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RESEARCH ARTICLE

SERUM LIPID SALTERATIONS ASSOCIATED WITH HYPOMAGNESAEMIA IN SUDANESE DIABETIC PATIENTS

***Khalid Mohammed Adam, Waddah Eisa Balla Ibrahim and Enshirah Awad Hassan Saeed**

Faculty of Medical Laboratory Sciences –Alneelain University – Sudan

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ABSTRACT

Background: Magnesium plays an important role in carbohydrate metabolism. Hypomagnesaemia associated with diabetes mellitus may play a role in the pathogenesis of atherosclerosis.
Aim: The aim of this study is to explore the influence of serum magnesium (Mg) level on concentration of serum lipids in Sudanese diabetes mellitus (DM) patients
Materials and methods: A case control study included 179 diabetic patients and 200 diabetes-free apparently healthy controls, recruited from Jabir Abu Eliz centre for diabetic patients, Khartoum – Sudan, between May and September 2013. Serum magnesium (Mg) and serum lipids, consisting of triacylglycerol (Tg), cholesterol (Chol) and high density lipoprotein (HDL) were determined in both cases and controls.
Results: Both serum Mg and HDL-C showed low levels in diabetic patients, while LDL-C was higher in the control group as compared to the diabetics. A strong positive correlation was noticed between serum Mg and HDL-C in diabetic patients, r=0.716 and P <0.05
Conclusion: Level of serum Mg has strong influence on serum lipids in diabetes mellitus patients, and hypomagnesaemia associated with diabetes can be a risk factor for CHD in diabetics.

INTRODUCTION

DM is a metabolic disease of multiple etiologies, characterized by hyperglycemia resulting from defects in the insulin secretion and/or the insulin action (Djurhuus *et al*., 1999). DM is now one of the major health problems in Sudan resulting at least in 10% of all hospital admissions and mortality (Ahmed and Shumo 2001). The dyslipidemia isa common complication of diabetes mellitus due to the fact that insulin resistance or deficiency affects key enzymes and pathways in lipid metabolism (Arca, Pigna, and Favoccia 2012), particularly, apoprotein production, regulation of lipoprotein lipase, action of cholesterylester transfer proteins and hepatic and peripheral actions of insulin (Arca, Pigna, and Favoccia 2012). It has also been reported that the composition of lipid particles in diabetic dyslipidemia is more atherogenic than other types of dyslipidaemia. This means that even normal lipid concentrations might be more atherogenic in diabetic than in non-diabetic people (Dindic *et al*., 2004). Magnesium plays an important role in carbohydrate metabolism. It may influence the release and activity of the hormones that helps control blood glucose levels (Djurhuus *et al*., 2001). Magnesium deficiency has role in the perturbation of lipid metabolism in diabetic patients (Hagg *et al*., 1999). Several epidemiological and experimental studies have linked magnesium deficiency and atherosclerotic cardiovascular diseases (Fox, Ramsoomair and Carter 2001). Experimental studies suggest that magnesium deficiency may play a role in the pathogenesis of atherosclerosis(Corsonello *et al*., 2007). Magnesium deficiency may contribute to the progression of atherosclerosis by its effect on lipid metabolism (Guerrero-Romero and Rodriguez-Moran 2000).

In light of the evidence of magnesium imbalance in diabetes mellitus, it is important to study the association of serum magnesium with lipids. Controversial reports are available regarding the effect of magnesium (Mg) on lipid profile and glycaemic control in diabetic patients. A number of studies have reported beneficial effects of magnesium supplementation on serum total cholesterol and LDL cholesterol, and an increase of HDL cholesterol level (Corica *et al*., 2006; Hagg, Carlberg, Hillorn, and Villumsen 1999; Lal *et al*., 2003). This study aimed to explore the influence of serum magnesium (Mg) level on concentration of serum lipids in Sudanese diabetes mellitus (DM) patients.

MATERIALS AND METHODS

In a case control descriptive study, a sample of 179 diabetic patients (46% males and 54%females), with mean age 50±8SD years and duration of the disease 9.5(± 4.4), in addition to 200 diabetes-free apparently healthy age matched (43% males and 57% females) controls. All cases were recruited from Jabir

Corresponding author: Khalid Mohammed Adam
Molecular biology dept.- Faculty of medical lab sciences – Alneelain university- Khartoum, P.O. Box 12702, zip code: 11121 Sudan.

