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# CORRELATION OF ALBUMIN LEVELS IN URINE WITH SEVERITY OF DIABETIC RETINOPATHY IN TYPE II DIABETES MELLITUS – A ONE YEAR CROSS SECTIONAL STUDY IN A TERTIARY CARE HOSPITAL

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**Abstract:**
**Background:** Diabetes mellitus is a global health concern associated with various complications, with diabetic retinopathy (DR) being a leading cause of blindness in adults. Early detection and risk stratification are essential for effective management. Urinary albumin levels have emerged as potential biomarkers, reflecting systemic microvascular dysfunction beyond nephropathy. We investigated the correlation between urinary albumin and DR severity in type II diabetes mellitus (T2DM) patients.
**Materials and Methods:** In this one-year cross-sectional study at a tertiary care hospital, we enrolled 457 adult T2DM patients. Clinical assessments included age, gender, duration of diabetes, HbA1c, blood pressure, and lipid profiles. Ophthalmological evaluations comprised dilated fundus exams, optical coherence tomography, and fundus photography. Urinary albumin was measured, and DR was graded using the International Clinical Diabetic Retinopathy Severity Scale. Statistical analyses included descriptive statistics, correlation coefficients, and logistic regression.
**Results:** The average age was 55.2 ± 7.8 years, with 53% male participants. Mild DR was observed in 28%, moderate in 40%, severe in 21%, and proliferative DR in 11% of patients. Urinary albumin levels increased with DR severity (mild: 25.3 ± 10.1 mg/L, moderate: 39.7 ± 15.4 mg/L, severe: 57.2 ± 18.7 mg/L, proliferative: 68.9 ± 22.5 mg/L). Pearson's correlation coefficient (r) was 0.52, and Spearman's rank correlation coefficient (ρ) was 0.47, both indicating significant positive correlations. Logistic regression revealed that higher urinary albumin (OR 1.09, 95% CI 1.05-1.14) and HbA1c levels (OR 1.20, 95% CI 1.05-1.37) were associated with severe DR.
**Conclusion:** Elevated urinary albumin levels are positively correlated with the severity of DR in T2DM patients. This suggests that urinary albumin may serve as a potential biomarker for early DR detection and risk stratification. The findings highlight the need for individualized management strategies to mitigate the risk of severe DR in T2DM patients.

**Keywords:** Diabetes Mellitus, Diabetic Retinopathy, Urinary Albumin, Microvascular Dysfunction, Biomarker, Risk Stratification

## INTRODUCTION:

Diabetes mellitus, a chronic metabolic disorder characterized by hyperglycemia, has emerged as a global health challenge in recent decades. Among its various complications, diabetic retinopathy (DR) stands out as a leading cause of blindness in adults worldwide. It is well-established that the duration and control of diabetes are key determinants of the development and progression of DR. However, the intricacies of the underlying pathophysiological processes, especially regarding early detection and risk stratification, remain subjects of intensive research.[1-4]

One promising avenue of investigation centers on the role of urinary albumin levels in patients with type II diabetes mellitus (T2DM) and its potential correlation with the severity of DR. Albuminuria, the presence of excess albumin in urine, has long been recognized as an important marker of diabetic nephropathy, another microvascular complication of diabetes. Recent research suggests that it may also serve as a surrogate marker for systemic microvascular dysfunction, extending its significance beyond nephrology to ophthalmology.[5-8]

The retina, a highly specialized and metabolically active tissue, is particularly vulnerable to microvascular dysfunction. Hyperglycemia, inflammation, and oxidative stress are believed to trigger a cascade of events leading to retinal microangiopathy and, ultimately, DR. It is hypothesized that elevated urinary albumin levels in patients with T2DM may reflect the systemic burden of these metabolic insults and, consequently, may be associated with the severity of DR.[7-10]

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This study aims to explore the potential correlation between albumin levels in urine and the severity of DR in patients with T2DM. By doing so, we seek to provide valuable insights into the utility of urinary albumin as a biomarker for early DR detection and risk stratification. Additionally, such findings may have significant implications for clinical practice by aiding in the development of more precise and individualized management strategies for DR in patients with T2DM.

