

Original article:

Calcium status in urine and serum of type 2 diabetic patients

¹Raston Mondal , ² Bholanath Maji

¹Associate Professor, Department of Community medicine, Burdwan medical college and hospital, Burdwan

² Assistant Professor, Department of Biochemistry, Burdwan medical college and hospital, Burdwan

Corresponding author : Bholanath Maji

Abstract

In type 2 diabetes mellitus (T2DM), various parameters are changed due to the disease process. Bone formation, muscle contraction, nerve impulse conduction are some of roles of calcium in our body. Studies regarding calcium levels in T2DM in India are few. This study tried to assess calcium levels in T2DM. With respect to patients, controls had lower serum calcium and higher urine calcium levels. This study concludes that normal balance of calcium in T2DM should be further evaluated.

Introduction

T2DM is a very common disease in the world; so, it is being increasingly important. Diabetes has various implications in the health of the population, economy and many other aspects of the society. India has a large number of patients suffering from diabetes. So, the importance of this disease is great and the nation, along with the world, strives to reduce the burden of T2DM.

Though hyperglycemia and insulin resistance are hallmarks of T2DM, metabolism of various other parameters is also altered. Calcium is best known for its role in bone metabolism, but it has equally important nonskeletal functions like neuromuscular, cell signalling, etc (1). Insulin secretion is a calcium-dependent process; therefore, alterations in calcium metabolism and transport can have deleterious effects on beta-cell insulin secretion (2). Calcium is essential for intracellular processes, mediated by insulin, in insulin-responsive tissues like skeletal muscle and adipose tissue (3). Changes in calcium levels in primary insulin target tissues may lead to peripheral insulin resistance via impaired insulin signal transduction (4). Like many other parameters in T2DM, calcium may also have variations in its serum and urinary levels. We have not found any data with respect to serum and urinary calcium levels in T2DM in India. Thus, the purpose of our study was to evaluate the calcium levels in T2DM, as this might help in a better understanding of the pathophysiology and can aid in the management of T2DM.

Materials and methods

This case control study was conducted in a tertiary care hospital, with subjects selected from the OPD patients randomly. The study protocol was approved by the Institutional ethics committee of the institute. T2DM patients, and healthy age and sex-matched patients' relatives attending the OPD were enrolled. 122 patients were initially enrolled for the study, but 10 patients and 4 controls dropped out later, so that ultimately 51 patients and 57 controls remained. Detailed medical history and relevant clinical examination was done; written consent was

obtained from all subjects after the study procedure was explained. Fasting blood samples (5 ml fresh blood) were drawn and collected in new, disposable plastic tubes under aseptic conditions for the estimation of serum calcium. 24-hour urine was collected to estimate urinary calcium. Assay of all the parameters were carried out in fully automated analyzer by OCPC method (5).

Statistical analysis:

The results obtained were statistically analysed by SPSS software using student's t-test.

Results

Table 1 shows the levels of serum (in mg/dl) and urine calcium (in mg/24 hours) in patients and controls as Mean + S.D.

Group	serum calcium	urine calcium
Patient	8.6 + 0.9	276 + 21.3 (n=51)
Control	9.3 + 1.2	253 + 17.8 (n=57)

Statistical analysis of serum calcium levels in patients and controls:

Unpaired t test results:

p value and statistical significance:

The two-tailed p value equals 0.0010

By conventional criteria, this difference is considered to be extremely statistically significant.

Confidence interval:

The mean of Group One minus Group Two equals -0.700

95% confidence interval of this difference: From -1.109 to -0.291

Intermediate values used in calculations:

t = 3.3972

df = 106

standard error of difference = 0.206

Statistical analysis of urine calcium levels in patients and controls:

Unpaired t test results:

p value and statistical significance:

The two-tailed p value is less than 0.0001

By conventional criteria, this difference is considered to be extremely statistically significant. Confidence

interval: The mean of Group One minus Group Two equals 23.000

95% confidence interval of this difference: From 15.537 to 30.463

Intermediate values used in calculations:

t = 6.1102

df = 106

standard error of difference = 3.764

Serum calcium was highly significantly decreased and urinary calcium excretion was found to be highly significantly increased in patients compared to controls.

Discussion

Insulin and its action is very much dependant on calcium, as is evident by the following facts - changes in calcium in primary insulin target tissues causes variations in insulin action (6) and decrease in insulin receptor phosphorylation, which is a calcium-dependent process (7). Changes in calcium alter adipocyte metabolism, which may lead to triglyceride accumulation via increased de novo lipogenesis and lack of suppression of insulin-mediated lipolysis (8). Changes in calcium levels in primary insulin target tissues leads to variations in insulin action (9). Patients with type 2 DM show decreased cellular calcium homeostasis in skeletal muscle, adipocytes, and liver cells (10,11). As because many diabetics show marked osteoporosis, periods of negative nitrogen balance and acidosis may be pathogenic factors for decrease of serum calcium (12). Calcium may be reduced in serum in T2DM due to less absorption of calcium (13, 14), or decreased levels of vitamin D (15,16). In our study decreased calcium levels were observed in patients, compared to controls (table 1).

Urinary calcium excretion is increased probably due to increased parathyroid stimulation (17,18,19) . Hypercalciuria of uncontrolled diabetes may be a form of renal hypercalciuria which could result in parathyroid stimulation, which in turn, might contribute to the development of osteopenia in patients with diabetes mellitus (17). Hypercalciuria may also be due to hypoparathyroidism in T2DM (20). Our study also observed increased urinary calcium excretion in patients, compared to controls (table 1).

All these findings and evidence point to an imbalance of calcium metabolism in T2DM. Further research in this area, with particular reference to additional assay of vitamin D, parathormone, phosphate and other parameters should gain an insight in this regard.

Conclusion:

To conclude, hypocalcemia, together with hypercalciuria, occur in T2DM, and the alteration of calcium homeostasis might have implications in the pathophysiology as well as management of T2DM.

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