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A CROSS-SECTIONAL STUDY ON THE ASSOCIATION OF HYPOMAGNESEMIA WITH DIABETIC COMPLICATIONS

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ABSTRACT

Background: Magnesium is considered an essential electrolyte for any living organism and is the fourth most abundant mineral in the human body. It serves as a cofactor for over 600 vital enzymatic reactions in the human body and an activator for an additional 200. The decrease in the level of magnesium may result in a defective tyrosine-kinase activity, causing detremental effect on the insulin receptors resulting in an impairment of insulin action.

Objective: To study the association of hypomagnesemia with diabetic complications in type2 diabetics

Materials and method: The present cross-sectional study was conducted at the Department of medicine, Bolan medical college/ Bolan medical complex hospital Quetta from July 2023 to December 2023 for six months of duration after the provision of the certificate from the institutional interview board. A total of 100 diabetic admitted patients were randomly selected for the study ages from 30 to 70 years irrespective of their gender. Informed consent was obtained from each participant. Magnesium levels below1.6 mg/dl were used as the standard for hypomagnesemia. All the participants were assured that their confidentiality and privacy would be maintained. The data was collected from each participant. All the collected data through physical assessment were analyzed by using the latest SPSS 24.

Results: A total of 100 diabetic admitted patients were randomly selected for the study ages from 30 to 70 years irrespective of their gender. The mean age of the participants was 53.86 ±9.74 years. The mean HbA1c of the participants was 8.7 ± 2.32. 48 % of them had HbA1c less than 8 while 52 % had greater than 8 HbA1c. The mean HbA1c in the hypomagnesemia group was 10.8 ± 1.98 while in normomagnesemia was 8.9 ± 2.2. There were 58.97%-foot ulcers among Group 1 while in Group 2 was 31.14%. 38.46 % and 14.75 % had neuropathy in Groups 1 and 2 respectively. Nephropathy in Group 1 was 28.20 % and in Group 2 was 11.47 %. 69.23% of Group 1 had retinopathy and 37.70 % was in Group 2. Hypertension was 23.07 % in Group 1 and 37.70% in Group 2, moreover, 7.69 % and 8.19% had coronary diseases in Groups 1 and 2 accordingly.

Conclusion: The current study concluded that hypomagnesemia was found to have an association with diabetic complications like neuropathy, nephropathy, foot ulcers, and poor glycemic control as evidenced by HbA1c.

Keywords: Neuropathy, retinopathy, HbA1c, hypertension, hypomagnesemia

Introduction

During the last several years, diabetes has become increasingly common all over the world. In 2017, researchers calculated a prevalence of 8.4 percent; by 2022, they anticipated a 9.9 percent rate, with approximately 629 million cases predicted by the year, 2045 [1]. Magnesium is considered an essential electrolyte for any living organism and is the fourth most abundant mineral in the human body [2]. It serves as a cofactor for over 600 vital enzymatic reactions in the human body and an activator for an additional 200 [3]. The decrease in the level of magnesium may result in a defective tyrosine-kinase activity, causing detremental effect on the insulin receptors resulting in an impairment of insulin action [4]. Magnesium controls the production of insulin by modulating several channels within beta cells. Since adequate cellular Mg2+ levels are mandatory at the receptors of insulin ,for a process called phosphorylation. Magnesium deficiency acts as a direct and major contributor to the development of resistance to insulin. This can be related to the reality that hypomagnesemia has been linked repeatedly to endocrine illnesses, especially type 2 diabetes [5]. Hypomagnesemia could be linked to the onset or progression of mellitus type 2 diabetes, although it is increasingly considered that diabetes itself induces hypomagnesemia [6]. Plasma magnesium ion concentrations among type 2 diabetes patients are consistently observed to be considerably less than those in non-diabetic healthy individuals [7,8]. Worldwide, between 14 to 48 % of people with diabetes also have hypomagnesemia [9-11]. Hypomagnesemia has been linked to a hastened progression of diabetes and a higher likelihood of serious complications in persons with diabetes. Nephropathy, retinopathy, as well as neuropathy, are examples of microvascular problems, while cardiac and peripheral arterial disease are examples of macrovascular complications [12,13,14]. Therefore, given the alarming rise in diabetes prevalence as well as the tight relationship that exists between metabolic regulation of the disease and disturbed magnesium equilibrium investigating a possible link between the two is crucial. Identifying the prevalence and contributing factors of hypomagnesemia may help governments and medical experts implement strategies to lessen the issue as well as give further justification for routine hypomagnesemia monitoring of levels of magnesium in all people with type 2 diabetes. In addition, the results may encourage diabetes patients to alter their diets and consume additional magnesium. More timely oral magnesium dietary supplements could reduce or avoid complications associated with diabetes. Therefore, in view of the above studies and limited research investigation in the area, the aim of the current study was to find the association of hypomagnesemia with diabetic complications.

MATERIAL AND METHODS

The present cross-sectional study was conducted at the Department of medicine, Bolan medical college/ Bolan medical complex hospital Quetta from July 2023 to December 2023 for six months of duration after the provision of the certificate from the institutional interview board. A total of 100 diabetic admitted patients were randomly selected for the study ages from 30 to 70 years irrespective of their gender. Informed consent was obtained from each participant. Magnesium levels below 1.6 mg/dl were used as the standard for hypomagnesemia. Hypomagnesemia patients served as cases, whereas healthy individuals served as controls. Individuals having type-2 diabetes, age according to the criteria and were willing to participate in the study were included in the study. Patients having chronic diseases kidney disease, autoimmune diseases, cancer patients on chemotherapy, age less than 30 years, and known cases of cardiovascular diseases were excluded from the study. All the participants were assured that their confidentiality and privacy would be maintained. The data was collected from each participant. All the collected data were analyzed by using the latest SPSS 24.

