Original Research

Prevalence and Prognostic Impact of Proteinuria in Diabetic Nephropathy: An Observational Study in a Tertiary Care Center

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Received date 12 March, 2024 Acceptance date 19 April, 2024

Abstract
Background: Diabetic nephropathy (DN) is a leading cause of chronic kidney disease and end-stage renal disease worldwide. Proteinuria is a key marker of kidney damage in diabetic patients, but its prevalence and prognostic implications remain underexplored.
Objective: To evaluate the prevalence of proteinuria in diabetic nephropathy patients and assess its prognostic impact on renal function, cardiovascular events, and mortality.
Methods: This observational study included 100 diabetic nephropathy patients from a tertiary care center. Clinical data, including demographics, duration of diabetes, comorbidities, and renal function (eGFR), were collected. Proteinuria was categorized as microalbuminuria, macroalbuminuria, or no proteinuria. Renal function, cardiovascular events, and mortality were monitored over a 12-month period.
Results: Proteinuria was present in 72% of participants, with 45% showing microalbuminuria and 27% macroalbuminuria. Longer diabetes duration and higher HbA1c levels were significantly associated with proteinuria ($p < 0.01$). Proteinuria was strongly correlated with renal function decline, with 35% of proteinuric patients showing a decline in eGFR ($p < 0.001$). Cardiovascular events occurred more frequently in proteinuric patients (40% vs. 15%, $p = 0.02$), and mortality was higher in this group (10% vs. 3.5%, $p = 0.04$). Multivariate analysis identified HbA1c >7%, hypertension, and diabetes duration >10 years as independent risk factors for proteinuria.
Conclusion: Proteinuria is a prevalent and significant prognostic factor in diabetic nephropathy, associated with faster renal function decline, increased cardiovascular risk, and higher mortality. Early detection and management of proteinuria are crucial for improving outcomes in diabetic nephropathy patients.
Keywords: Diabetic nephropathy, Proteinuria, Chronic kidney disease, Renal function, Cardiovascular events, Mortality, HbA1c, Hypertension

Introduction

Diabetic nephropathy (DN) is a leading cause of end-stage renal disease (ESRD) and contributes significantly to global morbidity and mortality[1]. It is characterized by progressive kidney damage, often detected early through the presence of proteinuria, a key marker of renal injury in diabetic patients[2]. According to the World Health Organization (WHO), the global prevalence of diabetes has been steadily increasing, leading to a concomitant rise in the incidence of diabetic nephropathy[3]. Proteinuria, particularly microalbuminuria, is one of the earliest signs of diabetic nephropathy and is strongly predictive of both renal and cardiovascular complications[4].

The pathophysiology of diabetic nephropathy is multifactorial, involving hyperglycemia, hypertension, inflammation, and metabolic abnormalities. Early identification of proteinuria allows for timely intervention, which may reduce the progression of kidney damage and associated complications[5]. While the association between proteinuria and the development of diabetic nephropathy is well established, its prognostic impact on long-term outcomes, including renal function decline, cardiovascular events, and mortality, requires further exploration[6].

Despite its importance, there is limited research focusing on the prevalence and prognostic significance of proteinuria specifically in the diabetic

nephropathy population in tertiary care settings. This study aims to evaluate the prevalence of proteinuria in patients with diabetic nephropathy and assess its relationship with renal function deterioration, the occurrence of cardiovascular events, and patient mortality.

By understanding the impact of proteinuria, this study seeks to highlight its value as a prognostic marker and its potential for improving early detection and management strategies for diabetic nephropathy.

Methodology

Study Design: This was a cross-sectional, observational study conducted at the Government Medical College, Srikakulam, from June 2022 to May 2023. The study aimed to evaluate the prevalence of proteinuria in diabetic nephropathy patients and assess its prognostic impact on renal function, cardiovascular events, and mortality.

Study Population: A total of 100 patients diagnosed with diabetic nephropathy were included in the study. The participants were recruited from the outpatient and inpatient departments of the Nephrology unit. Inclusion criteria included adult patients (aged 18 years and above) diagnosed with diabetic nephropathy based on clinical history, laboratory tests, and imaging studies. Exclusion criteria included patients with acute kidney injury, active infections, malignancies, or those with other secondary causes of kidney disease.

Data Collection: Data were collected using a standardized proforma, including demographic details (age, gender), clinical history (duration of diabetes, comorbidities like hypertension, cardiovascular diseases), and laboratory investigations. The following tests were performed for all participants:

Urinalysis: Urinary protein levels were measured to detect microalbuminuria and macroalbuminuria. Proteinuria was classified as:

Microalbuminuria: Urinary albumin excretion rate of 30-300 mg/day

Macroalbuminuria: Urinary albumin excretion rate >300 mg/day

Renal Function Tests: Serum creatinine and eGFR were used to assess kidney function.

