

Original Article

Association Between Hypomagnesaemia and Foot Ulcers in Type II Diabetes Mellitus

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ABSTRACT

Objective: The aim of the study was to seek the association between hypomagnesaemia and foot ulcers in type II diabetes mellitus and to verify the effect of age, sex, grades of ulcer, duration of ulcers and duration of diabetes and presence of hypomagnesaemia in the association with type 2 diabetes mellitus.

Study Design: cross sectional study.

Place and Duration of Study: This study was carried out in the indoor, setting of Medical Department Peoples Medical College Hospital Nawabshah from September 2009 to May 2010.

Samples: The subjects were divided into two groups. One was with Grade-I Diabetic foot ulcer and the other with Grade-II diabetic foot ulcers with type II diabetes mellitus. Both the groups contained 50 subjects each and were selected according to the inclusion and exclusion criteria.

Materials and Methods: After a brief interview of 100 patients regarding age, sex, duration of Type II diabetes mellitus, duration of foot ulcer and grade of foot ulcer, both groups underwent fasting serum Magnesium level and categorized on the basis of foot ulcers Grade-I and Grade-II according to Wagner's classification of diabetic foot ulcers.

Results: Chi – square test was applied to see the association and then odds ratio was calculated to check the strength of association. Out of 100 Type II diabetic patients, hypomagnesaemia was detected in 20 with grade I diabetic foot ulcer and in 37 patients with grade II diabetic foot ulcers having chi-square value of 13.071 and significance of 0.000 with likelihood ratio 13.554.

Conclusion: There is strong association between hypomagnesaemia in foot ulcers with Type II diabetes mellitus.

Key Words: Hypomagnesaemia, Type II diabetes mellitus, Foot ulcers.

INTRODUCTION

Diabetes is a common metabolic disorder that constitutes a major health problem in the world. Accurate diagnosis and appropriate management can greatly reduce the morbidity and mortality rate in the world.

The name "diabetes" comes from the Greek word for "siphon." Evidence from an Egyptian papyrus suggests that the ancient Egyptians were aware of an illness associated with the passage of much urine. The association of diabetes with its hallmark symptom captured the attention of medical investigators for centuries¹.

Diabetes mellitus is a syndrome with disordered metabolism and inappropriate hyperglycemia due to either a deficiency of insulin secretion or to a combination of insulin resistance and inadequate insulin secretion to compensate. Type II diabetes is the more prevalent form and results from insulin resistance with a defect in compensatory insulin secretion². The number of people with diabetes mellitus is increasing due to population growth, aging, urbanization, and increasing prevalence of obesity and physical inactivity.

In Pakistan there were 5.2 million cases in the year 2000 and it is estimated to be 13.9 millions in 2030³.

Diabetes is a common disorder with changing diagnostic criteria with clear objective measurements, approached easily, accurately that can confirm the diagnosis based on the patients history, clinical examination and laboratory evidence. Magnesium (Mg) ion is an essential element and is a cofactor in both glucose transporting mechanism of cell membranes and various enzymes which plays an important role in carbohydrate oxidation⁴. Hypomagnesemia occurs at an incidence of 13.5 to 47.7% among patients with Type II diabetes. Hypomagnesemia has been linked to poor glycemic control, coronary artery diseases, hypertension, diabetic retinopathy, and nephropathy, neuropathy, and foot ulcerations.

In the present era of high technological advances and increasing approach to disease complexity of medical knowledge it is very much necessary for all of us to explore the all aspect of the disease and the factors affecting it for the patient welfare. This study will help in future to manage the patients properly by reducing the risks of complications, treating the complications, avoiding the complications by giving the additional supplements of Magnesium as primary step to manage

the diabetes by adding the basic element to diet and as drug supplements.

MATERIALS AND METHODS

This cross-sectional study was conducted at Medicine Department at Peoples Medical College Hospital, Nawabshah, from September 2009 to May 2010. All patients of uncontrolled Type II diabetes mellitus with foot ulcers were included in this study. Detailed history was taken from all the patients regarding diabetes mellitus. Detailed clinical examination of the patients was done.