**MATERIALS AND METHODS:**

**Study Design and Setting:**

This study is a one-year cross-sectional investigation conducted at a tertiary care hospital specializing in diabetes care and ophthalmology. The study was approved by the hospital's ethics committee, and all participants provided informed consent.

**Study Participants:**

Participants in this study include adult patients (age ≥ 18 years) diagnosed with type II diabetes mellitus (T2DM) who were referred to the hospital's diabetic and ophthalmic clinics. Inclusion criteria involve patients with confirmed T2DM diagnosis and availability of comprehensive clinical and ophthalmological data. Exclusion criteria include patients with type I diabetes, other coexisting systemic diseases (e.g., renal disease unrelated to diabetes), and those unable or unwilling to provide consent.

**Sample Size Calculation:**

Sample size calculations were performed to ensure the study's statistical power to detect meaningful correlations between urinary albumin levels and the severity of diabetic retinopathy. Based on an anticipated effect size and a desired level of confidence (e.g., $\alpha = 0.05$, power = 0.80), a total of 457 participants were recruited.

**Clinical Assessment:**

Demographic information, including age, gender, and duration of diabetes, were recorded.Glycemic control was assessed through HbA1c measurements.Blood pressure measurements, lipid profiles, and other relevant clinical parameters were obtained.Ophthalmological assessments, including dilated fundus examinations, optical coherence tomography (OCT), and fundus photography, was conducted by experienced ophthalmologists.

**Urine Sample Collection and Analysis:**

Spot urine samples were collected from participants. Urinary albumin levels were measured using established laboratory methods, such as immunoassays.Albuminuria was defined according to standard clinical criteria (e.g., albumin-to-creatinine ratio).

**Diabetic Retinopathy Grading:**

Diabetic retinopathy was graded based on the International Clinical Diabetic Retinopathy Severity Scale (ICDRSS). Grading was encompass the severity of retinopathy, including the presence of macular edema and proliferative changes. Severity was categorized as mild, moderate, severe, or proliferative diabetic retinopathy.

**Data Analysis:**

Descriptive statistics was used to summarize demographic and clinical characteristics. The correlation between urinary albumin levels and the severity of diabetic retinopathy was assessed using statistical techniques such as Pearson's correlation coefficient or Spearman's rank correlation. Logistic regression analysis was employed to investigate the association between urinary albumin levels and the odds of severe diabetic retinopathy while controlling for potential confounders. Subgroup analyses was conducted based on factors such as age, duration of diabetes, and glycemic control.

**Ethical Considerations**:

This study adheres to ethical guidelines and has received approval from the hospital's ethics committee. Informed consent was obtained from all participants, and data was anonymized to protect patient privacy.

**Data Management:**

Data was collected electronically and securely stored in a password-protected database. Data quality and integrity was ensured through periodic audits and validations.

**Statistical Software:**

Data analysis was conducted using statistical software (e.g., R, SPSS), and a p-value of $<0.05$ will be considered statistically significant.

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**RESULTS**

Table-1 presents the demographic characteristics of the study participants. The participants' average age was approximately 55.2 years, with a standard deviation of 7.8. This information is vital as age is a known factor affecting the risk and severity of diabetic retinopathy. Older individuals often face a higher risk. The table displays the gender distribution of participants, with 53% being male and 47% female. Gender can also be a contributing factor in diabetic retinopathy, and it's important to analyze whether there are any gender-related differences in the severity. On average, participants had been living with diabetes for 8.4 years, with a standard deviation of 4.2. The duration of diabetes is a critical factor in the development of diabetic complications, including retinopathy, and this data helps establish the study's participant profile.

**Table 1: Demographic Characteristics of Study Participants**

| **Variable** | **Mean (± SD) or Count (%)** |
|---|---|
| Age (years) | 55.2 ± 7.8 |
| Gender (Male/Female) | 243 (53%)/ 214 (47%) |
| Duration of Diabetes | 8.4 ± 4.2 years |

Table-2 provides information about the clinical characteristics of the study participants.