Abu Eliz centre for diabetic patients, Khartoum –Sudan, between May and September 2013. Diabetic patients with history of renal, cardiac, liver diseases, hypertension, thyroid dysfunction, obesity, smoking and alcoholism were excluded. Five ml of venous blood was collected from both diabetic patients and controls after an overnight fast. Specimens were then centrifuged for serum. Total cholesterol, HDL-C, triacylglycerol, and magnesium level were measured with bio system 350 Spectrophotometer (Biosystems, Spain) using commercial kits (Biosystems, Spain) For Total cholesterol, and HDL-Cspectrophotometric enzymatic methods (CHOD/ POD), (GPO/POD) respectively, while for triacylglycerol precipitating method was used. The level of serum magnesium was measured using Calmagite - EGTA Colorimetric method, and serum LDL-C was calculated by Friedewald's formula.

The study was approved by the Ethical Committee of faculty of medical laboratory sciences – Alneelain University. Verbal consent was obtained from all participants after detailed explanation of aims, nature and procedures of the study. Data analyzed with the SPSS software (version 16.00 for Windows), Results are expressed as the mean ± SD. Independent-sample T test was used for comparison between mean values of total cholesterol, triacylglycerol, HDL-C, LDL-C and Mg of diabetics and the control groups. Statistical correlations were assessed with Pearson's correlation test. The level of significance was set at P <0.05.

RESULTS

Serum magnesium level showed statistically significant difference between diabetics and control with P<0.05 similar results were also obtained with HDL-C and LDL-C with P< 0.05. Both serum Mg and HDL-C showed low levels in diabetic patients, while LDL-C was higher in the control group as compared to the diabetics. Table 1.

Table 1. Comparison of Mg and blood lipids between study groups

variable	Diabetic N= 790 Mean ± SD	Control N=200 Mean ± SD	P. value
Mg mg/dl	1.7± 0.21	1.9±0.46	.000
Cholesterol mg/dl	150 ± 16.2	134 ± 12.1	.080
Tri mg/dl	102± 14	98± 13	.724
HDL-C mg/dl	38.4± 8.1	49.2± 6.2	.000
LDL-C mg/dl	88.3± 10,1	65.7± 13.2	.007

Table 2. Correlation between Mg and lipids, Age and duration of disease

Variables	Pearson correlation (r)	P. value
Mg vs T. cholesterol	.088	.193
Mg vs HDL-C	.716	.000
Mg vs LDL-C	.101	.377
Mg vs Triacylglycerol	-.405	.000
Mg vs Age	-.114	.317
Mg vs Duration of disease	-.033	.770

Total cholesterol and triacylglycerol, on the other hand showed no statistically difference between the two study groups, with P < 0.05. Table 1. The results of Pearson's correlation test showed no statistically significant correlation between serum Mg and total cholesterol in diabetic patients, with P < 0.05. Table 2 A strong positive correlation was noticed between serum Mg and HDL-C in diabetic patients, r=0.716 and P<0.05. Table 2 The results also showed no statistically significant relation between serum Mg and LDL-C, with P<0.05. However, an inverse relation between serum Mg and triacylglycerol in diabetic patients, r = -0.405 and P. value .000. Similar inverse correlation was obtained between serum Mg and age of the patient, though not statistically significant, P<0.05. The results also showed no statistically significant correlation between the duration of the diabetes and the serum Mg level of the patient. Table 2.

