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CORRELATION BETWEEN URINARY MICROALBUMIN, GLYCOSYLATED HAEMOGLOBIN AND SERUM MAGNESIUM IN TYPE 2 DIABETIC PATIENTS

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ABSTRACT: Background and Objectives: Diabetes mellitus comprises a group of common metabolic disorders that share the phenotype of hyperglycemia. One of the leading causes of diabetes mellitus related morbidity and mortality is diabetic nephropathy. The earliest stage of diabetic nephropathy is Microalbuminuria, which is the excretion of extremely small quantities of albumin in the range of 30 - 300 mg/day. Hypomagnesaemia may be a risk factor for the progression of complications in type 2 diabetes mellitus. **Material and Methods:** The material for the present study comprised of 60 patients of type 2 diabetes mellitus. Glycosylated hemoglobin, serum magnesium, and urinary microalbumin were measured. **Results:** It was found that the glycemic control, as indicated by glycosylated hemoglobin, is related significantly to microalbuminuria. Poor glycemic control leading to renal damage causes microalbuminuria. A significant inverse correlation between serum magnesium and urinary microalbumin levels was also observed. **Conclusion:** Estimation of urinary microalbumin, glycosylated hemoglobin and serum magnesium should be routinely done in confirmed cases of type 2 diabetes mellitus.

INTRODUCTION: Diabetes mellitus comprises a group of common metabolic disorders that share the phenotype of hyperglycemia. Chronic hyperglycemia in this disease is caused due to defect either in insulin secretion or insulin action, decreased glucose usage, and increased glucose production ^{1, 2}. One of the leading causes of diabetes mellitus morbidity and mortality is diabetic nephropathy.

The earliest detectable stage of diabetic nephropathy is microalbuminuria. Healthy persons excrete albumin in the range of 2.5- 25 mg/day, with a mean of about 10 mg/day. Microalbuminuria is defined as the excretion of extremely small quantities of albumin in the range of 30-300 mg/day. The appearance of microalbuminuria in diabetics is indicative of incipient nephropathy, which eventually progresses to overt nephropathy as well as an independent risk factor for cardiovascular diseases ^{3, 4, 5, 6, 7}.

In the early part of the last decade, certain scientific workers have predicted that hypomagnesaemia may be a risk factor for progression of complications in type 2 diabetes mellitus. They have suggested that magnesium deficiency may cause altered glucose

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disposition, diabetes insulin resistance, diabetic complications, hypertension, cardiovascular diseases, and abnormal platelet function⁸.

Based on the above, it was proposed to evaluate the urinary microalbumin and serum magnesium levels in patients of type 2 diabetes mellitus. Also, it would be interesting to correlate microalbuminuria and serum magnesium with glycemia control.

MATERIAL AND METHODS: The material for the present study comprised of 60 patients of type 2 diabetes mellitus. The patients were from the medicine OPD and IPD of the Himalayan Institute of Medical Sciences, Doiwala, Dehradun.

The patients were subjected to detailed clinical evaluation and investigations. Known patients of diabetic nephropathy, diabetics with albuminuria, and diabetics with high serum creatinine and high blood urea nitrogen were excluded from the study. Following investigations were performed:-

- 1. Glycosylated Hemoglobin:** It was measured by the cation exchange resin method⁹.
- 2. Serum Magnesium:** Magnesium was measured by colorimetric endpoint method¹⁰.

Above two tests were analyzed by using RA – 50 semi-automated analyzer (Bayer Diagnostics Indian Ltd.)

- 3. Urinary Microalbumin:** It was estimated by the immunoturbidimetric method as described by Hellsing. It is based on the principle that when undiluted urine is added to a buffer containing antibody for human serum albumin, it leads to the formation of the precipitate of the antigen-antibody complex which scatters light.

The absorbance of the resulting turbid solution at 340nm is directly proportional to the concentration of albumin (antigen) in the urine¹¹.

RESULTS: Table 1 shows the comparison of glycosylated hemoglobin level with mean urinary microalbumin in patients of type 2 diabetes mellitus.

