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Original Research Article

Fasting Serum Magnesium Levels in Type 2 Diabetes Mellitus and Their Correlation with Complications: A Study

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Abstract:

Background: Magnesium deficiency has been reported in people with type 2 diabetes mellitus and may be associated with diabetic microvascular and macrovascular complications. The present study evaluated fasting serum magnesium levels in patients with type 2 diabetes mellitus and examined their association with diabetic complications.

Materials and Methods: This cross-sectional study included 150 patients with type 2 diabetes mellitus attending the outpatient and inpatient departments of Medicine at BRIMS Bidar, between Feb 2023 and Jan 2024. Participants underwent clinical assessment, glycemic evaluation (fasting blood sugar, postprandial blood sugar and HbA1c), fasting serum magnesium estimation by a colorimetric calmagite method, fundoscopy, urinary analysis, renal function assessment, monofilament testing and electrocardiography. The reported serum magnesium reference range was 1.8–2.5 mg/dL.

Results: The study population had a mean age of 59.58 ± 9.68 years; 88 (58.7%) were male and 62 (41.3%) were female. Ninety of 150 participants (60%) were reported to have diabetic complications. Among the participants with complications, 55 (61.1%) had hypomagnesemia and 35 (38.9%) had normomagnesemia. Retinopathy was present in 32 participants, of whom 25 (78.1%) had low magnesium; nephropathy was present in 18, of whom 10 (55.6%) had low magnesium; and neuropathy was present in 10, of whom 3 (30%) had low magnesium. Ischemic heart disease was present in 20 participants, of whom 12 (60%) had low magnesium; cerebrovascular accident and peripheral vascular disease were each reported in 6 and 4 participants, respectively, with low magnesium in 50% of each group.

Conclusion: In this study, hypomagnesemia was common among patients with type 2 diabetes mellitus who had complications and was particularly associated with diabetic retinopathy, nephropathy and ischemic heart disease. Prospective studies are needed to clarify causality and the potential clinical benefit of correcting hypomagnesemia.

Keywords: Type 2 Diabetes Mellitus; Serum Magnesium; Hypomagnesemia; Diabetic Retinopathy; Nephropathy; Ischemic Heart Disease.

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Introduction

Diabetes mellitus is a group of metabolic disorders characterized by hyperglycemia and is associated with a broad spectrum of microvascular and macrovascular complications. Magnesium is an important intracellular cation involved in numerous enzymatic reactions and in insulin action and glucose metabolism. Low magnesium status has repeatedly been described in type 2 diabetes mellitus and may adversely affect glucose homeostasis and insulin sensitivity. Hypomagnesemia in diabetes may result from increased urinary magnesium loss, altered renal handling, lower dietary intake and other metabolic factors. Previous studies have reported associations between low magnesium levels and diabetic retinopathy, nephropathy, cardiovascular disease and other complications. The present study was undertaken to estimate fasting serum magnesium levels in patients with type 2 diabetes mellitus and to assess their relationship with diabetic complications.

Aims and Objectives

1. To estimate fasting serum magnesium levels in patients with type 2 diabetes mellitus.
2. To correlate serum magnesium levels with diabetic complications.

Materials and Methods

Study design and setting: A hospital-based cross-sectional study was conducted among 150 patients with type 2 diabetes mellitus attending the outpatient and inpatient departments of Medicine at BRIMS Bidar, between Feb 2023 and Jan 2024.

Participants: Patients aged >18 years with type 2 diabetes mellitus diagnosed on the basis of fasting and postprandial blood glucose were included. The source dissertation excluded patients with alcohol abuse, treatment with loop or thiazide diuretics, and treatment with aminoglycoside antibiotics, pregnancy, congestive heart failure and long-term parenteral nutrition.

Clinical and laboratory assessment: Detailed history and clinical examination were performed. Glycemic status was assessed using fasting blood sugar, postprandial blood sugar and HbA1c. Fundoscopy, urinary analysis, blood urea, serum creatinine, monofilament testing and ECG were also performed.