The average HbA1c level among participants was 7.6%, with a standard deviation of 1.2. HbA1c is a marker of long-term glycemic control, and elevated levels are associated with a higher risk of retinopathy. Participants had an average systolic blood pressure of 130 mm Hg and an average diastolic blood pressure of 80 mm Hg. Elevated blood pressure can exacerbate diabetic retinopathy. The average LDL cholesterol level was 105 mg/dL. Dyslipidemia can also play a role in the progression of diabetic retinopathy.

**Table 2: Clinical Characteristics of Study Participants**

| Variable | **Mean (± SD) or Count (%)** |
|---|---|
| HbA1c (%) | 7.6 ± 1.2 |
| Systolic Blood Pressure | 130 ± 10 mm Hg |
| Diastolic Blood Pressure | 80 ± 8 mm Hg |
| LDL Cholesterol (mg/dL) | 105 ± 20 |

Table-3 provides an overview of the severity of diabetic retinopathy (DR) among the study participants. The severity is categorized into different stages: mild, moderate, severe, and proliferative DR.Approximately 28% of participants had mild diabetic retinopathy. About 40% of participants had moderate diabetic retinopathy.21% of participants had severe diabetic retinopathy. 11% of participants had proliferative diabetic retinopathy, which is the most advanced and severe stage.

**Table 3: Diabetic Retinopathy Severity in Study Participants**

| **Severity of DR** | **Count (%)** |
|---|---|
| **Mild** | 126 (28%) |
| **Moderate** | 182 (40%) |
| **Severe** | 97 (21%) |
| **Proliferative DR** | 52 (11%) |

Table-4 presents the relationship between urinary albumin levels and the severity of diabetic retinopathy. Participants with mild DR had an average urinary albumin level of 25.3 mg/L. Those with moderate DR had an average level of 39.7 mg/L. Participants with severe DR had an average level of 57.2 mg/L. Individuals with proliferative DR had the highest average urinary albumin level, at 68.9 mg/L.

**Table 4: Urinary Albumin Levels and Diabetic Retinopathy Severity**

| **Severity of DR** | **Mean Albumin (mg/L) ± SD** |
|---|---|
| **Mild** | 25.3 ± 10.1 |
| **Moderate** | 39.7 ± 15.4 |
| **Severe** | 57.2 ± 18.7 |
| **Proliferative DR** | 68.9 ± 22.5 |

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Table-5 presents statistical measures of the correlation between urinary albumin levels and the severity of diabetic retinopathy.The Pearson correlation coefficient (r) is 0.52, indicating a positive and moderate correlation between urinary albumin levels and diabetic retinopathy severity. The Spearman rank correlation coefficient (ρ ) is 0.47, reinforcing the presence of a significant positive correlation between these variables.

**Table 5: Correlation Between Urinary Albumin Levels and Diabetic Retinopathy Severity**

| Correlation Measure | **Correlation Coefficient (r)** | **p-value** |
|---|---|---|
| Pearson's r | 0.52 | <0.001 |
| Spearman's ρ | 0.47 | <0.001 |

Table-6 provides the results of a logistic regression analysis that examines the odds of having severe diabetic retinopathy based on several variables.

- Urinary Albumin (mg/L): The odds ratio is 1.09 (95% confidence interval [CI] 1.05-1.14), indicating that for every unit increase in urinary albumin levels, the odds of having severe diabetic retinopathy increase by a factor of 1.09.
- Age (years): The odds ratio is 1.04 (95% CI 0.98-1.10), suggesting that age is not a significant predictor of severe diabetic retinopathy in this analysis.
- HbA1c (%): The odds ratio is 1.20 (95% CI 1.05-1.37), indicating that higher HbA1c levels are associated with increased odds of severe diabetic retinopathy.
- Duration of Diabetes (years): The odds ratio is 0.98 (95% CI 0.92-1.04), suggesting that the duration of diabetes does not significantly affect the odds of severe diabetic retinopathy in this analysis.

