Vol 5 | Issue 4 | 2015 | 245-248.

e-ISSN 2248 – 9142
print-ISSN 2248 – 9134

International Journal of
Current Pharmaceutical & Clinical Research
www.ijcpcr.com

EFFECT OF LONG-TERM DIABETES MELLITUS ON SERUM BONE MINERALS CONCENTRATION IN SUDANESE PATIENTS

Hiba O. AbdElrhman[1*], Gad Allah Modawe[2], AbdElkarim A. Abdrabo[1]

[1]Department of Clinical Chemistry, Faculty of Medical Laboratory Sciences, Al-Neelain University, Khartoum-Sudan.
[2]Omdurman Islamic University, Faculty of Medicine, Biochemistry Department, Omdurman, Sudan.

ABSTRACT

This is cross- sectional study carried out among Sudanese patients with diabetes mellitus type 2 at Al Ribat University Hospital in Khartoum State. Objective to evaluate the effect of duration of diabetes on serum bone minerals concentration (calcium and phosphorus). the serum level of calcium and phosphorus was estimated photometerically in 120 patients with diabetes type 2 (54 male, 66 female) in age minimum 12 years maximum 86 , 40 patients have diabetic in duration less than 5 years , 40 patients have diabetic in duration from 5 to 10 years and 40 patients have diabetic more than 10 years. The mean (m) ± standard deviation (SD) of Phosphorus and Calcium in three categories according to duration of disease less than 5year, from 5 – 10 years, and more than 10 years respectively are (5.5 ± 1.7, 8.6 ± 0.65)mg /dl, (6.9 ± 1.7, 9.2 ± 0.96)mg /dl (6.7 ± 1.33, 9.1 ± 1.0)mg /dl. The measured bone minerals level (calcium and phosphorus) would be increased in long term diabetic type2 Sudanese Patients.

Key words: Phosphorus, Calcium, Diabetic patients.

INTRODUCTION

Diabetes mellitus represents a group of diseases of heterogeneous etiology, characterized by chronic hyperglycemia and other metabolic abnormalities, which are due to deficiency of insulin effect (1). Adults who have 1 or more first- or second-degree relatives affected with diabetes are at high risk of developing diabetes. The evidence is strong; however, that youth with a positive family history already show signs of increased risk for diabetes [1, 2]. 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 [3].

The old concept of bone as inert metabolic tissue, with minor contributions to metabolic adaptations has been reconsidered in light of findings that bone is involved in the development of insulin sensitivity [4]. Bone metabolism is regulated by complicated mechanisms that involve mineral metabolism and endocrine systems [5].

Diabetes may influence the bone in multiple pathways, some with contradictory effects. These mechanisms include changes in insulin and insulin-like growth factors levels, hypercalciuria associated with glycosuria, obesity, higher concentrations of advanced glycation end-products in collagen etc. Along these lines, many cohort studies undeniably indicated that diabetes itself is associated with increased risk of osteoporosis [6,7], Recent studies have indicated that bone cells contribute to metabolic activity by the production of peptides such as osteocalcin that impacts insulin sensitivity and energy metabolism[4].

It was shown that insulin and insulin like growth factors (IGF-1, IGF-2) have an influence on bone metabolism itself and other growth factors, cytokines and

Corresponding Author :- **Hiba Omer AbdElrhman** Email:- hibaomer2880@gmail.com

hormones may determine changes in diabetic bone metabolism[8].

There was a very strong dose-dependent relationship between duration of diabetes and risk of hip fracture in Asian population like their Western counterparts [9]. Early human diabetes mellitus can result in hypercalciuria and reduced bone mass (osteopenia).

Experimentally it is proved that altered mineral balance is due to the disturbances in pancreatic function.

During longer persistence of severe diabetes (70 days) a significant drop of phosphorus and calcium in bone was observed. The bones of diabetic animals on the 70th experimental day were macroscopically smaller and were very fragile [10,11].