Cardiovascular Evaluation: Participants were monitored for cardiovascular events, including myocardial infarction, stroke, and heart failure during the study period.

HbA1c Levels: Glycemic control was assessed by measuring HbA1c levels.

Follow-up Period: The study participants were followed for a duration of 12 months, from June 2022 to May 2023. During this period, renal function, cardiovascular events, and mortality were monitored at regular intervals (3-month follow-ups). Patients who developed significant renal deterioration (eGFR <60 mL/min/1.73m²) or experienced cardiovascular events were identified[7].

Statistical Analysis: The data were analyzed using SPSS version 22. Descriptive statistics were used to summarize the demographic and clinical characteristics of the participants. The chi-square test was used to assess associations between categorical variables, while continuous variables were compared using independent t-tests. Multivariate regression analysis was performed to identify independent risk factors for proteinuria. A p-value of <0.05 was considered statistically significant.

Results

Study Population: A total of 100 diabetic patients with confirmed diabetic nephropathy were included in the study. The mean age of the participants was 58.2 ± 9.4 years, with 60% males and 40% females. The duration of diabetes in the cohort ranged from 5 to 25 years, with a mean duration of 15.3 ± 5.2 years.

Prevalence of Proteinuria: Proteinuria was detected in 72% (72/100) of the study population, with 45% (45/100) of the participants showing microalbuminuria and 27% (27/100) presenting with macroalbuminuria. The remaining 28% (28/100) had no significant proteinuria.

Demographic and Clinical Characteristics: The presence of proteinuria was significantly associated with longer duration of diabetes ($p < 0.01$).A higher proportion of males (75%) had proteinuria compared to females (65%) but this difference was not statistically significant ($p = 0.15$).Older age groups (>60 years) had a higher prevalence of proteinuria, with 80% of participants aged >60 years exhibiting proteinuria compared to 60% in those aged <60 years ($p = 0.02$).

Prognostic Impact of Proteinuria:

Renal Function Decline: Among patients with proteinuria, 35% (25/72) showed significant decline in renal function (eGFR <60 mL/min/1.73m²) over the study period of 12 months. In contrast, only 10% (3/28) of patients without proteinuria experienced a decline in renal function ($p < 0.001$).

Cardiovascular Events: Cardiovascular complications (e.g., myocardial infarction, stroke, and heart failure) were significantly more prevalent in patients with proteinuria (40%, 29/72) compared to those without proteinuria (15%, 4/28) ($p = 0.02$).

Mortality: There was a higher mortality rate in the proteinuria group, with 10% (7/72) of patients dying during the study period, compared to 3.5% (1/28) in the non-proteinuria group ($p = 0.04$). The majority of

deaths in the proteinuria group were attributed to cardiovascular causes (70%, 5/7).

Risk Factors for Proteinuria: Multivariate regression analysis showed that higher HbA1c levels ($p = 0.03$), longer duration of diabetes ($p = 0.01$), and hypertension ($p = 0.04$) were independently associated with an increased risk of proteinuria.

Table 1: Demographic and Clinical Characteristics of Study Population

Variable	Total (n = 100)	Proteinuria Present (n = 72)	Proteinuria Absent (n = 28)	p-value
Age (years)	58.2 ± 9.4	59.4 ± 9.1	55.1 ± 9.3	0.02
Gender				0.15
Male (%)	60%	75%	65%	
Female (%)	40%	25%	35%	
Duration of Diabetes (years)	15.3 ± 5.2	16.4 ± 5.3	13.2 ± 4.5	0.01
Hypertension (%)	65%	70%	50%	0.04
Body Mass Index (kg/m²)	28.5 ± 4.1	29.2 ± 4.3	27.3 ± 3.7	0.03

Table 2: Prevalence of Proteinuria in the Study Population

Proteinuria Category	n (%)
Microalbuminuria	45 (45%)
Macroalbuminuria	27 (27%)
No Proteinuria	28 (28%)
Total	100 (100%)

Table 3: Association Between Proteinuria and Renal Function Decline

Proteinuria Status	Renal Function Decline (eGFR <60 mL/min/1.73m²)	No Renal Function Decline	p-value
Proteinuria Present	25 (35%)	47 (65%)	<0.001
Proteinuria Absent	3 (10%)	25 (90%)	
Total	28 (28%)	72 (72%)	

Table 4: Cardiovascular Events in Relation to Proteinuria

Proteinuria Status	Cardiovascular Events (n = 100)	No Cardiovascular Events	p-value
Proteinuria Present	29 (40%)	43 (60%)	0.02
Proteinuria Absent	4 (15%)	24 (85%)	
Total	33 (33%)	67 (67%)	