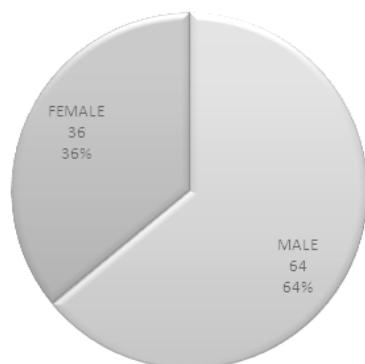
The venous blood were drawn after the admission of all patient in fasting state and sent to PMCH Nawabshah laboratory for analysis of serum Magnesium level by using Xylidyl Blue method with 3338 Merck test Kit (Merck). Level below <1.5 meq/l were labeled as hypomagnesaemia.

Inclusion criteria were all uncontrolled DM type II male/female patients of ≥ 45 years age, with diabetic foot ulcers patients associated grade-I foot ulcers and grade-II foot ulcers. Exclusion criteria were patients with acute complication of diabetes mellitus (such as diabetic keto-acidosis, lactic-acidosis, hypoglycemia, hyperosmolar non ketotic coma. Patients with gestational DM), cerebrovascular accidents, patients on dialysis with renal failure, patients on drugs like diuretics or containing Magnesium, patients on extra supplementation of Magnesium, foot ulcers other than type 2 DM and ulcers other than grade I and grade II.

RESULTS

One hundred cases of Type -II DM with foot ulcer were admitted during the study period. Out of 100 total patients 50 cases were Grade-I and 50 cases were Grade-II. 64(64%) were male and 36(36%) female with male female ratio of 1.7:1(Chart No.1). There was wide variation of age ranging from a minimum of 45-70 years with mean age of 57.31 ± 6.18 years.

Chart No 1



The education level was 30 un-educated, 53% primary, 15% middle and 02% patients were only matriculation pass. By occupation; male patients were 25% farmers, 26% laborers, 02% drivers in 11% patients were without any current occupation and all 36% female patients were housewives.

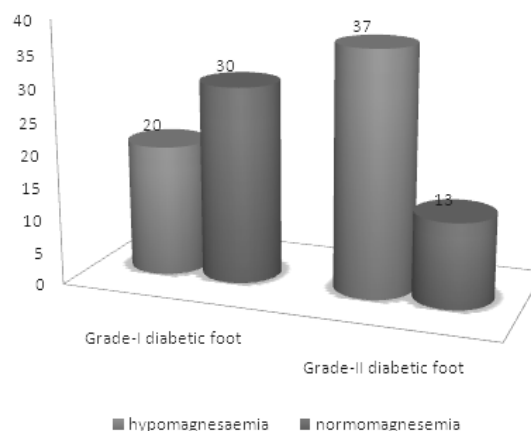
Duration of disease 30% patients had duration of less than 05 years, 39% had duration of 5-10 years and 31% patients had duration of more than 10 years.

After the analysis of serum Magnesium level out of 100 patients 57% were with low serum magnesium and 43% were with normal magnesium level and as the grade of foot ulcer increases the frequency of hypomagnesaemia also increases as in majority of the cases.

Out of 57 patients the duration of disease <05 years were in 15 cases, 05-10 years were in 14 cases and >10 years were in 28 cases associated with hypomagnesaemia, while remaining 43 patients the duration of disease < 05 years in 15 patients, 05-10 years in 25 patients and 03 with duration > 10 years were with normal serum magnesium level.

Duration of diabetic foot ulcer and duration of diabetes has a co-relation, as the duration of type II DM increases the risk of hypomagnesaemia also increases that was statistically significant with p -value <0.001 and simultaneously as the grade of foot ulcer progresses the risk of hypomagnesaemia also increases. In Grade-I diabetic foot ulcer patients 20(40%) have hypomagnesaemia and 30(60%) have normomagnesaemia and in Grade II 37(74%) patients have hypomagnesaemia and 13(26%) patients normomagnesaemia that was statistically significant with p -value <0.001 (Chart No.2).

Chart No.2



DISCUSSION

Diabetes mellitus is a major health problem and hypomagnesaemia represents an important issue in its management. It is matter of intensive research in

western countries. A comprehensive study of the problem should be based upon clinical assessment as well as biochemical and laboratory investigations, including co-relation of blood glucose concentrations with levels of insulin and counter-regulatory hormones like glucagon, adrenaline, cortisol, and many other important substances like trace elements like copper, zinc, magnesium and other trace elements.