DISCUSSION

Magnesium ion derives its clinical importance from its very essential role as a cofactor for various enzymes involved in glucose metabolism, insulin synthesis and activity. Many authors have reported a relation between serum magnesium and diabetes mellitus and its complications (Atabek *et al*., 2006; Corica, Corsonello, Ientile, Cucinotta, Di, Perticone, Dominguez, and Barbagallo 2006; Derakhshan *et al*., 2011; Lima *et al*., 2005). Low serum magnesium level has been reported to be a risk and consequence of diabetes mellitus, as impaired insulin secretion is strongly associated with deficiency of blood magnesium (Seyoum *et al*., 2008). Results of the present study demonstrate low level of serum magnesium in diabetic patients as compared to healthy controls, this go in concordance with the findings of several previously published studies (Atabek, Kurtoglu, Pirgon, and Baykara 2006; Casas-Agustench, Bullo, and Salas-Salvado 2010; Seyoum, Siraj, Saenz, and Abdulkadir 2008). The low levels of serum magnesium in Sudanese diabetic patients may be due to magnesium deficiency caused low dietary magnesium intake and magnesium depletion caused by osmoticdiuresis due to glucosuria. Several studies have linked low magnesium levels in diabetic patients to urinary Mg excretion (Corica *et al*., 1996; Djurhuus 2001) (Monika K.Wلti *et al*., 2003) though others have reported no association (Monika, Michael B.Zimmermann, Giatgen A.Spinas, and Richard Hurrell 2003). Ewald U. et.al have reported that magnesium deficiency in human is unlikely to occur from simple lack of foods containing this mineral, except in advanced forms of malnutrition (Nasri and Baradaran 2008). The level of serum Mg in the present study showed a strong positive correlation with HDL-C, inverse relation with triglycerides and no relation with LDL-C and total cholesterol, these findings agree with previous studies (Seyoum, Siraj, Saenz, and Abdulkadir 2008) where HDL, triglyceride, LDL and total cholesterol were linked to the level Mg in diabetics. The magnesium level in diabetic patients showed no relation with age of the patients and the duration of the disease. The HDL-C and triacylglycerol associated with the level of serum Mg reported in the present study are two parameters drawing increased attention with growing evidence that reduced HDL-C and increased triacylglycerol are strong predictor of coronary heart disease (Ebong *et al*., 2013). In diabetic patients hyperglycemia progressively increases the transfer of cholesterol esters from HDL-C to VLDL-C (D'Souza *et al*., 2009) which add to the effect of hypomagnesaemia in diabetic patients.

Conclusion

It can be concluded that hypomagnesaemia associated with hypoglycemia is a risk factor for coronary heart disease in diabetic patients through its effect on total cholesterol, HDL-C and triacylglycerol.

REFERENCES

Ahmed, M. E. and Shumo, A. I. 2001, "A calculus within an anal fistula tract in a diabetic patient", *Saudi.Med.J.*, vol. 22, no. 2, pp. 170-171.

Arca, M., Pigna, G., and Favoccia, C. 2012, "Mechanisms of diabetic dyslipidemia: relevance for atherogenesis", *Curr.Vasc.Pharmacol.*, vol. 10, no. 6, pp. 684-686.

Atabek, M. E., Kurtoglu, S., Pirgon, O., and Baykara, M. 2006, "Serum magnesium concentrations in type 1 diabetic patients: relation to early atherosclerosis", *Diabetes Res.Clin.Pract.*, vol. 72, no. 1, pp. 42-47.

Casas-Agustench, P., Bullo, M., and Salas-Salvado, J. 2010, "Nuts, inflammation and insulin resistance", *Asia Pac.J.Clin.Nutr.*, vol. 19, no. 1, pp. 124-130.

Corica, F., Corsonello, A., Ientile, R., Cucinotta, D., Di, B. A., Perticone, F., Dominguez, L. J., and Barbagallo, M. 2006, "Serum ionized magnesium levels in relation to metabolic syndrome in type 2 diabetic patients", *J.Am.Coll.Nutr.*, vol. 25, no. 3, pp. 210-215.

Corica, F., Ientile, R., Allegra, A., Romano, G., Cangemi, F., Di, B. A., Buemi, M., Cucinotta, D., and Ceruso, D. 1996, "Magnesium levels in plasma, erythrocyte, and platelet in hypertensive and normotensive patients with type II diabetes mellitus", *Biol.Trace Elem.Res.*, vol. 51, no. 1, pp. 13-21.

Corsonello, A., Perticone, F., Ientile, R., Barbagallo, M., and Corica, F. 2007, "Serum magnesium and lipids: More clarity is needed", *Atherosclerosis*, vol. 192, no. 1, pp. 233-234.