RESULTS

A total of 100 diabetic admitted patients were randomly selected for the study ages from 30 to 70 years irrespective of their gender. Amongst the 100 patients, 44% patients were from 30-50 years and 56 % of patients were from 51-70 years old. 47 % and 53 % were males and females respectively. The mean age of the participants was 53.86 ±9.74 years. 43 % of them had diabetes for less than 5 years and 57 % had

it for greater than 5 years. The mean HbA1c of the participants was 8.7 ± 2.32. 48 % of them had HbA1c less than 8 while 52 % had greater than 8 HbA1c. Table 2 highlights the complications associated with hypomagnesemia. The mean HbA1c in the hypomagnesemia group was 10.8 ± 1.98 while in normomagnesemia was 8.9 ± 2.2. There were 58.97%-foot ulcers among Group 1 while in Group 2 was 31.14%. 38.46 % and 14.75 % had neuropathy in Groups 1 and 2 respectively. Nephropathy in Group 1 was 28.20 % and in Group 2 was 11.47 %. 69.23% of Group 1 had retinopathy and 37.70 % was in Group 2. Hypertension was 23.07 % in Group 1 and 37.70% in Group 2, moreover, 7.69 % and 8.19% had coronary diseases in Groups 1 and 2 accordingly.

Table 1 Demographic characteristic

Age (years)	**Number**	**Percentage**
30-50	44	44 %
51-70	56	56%
Gender		
Male	47	47 %
Female	53	53%
Age (mean)		53.86 ±9.74
Duration of DM (years)		
< 5	43	43 %
≥ 5	57	57 %
HbA1c (Mean 8.7 ± 2.32)		
< 8	48	48 %
≥ 8	52	52 %

TABLE 2 Complications of Hypomagnesaemia

Complications	**Group 1 Hypomagnesaemia N= 39**	**Group 2 Normomagnesemia N= 61**
HbA1c (mean)	10.8 ± 1.98	8.9 ± 2.2
Foot ulcers	23 (58.97%)	19 (31.14%)
Neuropathy	15 (38.46 %)	9 (14.75 %)
Nephropathy	11 (28.20 %)	7 (11.47 %)
Retinopathy	27 (69.23%)	23 (37.70 %)
Proteinuria	5 (12.82 %)	3 (4.91 %)
Coronary artery disease	3 (7.69 %)	5 (8.19%)
Hypertension	9 (23.07%)	23 (37.70%)

DISCUSSION

The relationship between serum magnesium levels and diabetes has been studied extensively. Magnesium deficiency is linked to a number of endocrine as well as metabolic disorders, the most common of which is diabetes mellitus [15]. Hypomagnesemia appears to have multiple contributing factors among those with T2DM. The possibilities include insufficient intake, diabetes-related gastroparesis, autonomic dysfunction-related diarrhea, increased hyperfiltration through the glomerulus, magnesium loss through the kidney, acidosis of the metabolic system, glycosuria caused by osmotic diuresis, impaired magnesium resorption, in the kidneys due to diabetes-related insulin resistance [16, 17]. Amongst the 100 patients, 44% patients were from 30-50 years and 56 % of patients were from 51-70 years old. 47 % and 53 % were males and females respectively. The mean age of the participants was 53.86 ±9.74 years. 43 % of them had diabetes for less than 5 years and 57 % had it for greater than 5 years. The mean HbA1c of the participants was 8.7 ± 2.32. 48 % of them had HbA1c less than 8 while 52 % had greater than 8 HbA1c. In a similar study conducted by Hamarshih M et al the average age of the individuals had been 56.2% ± 10.8 years, 24.6% of them were smokers, and the vast majority of them were overweight. Sixty percent had been diagnosed with hypertension before, and the vast majority have suffered from diabetes for at least ten years. The average HbA1c for this group was

8.5% 2. One in ten people had low magnesium levels. Females (OR: 2.7), individuals with an HbA1c of 8% (OR: 2.4), along individuals with a prior diagnosis of diabetic retinal degeneration (OR: 2.7) were shown to be more susceptible at increased risk [16]. Another interesting conclusion of the research study is the substantial relationship between hypomagnesemia with the level of HbA1c (P-value = 0.019). Hypomagnesaemia was detected within 14.9% of individuals having HbA1c of ≥8%, comparable to 7.2% of individuals having HbA1c lower than 8%. The results highlight the adverse link between the level of magnesium with sugar regulation level, which was confirmed by various earlier undertaken investigations [18]. A comparable study conducted by Dasgupta A. et al reported that the hypomagnesemia group had an HbA1c average of 11.9%, while the control group averaged 9.8%. Sixty-four percent of those with hypomagnesemia had retinopathy, 47 percent had microalbuminuria, 17 percent had macroalbuminuria, 58.8 percent had foot ulcers, and 82.3 percent had neuropathy, as opposed to 45.8 percent (P = 0.118) of those without hypomagnesemia having retinal degeneration, macroalbuminuria as well as microalbuminuria, foot ulcers, or neuropathy. Hypomagnesemia was found associated with a lower prevalence of cardiovascular disease (17.6% vs. 39%) overall and in the subgroup 50+ years (27% vs. 25%) [15].

CONCLUSION

The current study concluded that hypomagnesemia was found to have an association with diabetic complications like neuropathy, nephropathy, foot ulcers, and poor glycemic control as evidenced by HbA1c.

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