ORIGINAL ARTICLE

HYPOMAGNESAEMIA IN DIABETES MELLITUS TYPE 2

[1]Shahzad Ali Jiskani, [2]Halar Rahim, [3]Sher Ali, [4]Madiha Zaki, [4]Dolat Singh

[1]Department of Pathology, Indus Medical College Hospital, Tando Muhammad Khan

[2]Department of Medicine, Jinnah Postgraduate Medical Centre, Karachi

[3]Department of Medicine, Shifa International Hospital, Islamabad

[2]Department of Medicine, Indus Medical College, Tando Muhammad Khan

Corresponding Author:

Shahzad Ali Jiskani,
MBBS, M. Phil (Haematology)
Senior Lecturer, Department of Pathology
Indus Medical College, Tando Muhammad Khan

Corresponding Author Email:
shahzadbaloach289@gmail.com

Co-Author:

Halar Rahim,
MBBS, FCPS (Medicine)
Postgraduate Trainee, Department of Medicine
Jinnah Postgraduate Medical Centre, Karachi

Sher Ali, MBBS, FCPS (Medicine)
Senior Medical Officer, Department of Medicine
Shifa International Hospital, Islamabad

Madiha Zaki,
MBBS, MRCP (Gastroenterology)
Consultant Gastroenterologist, Department of Medicine
Indus Medical College, Tando Muhammad Khan

Dolat Singh,
MBBS, MD (General Medicine)
Assist. Professor, Department of Medicine
Indus Medical College, Tando Muhammad Khan

Editorial received on: 13-07-2019
Editorial accepted on: 05-12-2019

ABSTRACT

Introduction: Patients of diabetes mellitus type 2 have insufficiency of many important elements including serum magnaesium. Hypomagnesaemia is related with complications of diabetes mellitus and amplified the duration of disease.

Objective: Main objective of the study is to evaluate the level of serum magnaesium levels and its association with glycated haemoglobin (HbA1c) in patients of diabetes mellitus type 2.

Methodology:

The study was prospective, carried out at Department of Pathology and Department of Medicine, Indus Medical College Hospital Tando Muhammad Khan between the duration of January 2018 to June 2018. 265 individuals were selected for this study and were classified as control group (n=135) and diabetic group (n=130). Samples of all participants were collected in EDTA-containing tube and Gel tube for the evaluation of HbA1c and serum magnaesium respectively. The variables were evaluated and analyzed in SPSS 21.0. The p – value of <0.05 was taken as significant statistically.

Article Citation:
Jiskani SA, Rahim H, Ali S, Zaki M, Singh D. Hypomagnesaemia in Diabetes Mellitus Type 2. JIMC. 2019; 2(2): 35-39

Results: Males in the study were 154 (58.1%) and females were 111 (41.88%). Mean age of the included participants in control and diabetic group was 48.3 ± 3.77 years and 49.10 ± 4.98 years respectively. Mean glycated haemoglobin in control group was 5.89 ± 1.02 %, and in diabetic group was 8.71 ± 1.86 %, with statistically significant association (p <0.001). The serum magnaesium level in control and diabetic group was 1.89 ± 0.25 mg/dL and 0.58 ± 0.13 mg/dL, with statistically significant correlation (p <0.001).

CONCLUSION:

Hypomagnesaemia was associated with increased level of glycated haemoglobin showing its strong correlation with glycaemic control.

KEYWORDS: Magnaesium, hypomagnesaemia, diabetes mellitus, insulin, glycaemic control, glycated haemoglobin.