Table 5: Mortality Rates in Proteinuria vs. Non-Proteinuria Groups

Proteinuria Status	Deaths (n = 100)	No Deaths	p-value
Proteinuria Present	7 (10%)	65 (90%)	0.04
Proteinuria Absent	1 (3.5%)	27 (96.5%)	
Total	8 (8%)	92 (92%)	

Table 6: Risk Factors Associated with Proteinuria

Risk Factor	p-value
HbA1c >7%	0.03
Duration of Diabetes >10 years	0.01
Hypertension	0.04
BMI >30	0.05

Discussion

The present study aimed to evaluate the prevalence of proteinuria in patients with diabetic nephropathy and its prognostic implications on renal function, cardiovascular events, and mortality. Our findings highlight the significant association between proteinuria and the worsening of renal function, increased cardiovascular risk, and higher mortality in diabetic nephropathy patients. These results are consistent with previous studies that emphasize proteinuria as a critical biomarker for disease progression in diabetic nephropathy.

Prevalence of Proteinuria

In our study, proteinuria was present in 72% of patients with diabetic nephropathy, with 45% having

microalbuminuria and 27% macroalbuminuria. This prevalence is higher than that reported in some studies, which have shown proteinuria rates ranging from 40% to 60% in similar patient populations . The high prevalence observed in our cohort could be attributed to the relatively advanced stage of nephropathy in the study participants, most of whom had been living with diabetes for over 10 years. Additionally, the presence of hypertension in 65% of participants further predisposes to kidney damage and accelerates the development of proteinuria[8,9].

Impact on Renal Function

The association between proteinuria and renal function deterioration was striking. Of the patients with proteinuria, 35% showed a decline in estimated glomerular filtration rate (eGFR), indicating worsening kidney function over the follow-up period. This is in line with findings from large cohort studies, which have shown that proteinuria is one of the earliest indicators of progressive renal decline in diabetic nephropathy. Proteinuria is thought to contribute to kidney damage through a variety of mechanisms, including increased glomerular filtration pressure, inflammation, and fibrosis. Thus, early identification of proteinuria and timely intervention with angiotensin-converting enzyme inhibitors (ACEIs) or angiotensin receptor blockers (ARBs) may help slow the progression of nephropathy[10,11].

Cardiovascular Risk

Our study also revealed a significantly higher incidence of cardiovascular events (40% in proteinuric patients versus 15% in non-proteinuric patients). This finding supports the established link between kidney dysfunction and cardiovascular morbidity in diabetic nephropathy patients. Proteinuria reflects systemic endothelial dysfunction and inflammatory processes that also contribute to the development of atherosclerosis and other cardiovascular complications (Liu et al., 2020). It is well-documented that diabetic patients with proteinuria are at a higher risk of both macrovascular and microvascular events, including heart failure, stroke, and myocardial infarction[12].

Mortality

The mortality rate was higher among patients with proteinuria (10%) compared to those without proteinuria (3.5%). This is consistent with previous studies that have shown proteinuria to be an independent predictor of mortality in diabetic nephropathy . The presence of proteinuria is indicative of more severe kidney damage and an overall worse prognosis, which is reflected in the increased mortality observed in our study. Moreover, proteinuria is often associated with other comorbidities, including cardiovascular disease, which further exacerbates the risk of death[12].

Risk Factors for Proteinuria

Our study identified several factors that were significantly associated with the presence of proteinuria, including longer duration of diabetes, higher HbA1c levels, and the presence of hypertension. These findings are consistent with the literature, which identifies hyperglycemia and hypertension as key risk factors for the development of proteinuria in diabetic patients (Soni et al., 2020). Tight control of blood glucose and blood pressure remains crucial in the management of diabetic nephropathy and prevention of proteinuria.

Limitations

While this study provides valuable insights into the role of proteinuria in diabetic nephropathy, there are several limitations. The observational design limits causal inferences, and the relatively short follow-up period may not capture the full long-term effects of proteinuria on kidney function and mortality. Furthermore, the study was conducted at a single tertiary care center, which may limit the generalizability of the results. Future studies with larger sample sizes and longer follow-up periods are needed to validate these findings.

Conclusion

Proteinuria is a prevalent and significant marker of disease progression in diabetic nephropathy. It is strongly associated with a decline in renal function, increased cardiovascular events, and higher mortality. Early detection of proteinuria and appropriate management may help mitigate the adverse outcomes associated with diabetic nephropathy. The results of this study underscore the need for routine screening for proteinuria in diabetic patients and prompt intervention to improve patient outcomes.

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