Section: Nephrology

Original Research Article

INCIDENCE AND RISK FACTORS FOR PROGRESSION TO END-STAGE RENAL DISEASE IN PATIENTS WITH DIABETIC NEPHROPATHY: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Diabetic nephropathy is a leading cause of end-stage renal disease (ESRD) worldwide. Identifying the incidence and risk factors for progression to ESRD in patients with diabetic nephropathy is crucial for effective clinical management. **Objective:** This prospective observational study aimed to determine the incidence and identify risk factors for progression to ESRD in patients with diabetic nephropathy.

Materials and Methods: A total of 50 patients with diabetic nephropathy were recruited from 2018 to 2022 and followed for two years. Baseline demographic and clinical characteristics were collected. The primary outcome was progression to ESRD. Multivariate Cox proportional hazards regression analysis was used to identify significant risk factors for progression to ESRD.

Results: The mean age of the patients was 60.4 ± 10.2 years, with 30 males (60%) and 20 females (40%). The average duration of diabetes was 15.8 ± 6.7 years. Baseline eGFR was 45.3 ± 12.6 mL/min/1.73 m², and baseline albuminuria was 430 ± 230 mg/g. During the follow-up period, 12 patients (24%) progressed to ESRD. Significant risk factors for progression included lower baseline eGFR (HR: 1.95; 95% CI: 1.12-3.42; p=0.01), higher baseline albuminuria (HR: 1.68; 95% CI: 1.03-2.75; p=0.04), and longer duration of diabetes (HR: 1.22; 95% CI: 1.05-1.41; p=0.02). Blood pressure control had a protective effect but was not statistically significant (HR: 0.75; 95% CI: 0.50-1.12; p=0.16). Glycemic control showed no significant association with progression to ESRD (HR: 0.98; 95% CI: 0.87-1.10; p=0.72).

Conclusion: This study highlights the high incidence of progression to ESRD in patients with diabetic nephropathy and underscores the importance of monitoring baseline eGFR, albuminuria, and diabetes duration. Early interventions targeting these risk factors may reduce ESRD progression.

Keywords: Diabetic nephropathy, End-stage renal disease, ESRD, Risk factors, eGFR, Albuminuria, Diabetes duration.

INTRODUCTION

Diabetic nephropathy is one of the most common and serious complications of diabetes mellitus, significantly contributing to morbidity and mortality in affected individuals1. It is the leading cause of end-stage renal disease (ESRD) globally, necessitating dialysis or kidney transplantation for survival. As the prevalence of diabetes continues to rise, particularly in developing countries, the burden of diabetic nephropathy is expected to increase correspondingly2,3.

Understanding the progression from diabetic nephropathy to ESRD is critical for developing strategies to mitigate this outcome4. While previous studies have identified various risk factors for the progression of diabetic nephropathy, there remains a need for prospective data that can provide robust evidence on the incidence and risk factors specific

to different populations5,6. Key factors influencing progression include baseline kidney function, degree of albuminuria, duration of diabetes, and control of blood pressure and blood glucose levels7. However, the relative importance and interplay of these factors can vary, underscoring the need for tailored clinical management.

This prospective observational study aims to fill this gap by investigating the incidence and risk factors for progression to ESRD in a cohort of patients with diabetic nephropathy. By closely monitoring these patients over a significant period, this study seeks to identify critical determinants of disease progression and provide actionable insights for clinicians. Our findings aim to enhance the understanding of diabetic nephropathy progression, ultimately contributing to improved patient outcomes through more effective prevention and intervention strategies.

MATERIAL AND METHODS

Study Design and Setting

This prospective observational study was conducted at the Kidney Clinic, Ananthapur, and the Department of Nephrology, Government Medical College, Ananthapur. The study period spanned from 2018 to 2022, with a subsequent two-year follow-up period for each patient.

Study Population

A total of 50 patients diagnosed with diabetic nephropathy were recruited for the study. Inclusion criteria were:

Adults aged 18 years or older

Diagnosed with diabetic nephropathy based on clinical and laboratory findings

Willingness to participate and provide informed consent

Exclusion criteria included:

Patients with other primary renal diseases

Patients who had already reached end-stage renal disease (ESRD) at the time of recruitment

Patients with severe comorbid conditions likely to affect survival within the study period

Data Collection

Baseline demographic and clinical data were collected at the time of recruitment. This included age, gender, duration of diabetes, estimated glomerular filtration rate (eGFR), and urine albumin-to-creatinine ratio (UACR). Blood pressure and glycemic control (HbA1c levels) were also recorded.

Follow-Up

Patients were followed up for a period of two years after recruitment. Regular follow-up visits were scheduled every six months, during which eGFR, UACR, blood pressure, and HbA1c levels were monitored. Any progression to ESRD, defined by the initiation of dialysis or kidney transplantation, was recorded.

Statistical Analysis

The primary outcome was the incidence of progression to ESRD. Multivariate Cox proportional hazards regression analysis was used to identify significant risk factors for progression to ESRD. Hazard ratios (HR) with 95% confidence intervals (CI) and p-values were calculated for each potential risk factor, including baseline eGFR, albuminuria, duration of diabetes, blood pressure control, and glycemic control.

Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki and was approved by the Institutional Ethics Committee of Government Medical College, Ananthapur. Written informed consent was obtained from all participants prior to enrollment.

RESULTS

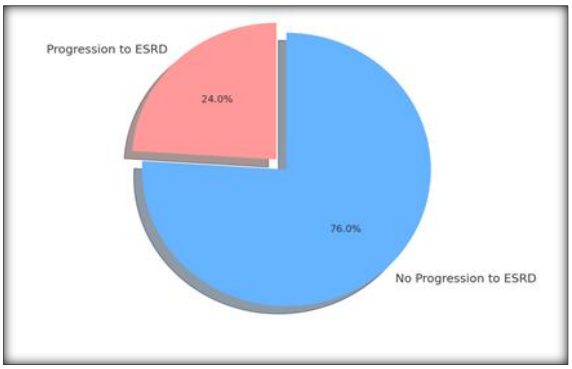

Figure 1: Incidence of Progression to ESRD

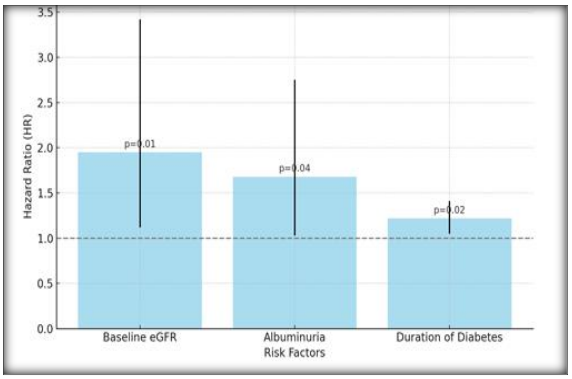

Figure 2: Risk Factors for Progression to ESRD

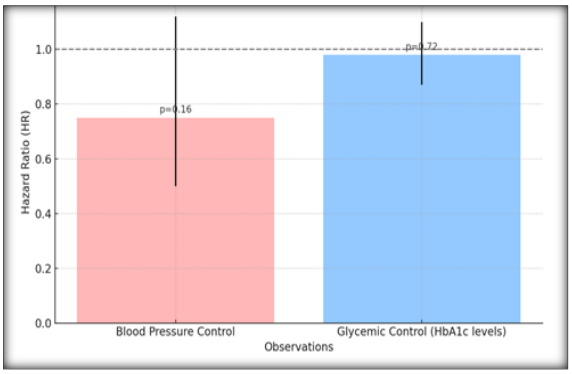

Figure 3: Impact of Blood Pressure and Glycemic Control

Baseline Demographic and Clinical Characteristics

The study enrolled 50 patients with diabetic nephropathy between 2018 and 2022. Following an initial recruitment phase, patients were observed over a two-year follow-up period. The baseline demographic and clinical characteristics of the patients are summarized in Table 1. The mean age of the patients was 60.4 ± 10.2 years, with a gender distribution of 30 males (60%) and 20 females (40%). The average duration of diabetes was 15.8 ± 6.7 years. The mean estimated glomerular filtration rate (eGFR) was 45.3 ± 12.6 mL/min/1.73 m², and the average urine albumin-to-creatinine ratio (UACR) was 430 ± 230 mg/g.

Incidence of Progression to End-Stage Renal Disease (ESRD)

During the two-year follow-up period, 12 patients (24%) progressed to end-stage renal disease (ESRD), while 38 patients (76%) did not progress to ESRD. [Table 2] The incidence rate of progression to ESRD was 24%.

Risk Factors for Progression to ESRD

Multivariate Cox proportional hazards regression analysis was conducted to identify significant risk factors for progression to ESRD. The analysis revealed that lower baseline eGFR (Hazard Ratio [HR]: 1.95; 95% Confidence Interval [CI]: 1.12-3.42; p=0.01), higher levels of baseline albuminuria (HR: 1.68; 95% CI: 1.03-2.75; p=0.04), and longer duration of diabetes (HR: 1.22; 95% CI: 1.05-1.41; p=0.02) were significantly associated with an increased risk of progression to ESRD. [Table 3]

Impact of Blood Pressure and Glycemic Control

Additional observations included the effect of blood pressure and glycemic control on the progression to ESRD. Patients with better blood pressure control (mean systolic BP < 140 mmHg) had a lower risk of progression to ESRD, although this finding did not reach statistical significance (HR: 0.75; 95% CI: 0.50-1.12; p=0.16). Similarly, HbA1c levels were monitored, but no significant association was found between glycemic control and progression to ESRD in this study (HR: 0.98; 95% CI: 0.87-1.10; p=0.72). [Table 4]