INTRODUCTION

Magnaesium (Mg) is one the main electrolytes and is the most plentiful divalent intracellular cation in cells, and comes next to potassium as cellular ion. [1] Total magnaesium is present in three distinctive forms namely; protein – bound, complexes and free cation. The most abundant form of magnaesium is intracellular type which is cofactor of various enzymatic processes. Magnaesium – ATP complex plays very essential role in metabolism of the body, contraction of muscles, transfer of methyl groups and others. Magnaesium is also required for the action of insulin signal, proliferation of cells and is important for the membranes of calcium (Ca^{2+}), sodium (Na^{+}) and potassium (K^{+}) ions. [2] It also plays important part in homeostasis of glucose and sensitivity of insulin in type 2 diabetes mellitus. Evidence shows low level of magnaesium in diabetic patients; and is especially related to neurological complications of the diabetes mellitus. [3]

In type 1 diabetes mellitus patients with proteinuria or microalbuminuria, significant decrease in ionized magnaesium has been found. [4] Low intake and increased loss of magnaesium usually favours depletion of magnaesium (Mg^{+2}) in patients with diabetes mellitus; though absorption as well as preservation of magnaesium (Mg^{+2}) is mostly not affected. [5] Therefore, low level of magnaesium may cause worsening of diabetes mellitus and can even induce more hypomagnesaemia. Evidence suggested low levels of magnaesium in diabetic patient as compared to non – diabetic controls and may also be caused because of resistance to insulin and systemic inflammation. [6] Due to osmotic diuresis, magnaesium is lost frequently. Hypomagnesaemia is also related inversely to glycaemic control. Past evidences showed low risk of complications in diabetic patients by giving adequate magnaesium intake. [7]

Here we conducted a study to compare serum magnaesium (Mg^{+2}) concentration in patients with diabetes mellitus type 2 and controls (non-diabetics).

PATIENTS AND METHODS

The study is a prospective cross – sectional, performed at Department of Pathology and Department of Medicine, Indus Medical College Hospital Tando Muhammad Khan. A total of 130 diabetes mellitus type 2 patients, and 135 controls were selected for the study. Study was conducted between the periods of 6 months (January 2018 to June 2018). All patients with diabetes mellitus type 2 with no co-morbid conditions were integrated in the study. Patients aged between 30 years and 70 years were included. 135 normal controls were also included. Patients with renal, cardiac, neurological or other complications were excluded from the study.

Overnight fasting sample of 5mL venous whole blood was extracted by aseptic measures and standard procedure. The 2.5 mL blood was shifted to collection tube containing lithium

heparin. Serum was separated without any delay by centrifugation. Samples were analyzed for serum magnaesium. Remaining 2.5 mL was shifted to collection tube containing EDTA and was used for analysis of HbA1c. Magnaesium and HbA1c were measured using COBAS C111 Chemistry Analyzer Roche. Data was analyzed using SPSS 21.0. Data was presented as mean, standard deviation etc. Parameters were evaluated and compared using independent t-test. The p – value of <0.05 was considered as significant statistically.

RESULTS

Among 265 participants, 154 (58.11%) were male while 111 (41.88) were females. All participants were divided into two groups: control and diabetic groups. Control group consisted of 135 normal individuals. Out of 135 control individuals, 79 (58.51%) were male while 56 (41.48%) were female (Figure 1). Diabetic group consisted of 130 diabetic individuals. Out of 130 diabetic group, 75 (57.69%) were male and 55 (42.30%) were females. Mean age in control and diabetic groups was 48.3 ± 3.77 years and 49.10 ± 4.98 years respectively. P – value was not statistically significant. In control group, mean glycated haemoglobin was 5.89 ± 1.02 %, while in diabetic group it was 8.71 ± 1.86 %. P – value was <0.001. In control group, mean serum magnaesium level was 1.89 ± 0.25 mg/dL, while in diabetic group it was 0.58 ± 0.13 mg/dL. P – value was <0.001.