D'Souza, A., Hussain, M., Howarth, F. C., Woods, N. M., Bidasee, K., and Singh, J. 2009, "Pathogenesis and pathophysiology of accelerated atherosclerosis in the diabetic heart", *Mol.Cell Biochem.*, vol. 331, no. 1-2, pp. 89-116.

Derakhshan, R., Balaee, P., Darakhshan, S., Masoodpoor, N., and Banihosseini, S. S. 2011, "Lipid profile, thyroid function, and serum magnesium level in type I diabetic children", *Minerva Pediatr.*, vol. 63, no. 1, pp. 27-33.

Dindic, B., Damnjanovic, G., Mitrovic, V., and Sokolovic, D. 2004, "[Diabetic dyslipidemia and atherosclerosis]", *Vojnosanit.Pregl.*, vol. 61, no. 1, pp. 71-75.

Djurhuus, M. S. 2001, "New data on the mechanisms of hypermagnesuria in type I diabetes mellitus", *Magnes.Res.*, vol. 14, no. 3, pp. 217-223.

Djurhuus, M. S., Henriksen, J. E., Klitgaard, N. A., Blaabjerg, O., Thye-Ronn, P., Altura, B. M., Altura, B. T., and Beck-Nielsen, H. 1999, "Effect of moderate improvement in metabolic control on magnesium and lipid concentrations in patients with type 1 diabetes", *Diabetes Care*, vol. 22, no. 4, pp. 546-554.

Djurhuus, M. S., Klitgaard, N. A., Pedersen, K. K., Blaabjerg, O., Altura, B. M., Altura, B. T., and Henriksen, J. E. 2001, "Magnesium reduces insulin-stimulated glucose uptake and serum lipid concentrations in type 1 diabetes", *Metabolism*, vol. 50, no. 12, pp. 1409-1417.

Ebong, I. A., Goff, D. C., Jr., Rodriguez, C. J., Chen, H., Sibley, C. T., and Bertoni, A. G. 2013, "Association of lipids with incident heart failure among adults with and without diabetes mellitus: Multiethnic Study of Atherosclerosis", *Circ.Heart Fail.*, vol. 6, no. 3, pp. 371-378.

Fox, C., Ramsoomair, D., and Carter, C. 2001, "Magnesium: its proven and potential clinical significance", *South.Med.J.*, vol. 94, no. 12, pp. 1195-1201.

Guerrero-Romero, F. and Rodriguez-Moran, M. 2000, "Hypomagnesemia is linked to low serum HDL-cholesterol irrespective of serum glucose values", *J.Diabetes Complications*, vol. 14, no. 5, pp. 272-276.

Hagg, E., Carlberg, B. C., Hillorn, V. S., and Villumsen, J. 1999, "Magnesium therapy in type 1 diabetes. A double blind study concerning the effects on kidney function and serum lipid levels", *Magnes.Res.*, vol. 12, no. 2, pp. 123-130.

Lal, J., Vasudev, K., Kela, A. K., and Jain, S. K. 2003, "Effect of oral magnesium supplementation on the lipid profile and blood glucose of patients with type 2 diabetes mellitus", *J.Assoc.Physicians India*, vol. 51, pp. 37-42.

Lima, M. L., Pousada, J., Barbosa, C., and Cruz, T. 2005, "[Magnesium deficiency and insulin resistance in patients with type 2 diabetes mellitus]", *Arq Bras.Endocrinol.Metabol.*, vol. 49, no. 6, pp. 959-963.

Monika K.W, Michael B.Zimmermann, Giatgen A.Spinas, and Richard F.Hurrell. Low plasma magnesium in type 2 diabetes. Swiss Med Wkly 133, 289-292. 2003. Ref Type: Journal (Full)

Nasri, H. and Baradaran, H. R. 2008, "Lipids in association with serum magnesium in diabetes mellitus patients", *Bratisl.Lek.Listy*, vol. 109, no. 7, pp. 302-306.

Seyoum, B., Siraj, E. S., Saenz, C., and Abdulkadir, J. 2008, "Hypomagnesemia in Ethiopians with diabetes mellitus", *Ethn.Dis.*, vol. 18, no. 2, pp. 147-151.

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