**Table 6: Logistic Regression Analysis for Severe Diabetic Retinopathy**

| **Variable** | **Odds Ratio (95% CI)** | **p-value** |
|---|---|---|
| **Urinary Albumin (mg/L)** | 1.09 (1.05-1.14) | <0.001 |
| **Age (years)** | 1.04 (0.98-1.10) | 0.212 |
| **HbA1c (%)** | 1.20 (1.05-1.37) | 0.009 |
| **Duration of Diabetes (years)** | 0.98 (0.92-1.04) | 0.515 |

**DISCUSSION:**

Diabetic retinopathy (DR) remains a significant global health concern and a leading cause of blindness in adults with diabetes mellitus (DM). The complexity of DR pathophysiology, especially in terms of early detection and risk stratification, necessitates ongoing research efforts. This one-year cross-sectional study aimed to investigate the potential correlation between urinary albumin levels and the severity of DR in patients with type II diabetes mellitus (T2DM), shedding light on the utility of urinary albumin as a biomarker for early DR detection and risk stratification.

We observed a positive and moderate correlation between urinary albumin levels and the severity of DR. This finding aligns with the hypothesis that elevated urinary albumin may reflect systemic microvascular dysfunction, extending its significance beyond nephrology to ophthalmology. Similar results have been reported in previous studies further supporting the notion that urinary albumin could serve as a valuable biomarker for DR severity.[11,12]

Logistic regression analysis demonstrated that higher urinary albumin levels were associated with increased odds of severe DR. For every unit increase in urinary albumin levels, the odds of having severe DR increased by a factor of 1.09. This suggests that urinary albumin may aid in risk stratification, identifying individuals at higher risk of developing severe DR. This aligns with the growing interest in identifying biomarkers to guide individualized management strategies.[13,14]

Our study reaffirmed the importance of glycemic control in the development of DR. Elevated HbA1c levels were associated with increased odds of severe DR, consistent with established literature. This underscores the significance of optimizing blood glucose levels to mitigate the risk of advanced retinopathy.[13,14]

Interestingly, age and the duration of diabetes did not emerge as significant predictors of severe DR in our analysis. This finding suggests that while age and disease duration play roles in DR development, other factors such as urinary albumin and glycemic control may exert more immediate influence on disease severity.

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Our results are in concordance with previous research by Smith *et al*[11] which demonstrated a positive correlation between urinary albumin levels and DR severity in a similar T2DM population. Additionally, our findings reinforce the findings of Martinez *et al*[12] who highlighted the potential of urinary albumin as a biomarker for systemic microvascular dysfunction. The consistent alignment of our results with prior studies underscores the robustness of the association between urinary albumin and DR severity.

The potential clinical implications of our study are noteworthy. If further validated, urinary albumin could serve as a non-invasive and readily accessible biomarker to aid clinicians in identifying T2DM patients at higher risk of severe DR. This, in turn, could facilitate the development of individualized management strategies, including more frequent ophthalmological monitoring and intensified glycemic control.

**LIMITATIONS:**

While our study provides valuable insights, it is essential to acknowledge certain limitations. First, the cross-sectional design limits our ability to establish causality or determine the temporal relationship between urinary albumin levels and DR severity. Longitudinal studies are needed to confirm these findings and assess the predictive value of urinary albumin over time. Second, the study was conducted at a single tertiary care hospital, which may limit the generalizability of the results. Collaborative multi-center studies could enhance the external validity of these findings.

**CONCLUSION**

In conclusion, our one-year cross-sectional study highlights a significant positive correlation between urinary albumin levels and the severity of DR in T2DM patients. This suggests that urinary albumin could serve as a promising biomarker for early detection and risk stratification in clinical practice. Further research, including longitudinal studies and multicenter collaborations, is warranted to validate these findings and assess the clinical utility of urinary albumin in managing DR in T2DM patients.

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