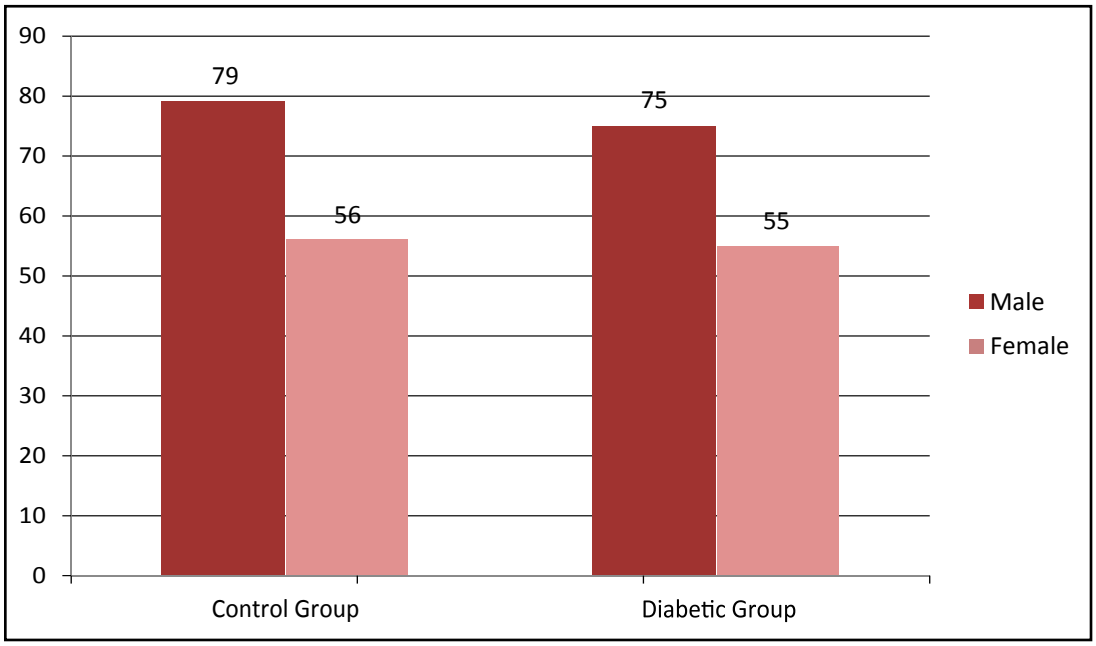

Figure 1: Gender Distribution (n=265)

Table 1: Comparison of Serum Magnaesium Levels in Control and Diabetes Groups (n=265)

	Control Group	Diabetic Group	P – value
Age (years) mean	48.41 ± 3.77	49.10 ±4.98	0.794
HbA1c (%) mean	5.89 ± 1.02	8.71 ± 1.86	<0.001
Serum magnaesium (mg/dL) mean	1.89 ± 0.25	0.58 ± 0.13	<0.001 (Table 1)

DISCUSSION

Magnaesium is one of the most important elements for the body. It acts as cofactor in more than 300 enzymatic processes, especially involves phosphate group transfer. It has important part in maintenance of cardiac function and excitability of neuromuscular junctions. [8] This study showed significant difference of serum magnaesium levels in context of HbA1c levels in diabetic patients in comparison of control group (p – value <0.001). Murthy et al showed in his study that low level of magnaesium was significantly related to diabetic nephropathy as well as retinopathy. Serum Magnaesium level was decreased in diabetic patients as compared to control group. [9] Manikandan et al showed in his study that level of serum magnaesium was low in diabetic patients and were significantly associated with microvascular and macrovascular complications. [10] Omero et al proved in his study that supplementation of oral magnaesium replenished level of serum magnaesium, sensitivity to insulin and metabolic control in diabetic patients who had initially reduced level of magnaesium. [11] El-said demonstrated that hypomagnesaemia was closely associated with diabetic mellitus and glycaemic control. [12] Noor et al showed that hypomagnesaemia was present in diabetic patients and was associated with increased duration of diabetes mellitus. [7] Nair et al showed correlation of serum magnaesium with various factors. He demonstrated that low level of magnaesium was associated with diabetes patients with hypertension and other related complications i.e. retinopathy, cellulitis, neuropathy etc. Level of glycated haemoglobin was significantly high in patients with low magnaesium levels. [13]

Mechanism of deficiency of magnaesium in the progression of complications of diabetes mellitus has not been understood completely. Level of serum magnaesium is associated with resistance of insulin and function of β – cells in patients with diabetes mellitus. Likewise, deficiency of magnaesium is linked to decreased function of β – cells and increased resistance to insulin that lead to increased level of plasma glucose. [14] Depletion of serum magnaesium has negative correlation with homeostatic of glucose and insulin sensitivity. Hypomagnesaemia may alter the transport of cellular glucose by varying $Na^{+-}K^{+-}$ATP gradients, decrease secretion of pancreatic insulin, defective signalling of post – receptor insulin and decrease the interaction of insulin – to – insulin receptors. Hypomagnesaemia is also shown to destroy the activity of tyrosine kinase and receptors capable of signalling. [15] Present study demonstrated the same findings of decreased level of serum magnaesium in diabetic patients suggestive of its strong correlation with glycaemic control.