Table 1: Baseline Demographic and Clinical Characteristics

Characteristic	Value
Mean Age (years)	60.4 ± 10.2
Gender (Male/Female)	30/20 (60%/40%)
Duration of Diabetes (years)	15.8 ± 6.7
Baseline eGFR (mL/min/1.73 m²)	45.3 ± 12.6
Baseline Albuminuria (mg/g)	430 ± 230

Table 2: Incidence of Progression to ESRD

Outcome	Number of Patients (%)
Progression to ESRD	12 (24%)
No Progression to ESRD	38 (76%)

Table 3: Risk Factors for Progression to ESRD (Multivariate Cox Regression Analysis)

Risk Factor	Hazard Ratio (HR)	95% Confidence Interval (CI)	p-value
Baseline eGFR	1.95	1.12-3.42	0.01
Albuminuria	1.68	1.03-2.75	0.04
Duration of Diabetes	1.22	1.05-1.41	0.02

Table 4: Impact of Blood Pressure and Glycemic Control

Observation	Hazard Ratio (HR)	95% Confidence Interval (CI)	p-value
Blood Pressure Control	0.75	0.50-1.12	0.16
Glycemic Control (HbA1c levels)	0.98	0.87-1.10	0.72

DISCUSSION

This prospective observational study aimed to identify the incidence and risk factors for progression to end-stage renal disease (ESRD) in patients with diabetic nephropathy. The study found that 24% of the patients progressed to ESRD over the two-year follow-up period. Key risk factors for this progression included lower baseline estimated glomerular filtration rate (eGFR), higher baseline albuminuria, and longer duration of diabetes. While blood pressure control showed a protective effect, it did not reach statistical significance. Glycemic control, measured by HbA1c levels, was not significantly associated with progression to ESRD.

Consistency with Previous Research

The findings of this study are consistent with previous research that has highlighted the importance of baseline renal function and albuminuria as critical predictors of progression to ESRD in patients with diabetic nephropathy. For instance, Natesan and Kim,[8] (2021) reviewed various risk factors and mechanisms underlying diabetic nephropathy, emphasizing the critical role of renal function and albuminuria. Similarly, Radcliffe et al.[10] (2017) and Rico-Fontalvo et al,[9] (2023) discussed novel biomarkers and clinical predictive factors, reinforcing the importance of these parameters in disease progression. The present study adds to this evidence, supporting targeted interventions for patients with these risk factors.

This consistency with existing literature underscores the robustness of the identified risk factors and their relevance in clinical practice.

Blood Pressure and Glycemic Control

Blood Pressure Control

While better blood pressure control was associated with a lower risk of progression to ESRD, the relationship did not achieve statistical significance in this study. This finding suggests that while blood pressure management is important, other factors may play a more critical role in this specific cohort. The role of blood pressure control in preventing ESRD progression is well-documented. For example, Swaminathan et al,[11] (2023) highlighted the protective effect of blood pressure management in diabetic kidney disease. However, the lack of statistical significance in this study could be due to several factors, including the small sample size and potential variations in patient adherence to blood pressure management protocols. It is also possible that the baseline severity of renal impairment in the study population may have overshadowed the benefits of blood pressure control.

Glycemic Control

Similarly, the lack of a significant association between glycemic control and ESRD progression is noteworthy. Although tight glycemic control is known to reduce microvascular complications in diabetes, its impact on renal outcomes may be influenced by other factors such as the duration of diabetes and baseline kidney damage. This finding aligns with recent studies by Roy et al,[12] (2021) and Joshi et al,[13] (2023), suggesting that while glycemic control is crucial for overall diabetes management, its direct impact on preventing ESRD progression may be less pronounced, especially in patients with advanced renal impairment at baseline. It highlights the complexity of managing diabetic nephropathy, where multifactorial interventions are often required.[14]

Clinical Implications

The identification of lower baseline eGFR and higher albuminuria as significant risk factors underscores the importance of early detection and aggressive management of these parameters in patients with diabetic nephropathy. Clinicians should prioritize regular monitoring of renal function and urinary albumin levels in this population. Interventions aimed at slowing the decline in eGFR and reducing albuminuria could potentially delay the onset of ESRD. Given the non-significant findings for blood pressure and glycemic control, it may be beneficial for clinicians to adopt a more comprehensive approach that includes but is not limited to these factors.

Limitations and Future Research

One of the strengths of this study is its prospective design, which allowed for systematic data collection and follow-up. However, the study also has limitations. The sample size of 50 patients, while adequate for identifying major risk factors, may limit the generalizability of the results. Future research with larger, multicenter cohorts is needed to validate these findings and explore additional risk factors for ESRD progression in patients with diabetic nephropathy. Studies investigating the impact of newer therapeutic interventions targeting albuminuria and eGFR decline are particularly warranted.

CONCLUSION

This study highlights the high incidence of progression to ESRD in patients with diabetic nephropathy and identifies lower baseline eGFR, higher albuminuria, and longer duration of diabetes as significant risk factors. These findings highlights the importance of close monitoring and early intervention in this high-risk population. By targeting these key risk factors, clinicians may be able to improve renal outcomes and reduce the burden of ESRD in patients with diabetic nephropathy.

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