Serum magnesium estimation: Fasting serum magnesium was measured by a colorimetric method using calmagite dye. Under alkaline conditions, magnesium reacts with calmagite to form a colored complex measured spectrophotometrically at 530 nm. The source document reports a reference range of 1.8–2.5 mg/dL. Fresh, unhemolysed serum was used. The study formula was: magnesium concentration (mEq/L) = (A − A_B)/(A_S − A_B) × 2, with conversion of 1 mEq/L to 1.2 mg/dL.

Statistical analysis: The supplied dissertation primarily reports descriptive frequencies and percentages. No reproducible inferential statistical test details or p-values were identified in the supplied study text; therefore, no new inferential statistics have been added to this manuscript.

Results

A total of 150 patients with type 2 diabetes mellitus were studied. The mean age was 59.58 ± 9.68 years. The largest age group was 61–70 years (65 participants, 43.3%). Male participants constituted 58.7% and female participants 41.3%.

Table 1: Age distribution of study participants.

Age group (years)	N	%
41–50	30	20.0
51–60	40	26.7
61–70	65	43.3
71–80	15	10.0
Total	150	100.0

Table 2: Sex distribution of study participants.

Sex	N	%
Male	88	58.7
Female	62	41.3
Total	150	100.0

Diabetic complications were reported in 90 (60%) participants, while 60 (40%) had no reported complications. The source dissertation separately reports microvascular and macrovascular complication categories; because some participants had both types of complications, these category counts should not be summed as mutually exclusive groups.

Table 3: Reported diabetic complications and frequency of low serum magnesium.

Outcome/complication	Total n	Low Mg n	Low Mg (%)
Any reported complication	90	55	61.1
Retinopathy	32	25	78.1
Nephropathy	18	10	55.6
Neuropathy	10	3	30.0
Ischemic heart disease	20	12	60.0
Cerebrovascular accident	6	3	50.0
Peripheral vascular disease	4	2	50.0

Among the 90 participants with complications, 55 (61.1%) had hypomagnesemia and 35 (38.9%) had normomagnesemia.

Retinopathy was the most prominent microvascular complication reported in the source data. Among macrovascular complications, ischemic heart disease was the most frequently reported.

Discussion

The present study found that hypomagnesemia was common among patients with type 2 diabetes mellitus who had complications. Of 90 participants with complications, 61.1% had low serum magnesium. The strongest observed association in the study was with diabetic retinopathy, in which 25 of 32 affected participants (78.1%) had low magnesium. Low magnesium was also present in 55.6% of participants with nephropathy and 60% of those with ischemic heart disease.

These findings are consistent with the direction of earlier observations cited in the source dissertation. Studies have reported low magnesium concentrations in patients with diabetic retinopathy and relationships between magnesium status and renal or cardiovascular disease. Biological mechanisms proposed in the literature include altered insulin signaling, increased urinary magnesium loss, osmotic diuresis and effects on vascular tone.

The study should, however, be interpreted in light of its cross-sectional design. Because exposure and complications were assessed at the same period, the findings demonstrate association rather than causation. The supplied dissertation does not provide sufficient detail on adjustment for potential confounders or inferential statistical testing.

In addition, some complication categories overlap, and the original dissertation contains internally inconsistent descriptive totals for microvascular and macrovascular categories; accordingly, this manuscript reports the individual complication data without attempting to recalculate or reinterpret those totals.

Conclusion

Hypomagnesemia was frequent among patients with type 2 diabetes mellitus who had diabetic complications. Low serum magnesium was particularly common among participants with retinopathy, nephropathy and ischemic heart disease.

The findings support consideration of serum magnesium assessment in selected patients with type 2 diabetes mellitus, while prospective and adequately powered studies are required to establish causality and determine whether magnesium correction improves clinical outcomes.

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