CONCLUSION

Hypomagnesaemia was found to be associated with increased glycated haemoglobin in diabetic patients in our study. Considering serum magnaesium estimation as routine diagnostic and monitoring panel of diabetic patients may determine the early hypomagnesaemia and diabetic complications. Early intervention by supplementary magnaesium diet or therapy may reverse or control the effects produced by low level of magnaesium.

References

1. Barbagallo M, Dominguez LJ. Magnaesium and type 2 diabetes. World J Diabetes. 2015;6(10):1152–7.
2. Belhasan O, Sheriff D. Serum Magnaesium Levels in Type 2 Diabetic Libyan Patients. J Pancreas. 2017;18(2):121–4.
3. Kumar CA, Gopal S, Kolli D, Katta S, Katta S. Serum Magnaesium Levels in Type 2 Diabetes Patients and its Relation with Diabetic Nephropathy. IJMRHS. 2018;7(7):90–4.

4. Parlapally RP, Kumari KR, Jyothi SA. Serum Magnaesium Levels in Type 2 Diabetes. Int J Sci Stud. 2016;4(5):176–9.

5. Barbagallo M, Dominguez LJ. Magnaesium and Type 2 Diabetes : An Update. Int J Diabetes Clin Res. 2015;2(1):1–5.

6. Misra P, Bhatia K, Singh A, Ambade VN, Mukherjee B. Study of Plasma Glycaemic Levels and Serum Magnaesium Levels in Diabetes Mellitus (DM) and Non-Diabetic Healthy Controls : A Comparative Study Section : Biochemistry. IJCMR. 2019;6(4):6–9.

7. Noor MM, Nazir Q, Khan TM, Gillani S, Abbasi MA, Rauf A, et al. Association Between Low Serum Magnaesium Level and Type 2 Diabetes Mellitus in Abbottabad. J Ayub Med Coll Abottabad. 2019;31(2):226–9.

8. Biradar S, Patil S, Kadeli D. Study of Serum magnaesium levels in Type -2 Diabetes Mellitus. Int J Cur Res Rev. 2017;9(4):2016–8.

9. Murthy PR, Palvai K. A Study of Serum Magnaesium Levels in Type 2 Diabetes Mellitus. Int J Sci Stud. 2019;6(10):92–8.

10. Manikandan S, Jayaraman T, Rajendran K, Suthakaran PK, Devayani L, Nair V, et al. Study on serum magnaesium levels and glycaemic status in newly detected type 2 diabetes patients. Int J Adv Med. 2016;3(1):11–4.

11. Omero FEGU. Improves Insulin Sensitivity and Metabolic Control in Type 2 Diabetic. Diabetes Care. 2003;26(4):1147–52.

12. El-said NH, Sadik NA, Mohammed NAE. Magnaesium in type 2 diabetes mellitus and its correlation with glycaemic control. Int J Res Med Sci. 2015;3(8):1958–63.

13. Nair HR, Ramesan RK. Study of Serum Magnaesium in Type 2 Diabetes Mellitus. Int J Curr Res. 2017;9(4):49433–6.

14. Lu J, Gu Y, Guo M, Chen P, Wang H, Yu X. Serum Magnaesium Concentration Is Inversely Associated with Albuminuria and Retinopathy among Patients with Diabetes. J Diabetes Res. 2016; doi:10.1155/2016/1260141.

15. Saeed H, Haj S, Qasim B. Estimation of magnaesium level in type 2 diabetes mellitus and its correlation with HbA1c level. Endocrinol Diab Metab. 2019;2:e48.