TABLE 1: COMPARISON OF GLYCOSYLATED HEMOGLOBIN LEVEL WITH MEAN URINARY MICROALBUMIN IN PATIENTS OF TYPE 2 DIABETES MELLITUS

Glycosylated hemoglobin (HbA1c)	No. of patients	Mean urinary microalbumin (mg/24 h)	P-value
≤ 7%	40	40.27 ± 7.83	≤ 0.03
>7%	20	67.95 ± 11.02	

As shown in Table 1, the patients of DM having HbA1c ≤ 7% had a mean urinary microalbumin level of 40.27 mg/24h and the patients of DM having HbA1c >7% had a mean urinary microalbumin level of 67.95 mg/24 hrs (p ≤ 0.03). This is statistically significant.

Table 2 shows the comparison of serum magnesium levels with mean urinary microalbumin in patients of type 2 diabetes mellitus.

TABLE 2: COMPARISON OF SERUM MAGNESIUM LEVELS WITH MEAN URINARY MICROALBUMIN IN PATIENTS OF TYPE 2 DIABETES MELLITUS

Serum Magnesium (mg/dl)	No. of patients	Mean urinary microalbumin (mg/24 h)	P value
≥ 1.5%	27	66.82 ± 9.6	≤ 0.04
> 1.5%	33	41.68 ± 9.05	

As shown in Table 2, the patients of DM having serum magnesium ≤ 1.5% mg/dl had mean urinary microalbumin level of 66.82 mg/24hrs and the patients of DM having serum magnesium ≥ 1.5% mg/dl had a mean urinary microalbumin level of 41.68 mg/24h (p ≤ 0.04). This is statistically significant.

Table 3 shows the comparison of glycosylated hemoglobin with mean serum microalbumin in patients of type 2 diabetes mellitus.

TABLE 3: COMPARISON OF GLYCOSYLATED HEMOGLOBIN WITH MEAN SERUM MICROALBUMIN IN PATIENTS OF TYPE 2 DIABETES MELLITUS

Glycosylated hemoglobin (HbA1c)	No. of patients	Mean urinary microalbumin (mg/24 h)	P-value
≤ 7%	40	1.7 ± 0.07	≤ 0.53
> 7%	20	1.64 ± 0.07	

As shown in Table 3, the patients of DM having HbA1c ≤ 7% had mean serum microalbumin level of 1.7 mg/dl and the patients of DM having HbA1c >7% had mean serum microalbumin level of 1.64 mg/dl (p ≤ 0.53). The mean serum magnesium level is lower in patients of DM having HbA1c >7%, but this is not statistically significant.

DISCUSSION: In the present study, HbA1c levels showed a significant correlation with urinary microalbumin level ($p \leq 0.03$) as is evident from **Table 1**. This finding is in agreement with the observations of Feldt-Rasmussen and coworkers as well as Maiti A and coworkers who also found that microalbuminuria had a significant correlation with HbA1c level. In the present study, as well as in their studies, patients with significant microalbuminuria had HbA1c levels $>7\%$ ^{12, 13}. It is evident, therefore, that HbA1c has a significant correlation with urinary microalbumin level. Thus it is clear that glycemic control over a long period has a greater influence on the urinary microalbumin level. As it has been reported that serum magnesium level is inversely related to the level of urinary microalbumin in diabetics and is a useful tool for the study of diabetic nephropathy, it was considered prudent to estimate serum magnesium in the above study. As shown in **Table 2**, serum magnesium level significantly decreased with an increase in urinary microalbumin level ($p \leq 0.04$).

The relationship between serum ionized serum and microalbuminuria was earlier studied by Corsonello and coworkers, and they found that increased urinary microalbumin shows a significant corresponding decrease in serum ionized magnesium. The present study indicates that no significant correlation was found between HbA1c levels and total serum magnesium. However, Corsonello and co-workers, as well as Kundu and co-workers, have demonstrated a significant negative correlation between glycosylated hemoglobin and serum ionized magnesium concentration^{14, 15}.

CONCLUSION: It was concluded that glycemic control, as measured by glycosylated hemoglobin case of type 2 diabetes mellitus, had a significant correlation with microalbuminuria. There was a significant inverse correlation between serum magnesium and urinary microalbumin levels. Therefore, estimation of urinary microalbumin, glycosylated hemoglobin, and serum magnesium

should be routinely done in confirmed cases of type 2 diabetes mellitus.

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CONFLICT OF INTEREST: Nil

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