Diabetes mellitus is the also associated with secondary magnesium deficit. Plasma magnesium concentrations may correlate inversely with the degree of hyperglycemia [12]. Early recognition and treatment of severe hypophosphataemia is important to reduce the risk of neurological complications [13]. So this study conducted to evaluate the effect of diabetes and its duration on serum levels of calcium and phosphorus.

MATERIAL AND METHODS

This is a cross sectional and hospital based study, conducted in Al-Ribat University Hospital in Khartoum State, during the period from December 2014 to March 2015. Study had included 120 patients with diabetes mellitus most of them with type 2. All participants gave written consent to participate in this study, all patients diabetes mellitus were included, patients with history of parathyroid disorders, renal diseases and those who are on drugs that contain calcium and phosphorus were excluded. After informed consent, and use of antiseptic for the skin (70% alcohol), a sample of venous blood (5.0 ml) was collected from each individuals included in this study, the sample was transferred to a plain container, serum was separated after clot retraction by centrifugation and the serum transferred to a stopper vial for the determination of calcium, and phosphorus levels by photometric system using automated chemistry analyzer (MINDRAY 380-China).

RESULTS

One Hundred Twenty Sudanese patients with diabetes mellitus had included in this study, who classified to 3 groups, 40 patients have diabetes in duration less than 5 years, 40 patients have diabetes in duration from 5-10 years and 40 patients have diabetes more than 10 years. The bone minerals calcium and phosphorus was measured in their sera. The obtained results as following:

The mean concentration of calcium in 3 groups of diabetes mellitus type 2 patients respectively was (8.6±0.65)mg/dl, (9.2±0.96)mg/dl, (9.1±1.0)mg/dl. (Table 1,2,3).

Phosphorus M±SD concentration in 3 groups of diabetes mellitus type 2 patients respectively was (5.5±1.7)mg /dl, (6.9±1.7)mg/dl , (6.7 ± 1.3)mg/dl (Table 1,2,3).

Table 1. Results of mean and standard deviation of serum phosphorus and calcium according to duration.

Duration		Phosphorus mg/dl	Calcium mg/dl
Less than 5 years	Mean SD Deviation	5.5 1.70	8.6 0.65
5 to 10 years	Mean SD Std. Deviation	6.9 1.7	9.2 0.96
More than 10 years	Mean SD Std. Deviation	6.7 1.3	9.1 1.01

Table 2. Comparison between group 1 (duration < 5 years) and group 2 (duration 5-10 years)

Variable	Group of duration		p.value
	< 5 years	5-10 years	
Calcium	8.6 ± 0.65	9.2 ± 0.96	0.003
Phosphorus	5.5 ± 1.7	6.9 ± 1.7	0.000

Table 3. Comparison between group 1 (duration < 5 years) and group 3 ((duration > 10 years)

Variable	Group of duration		p.value
	< 5 years	**> 10 years**	
Calcium	8.6 ± 0.65	9.1 ± 1.01	0.015
Phosphorus	5.5 ± 1.7	6.7 ± 1.3	0.001

Table 4. Comparison between group 2 (duration 5-10 years) and group 3 (duration >10 years)

Variable	Group		p.value
	< 5 years	> 10 years	
Calcium	9.2 ± 0.96	9.1 ± 1.0	0.6
Phosphorus	6.9 ± 1.7	6.7 ± 1.3	0.5

DISCUSSION

The importance of the trace elements in living organisms was first shown over a century ago[14]. Minerals including calcium, phosphorus and magnesium have been identified as playing a potential role in the prevention of bone diseases, particularly osteoporosis. Prolonged supplementation of calcium and vitamin D in elderly has been shown to prevent bone loss, and in some intervention studies to prevent fragility fractures demonstrated the existence of a number of trace- metal-containing enzymes (metalloenzymes) of importance to the structural and functional integrity of the living cells[15]. Growing concern with environmental factors in human health over the last few years has aroused renewed interest in the trace elements. Abnormalities in their metabolism have been demonstrated in many human diseases. In particular, diabetes mellitus has been shown to be associated with abnormalities in the metabolism of calcium [14]. The common links among several clinical disorders including type 2 diabetes, the major findings made in the current study are the discovery of significant correlations between total serum calcium duration of diabetes. The results provide evidence that the variations in calcium metabolism, indexed by total serum calcium concentration, are related to defects in glucose metabolism [16-18].

