²⁵⁾

Functional hypoparathyroidism has been described in diabetic patients, and low calcium and low parathyroid hormone observed during poor blood glucose control⁽²⁶⁾ which agrees with our result in which there is significant decrease in parathyroid hormone in diabetic patients when compared with control subjects, Peter Schwarz⁽²⁷⁾ indicate that there is a mild shift down wards in the set point for parathyroid hormone secretion in diabetic patients.

The inverse correlation noted between blood glucose and parathyroid hormone suggest that hyperglycaemia may have an inhibitory action on the synthesis and secretion of parathyroid hormone and it is attractive to speculate that hyperglycaemia together with an insulin deficit may lead to a hypoparathyroid state and a downregulation of PTH receptors⁽²⁸⁾ also Yamguchim⁽²⁹⁾ found that the administration of PTH in parathyroidectomized rats decrease both serum glucose and insulin level.

Conclusion:

There was a decrease in parathyroid hormone level, and increased calcium level in serum diabetic patients.

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