There are lot of studies about the diabetes and its complications but there is limited data available in our setup. The data collected in these patients indicates that in adult practice problem of hypomagnesaemia is more pronounced in Type II diabetics with its chronic complication like foot ulcers. In my study the hypomagnesaemia is a common finding in two sub groups of diabetic foot ulcer (grade-I and grade-II). Out of 100 patients there 64(64%) were male and 36(36%) female with male female ratio of 1.7:1. In our study there were decreased ratio of females as compared with males, the possibility of our social back ground low level of education are important factors to influence it. There was wide variation of age ranging from a minimum of 45-70 years with mean age of 57.31 ± 6.18 years. However the male to female distribution given by Kaur T⁵ are 203 male and 197 female with male female ratio is 1:1.03 and age range between 30 to 70 years.

Some previous decades, the interest of health professionals towards the importance of education concerning self management of type II diabetes has been rapidly increased. The final goal of educating patients with diabetes mellitus type II is to accomplish changes of the human behavior through acquisition of knowledge and understanding of the disease⁶. In our study education level was 30 un-educated, 53% primary, 15% middle and 02% patients were only matriculation pass. By occupation; male patients were 25% farmers, 26% laborers, 02% drivers in 11% patients were without any current occupation and all 36% female patients were housewives.

In our study normomagnesemia were 43% and hypomagnesaemia were out of 57%; while some other studies reported were hypomagnesaemia in patients type I and type II diabetes mellitus, with an incidence of 25%–39%^{7,8,9}.

Diabetes mellitus is one of the most common causes of magnesium deficiency¹⁰. Hypomagnesaemia is related to poor metabolic control, which is attributed to increase in urinary magnesium losses¹¹ and although we did not determine glycosylated hemoglobin levels in our patients, poor diabetic control might be an additional factor for their hypomagnesemia. Other factors, however including vomiting, diarrhea, low sodium intake and diuretic use may play a role in magnesium deficiency in diabetes. Recent evidence suggests that insulin enhances the transport of

magnesium into cells; thus, lack of insulin may result in an intracellular magnesium deficit^{12,13}. In our study showed hypomagnesemia with the duration of disease <05 years were in 15 cases, 05-10 years were in 14 cases and >10 years were in 28 cases associated with hypomagnesaemia, while remaining 43 patients the duration of disease < 05 years in 15 patients, 05-10 years in 25 patients and 03 with duration > 10 years were with normal serum magnesium level. While the study of Ankush RD showed Decreased levels of plasma magnesium, erythrocyte reduced glutathione and erythrocyte superoxide dismutase activity while increased levels of plasma lipid peroxides, nitric oxide end products and erythrocyte membrane lipid peroxides were observed in patients with type-2 diabetes mellitus¹⁴.

The diabetic state interferes in the maintenance of the normal concentrations on body Mg, being able to trigger hypomagnesemia easily, mainly in poor metabolic control, which leads more spontaneously the outcome of diabetic chronic complications.

In our study results showed Grade-I diabetic foot ulcer patients 20(40%) have hypomagnesaemia and 30(60%) have normomagnesemia and in Grade II 37(74%) patients have hypomagnesaemia and 13(26%) patients normomagnesemia that was statistically significant with p-value <0.001. However study of Moran R¹⁵ suggested that hypomagnesemia may be associated with an increased risk of diabetic foot ulcers. Indeed, they observed a higher incidence of hypomagnesemia among their patients with diabetic foot ulcers compared with those without the condition (93.9% of the 33 patients with diabetic foot ulcers compared with 73.1% of the 66 patients without diabetic foot ulcers; p value 0.02)¹⁶.

As such, extrapolations to Mg deficiency should be viewed with caution because in our setup male mostly do the strenuous daily rough work and are more prone to get injuries which are not noted as in routine deal as simple injury.

CONCLUSION

The diabetic condition interferes in the maintenance of the normal Mg concentrations, which leads more spontaneously the conclusion of chronic complications associated with Type II DM with foot ulcers. Diabetic foot ulcers in 57% of patients as concluded from my study.

Recommendations

I therefore emphasize that serum magnesium be routinely included for the analysis and early correction be made so that DM with the complication of foot ulcer can be prevented and controlled accordingly.

We recommend periodic determination of magnesium levels and appropriate magnesium replacement. To

examine the effect of magnesium replacement on outcomes, a long-term prospective study is needed.

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