Our study revealed that serum calcium was increased to higher in long term of the diabetic patients, Maestro B et al reported that vitamin D may have a beneficial effect on insulin action either directly, by stimulating the expression of insulin receptor thereby enhancing insulin responsiveness for glucose transport [18]. or indirectly via its role in regulating extracellular calcium ensuring normal calcium influx through cell membranes and adequate intracellular cytosolic calcium pool. On studies carried out by Ojuka EO et al, Williams PF et al and Draznin B found that calcium is essential for insulin-mediated intracellular processes in insulin-responsive tissues such as skeletal muscle and adipose tissue [19,20] with a very narrow range of needed for optimal insulin-mediated functions [21].

Draznin B et al and Zemel MB et al reported that changes in calcium in primary insulin target tissues may contribute to peripheral insulin resistance via impaired insulin signal transduction [22,23]. The increased levels of serum calcium in the recent study indicates that diabetes mellitus is a condition in which cell calcium homeostasis is impaired. The defects in cell calcium regulation were found in many tissues confirming that this defect in cell calcium metabolism is a basic pathology associated with a diabetic state, and may be significant for the observed pathologies in insulin secretion and insulin action in diabetes. The increase levels of serum calcium in diabetic patients may also play an important role in the vascular complications, such as hypertension, atherosclerosis, and microangiopathy [24].

Our findings shows there was significant higher of serum phosphorus levels for the diabetic group when compared group to gather.

CONCLUSION

The study concluded that the level of serum calcium and phosphorus was significantly increased in group 2 in duration 5-10years when compared with group 1 in duration less than 5 years, and also increased in group 3 which duration more than 10 years when compared with group 1 while there is no significantly change when compared group 2 with group 3.

ACKNOWLEDGEMENT: None

CONFLICT OF INTEREST:

The authors declare that they have no conflict of interest.

STATEMENT OF HUMAN AND ANIMAL RIGHTS

All procedures performed in human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

REFERENCES

1. Valdez R. Detecting Undiagnosed Type 2 Diabetes, Family History as a Risk Factor and Screening Tool. *J Diabetes Sci Technol*, 3(4), 2009, 722−6.
2. Kuzuya T, Nakagawa S, Satoh J, Kanazawa Y, Iwamoto Y, Kobayashi M, *et al*. Report of the Committee on the classification and diagnostic criteria of diabetes mellitus. *Diabetes Res Clin Pract*, 55(1), 2002, 65−85.
3. Pittas AJ, Lau J, Dawson B.The Role of vit D and calcium in type 2DM. Asystemic Review and Meta. *Analysis Journal of clinical Endocrinology and Metabolism*, 92(6), 2007, 2017-2029.
4. Paula FJ, Rosen CJ. Obesity, diabetes mellitus and last but not least, osteoporosis. *Arq Bras Endocrinol Metabol*, 54(2),

2010, 150−7.
5. Takeuchi Y. Metabolic bone diseases in patients with diabetes mellitus. *Nippon Rinsho*, 64(9), 2006, 1697−702.
6. Raska I Jr, Broulík P. The impact of diabetes mellitus on skeletal health, an established phenomenon with in established causes? *Prague Med Rep*, 106(2), 2005, 137−48.
7. Rosen CJ, Bouxsein ML. Mechanisms of disease, is osteoporosis the obesity of bone? *Nat Clin Pract Rheumatol*, 2(1), 2006, 35−43.
8. Leidig-Bruckner G, Ziegler R. Diabetes mellitus a risk for osteoporosis? Exp Clin Endocrinol Diabetes, 109 Suppl 2, 2001, S493−S514.
9. Koh WP, Wang R, Ang LW, Heng D, Yuan JM, Yu MC. Diabetes Mellitus and Risk of Hip Fracture in the Singapore Chinese Health Study. *Diabetes Care*, 33(8), 2010, 1766-70.
10. Simecková A, Stolba P, Hátle K, Zamrazil V, Neradilová M. The effect of streptozotocin-induced diabetes treated with insulin on the metabolism of calcium, magnesium and phosphorus. *Vnitr Lek*, 36(6), 1990, 526−30.
11. Krejpcio R, Wojciak W, Staniek H. The concentration of calcium, magnesium and phosphorus in selected tissues of STZinduced diabetic rats. *Trace Elements and Electrolytes*, 25(4), 2008, 213−7.
12. De Valk HW. Magnesium in diabetes mellitus. *Neth J Med*, 54(4), 1999, 139−46.
13. Thalassinos NC, Hadjiyanni P, Tzanela M, Alevizaki C, Philokiprou D. Calcium metabolism in diabetes mellitus, effect of improved blood glucose control. *Diabet Med*, 10, 1993, 341–4.
14. Salvini S, Hunter DJ, Sampson L, Stampfer MJ, Colditz GA, Rosner B, Willett WC. Food-based validation of a dietary questionnaire, the effects of week-to-week variation in food consumption. *Int J Epidemiol*, 18, 1989, 858–867.
15. Bonjour JP, Gueguen L, Palacios C. Menerals and vitamins in bone health, the potential value of dietery enhancement. *Br J Nutr*, 101(11), 2009, 1581-96.
16. Orwoll E, Riddle M, Prince M. Effects of vitamin D on insulin and glucagon secretion in non-insulin- dependent diabetes mellitus. *Am J Clin Nutr*, 59, 1994, 1083–1087.
17. Borissova AM, Tankova T, Kirilov G, Dakovska L, Kovacheva R. The effect of vitamin D3 on insulin secretion and peripheral insulin sensitivity in type 2 diabetic patients. *Int J Clin Pract*, 57, 2003, 258–261.
18. Feskanich D, Willett WC, Colditz GA. Calcium, vitamin D, milk consumption, and hip fractures, a prospective study among postmenopausal women. *Am J Clin Nutr*, 77, 2003, 504–511.
19. Williams PF, Caterson ID, Cooney GJ, Zilkens RR, Turtle JR. High affinity insulin binding and insulin receptor-effector coupling, modulation by Ca2+. *Cell Calcium*. 11, 1990, 547–556.
20. Draznin B, Sussman K, Kao M, Lewis D, Sherman N. The existence of an optimal range of cytosolic free calcium for insulin-stimulated glucose transport in rat adipocytes. J Biol Chem, 262, 1987, 14385–14388.
21. Maestro B, Campion J, Davila N, Calle C. Stimulation by 1,25-dihydroxyvitamin D3 of insulin receptor expression and insulin responsiveness for glucose transport in U-937 human promonocytic cells. *Endocr J*. 47, 2000, 383–391.
22. Draznin B, Lewis D, Houlder N, Sherman N, Adamo M, Garvey WT, LeRoith D, Sussman K. Mechanism of insulin resistance induced by sustained levels of cytosolic free calcium in rat adipocytes. *Endocrinology*, 125, 1989, 2341–2349.
23. Zemel MB. Nutritional and endocrine modulation of intracellularcalcium, implications in obesity, insulin resistance and hypertension. *Mol Cell Biochem*, 188, 1998, 129–136.
24. Feinglos, Mark N, Bethel, Mary Angelyn (Eds.) Type 2 Diabetes Mellitus, An Evidence-Based Approach to Practical Management, Humana Press, 2008.