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Original Research Article

# Evaluating Serum Anti-Phospholipase A2 Receptor (PLA2R) Antibodies as Predictors of Disease Progression in Primary Membranous Nephropathy

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**Conflict of interest: Nil**

**Abstract:**

**Background:** Primary membranous nephropathy is an important cause of nephrotic syndrome whose outcome may vary from benign to end-stage renal failure. However, the role of serum Anti-Phospholipase A2 Receptor antibody in predicting the outcome remains under study. The present study assesses the predictive value for anti-PLA2R antibodies in terms of the clinical outcome of PMN.

**Methods:** The prospective observational study was carried out from May 2021 to May 2023 in S.C.B. Medical College and Hospital, Cuttack. Forty-nine patients with biopsy-proven PMN and positive anti-PLA2R antibody tests were enrolled in this study. Clinical data at baseline and after six months of follow-up were collected. Key parameters such as serum creatinine, serum albumin, 24-hour urine protein, and eGFR were assessed. In the present study, the relationship of anti-PLA2R antibody level to clinical remission was evaluated in patients managed either conservatively or with immunosuppressive therapy.

**Results:** It was found that patients with a lower anti-PLA2R antibody level had higher spontaneous remission rates compared to those at high levels. Specifically, 80% of patients with low anti-PLA2R levels reached remission after receiving conservative therapy, which was much higher compared to 33% of those with high levels. Among the patients who received immunosuppressive therapy, 83.3% of those with low anti-PLA2R levels reached remission compared with 27.3% of those with high anti-PLA2R levels. These results indicate that the anti-PLA2R antibody level is a strong predictor of treatment response and disease outcome.

**Conclusion:** Anti-PLA2R antibody levels are a useful biomarker for predicting the clinical outcome of primary membranous nephropathy. Low levels of anti-PLA2R antibodies could indicate better responsiveness to both conservative and immunosuppressive treatments. Anti-PLA2R antibodies, if incorporated into routine practice, may promote individually tailored treatment decisions and strategies for the optimization of management.

**Keywords:** Primary Membranous Nephropathy, Anti-Phospholipase A2 Receptor, Serum Anti-PLA2R Antibody, Clinical Remission, Immunosuppressive Therapy, Nephrotic Syndrome, Biomarkers.



## Introduction

It represents one of the major causes of nephrotic syndrome in adults and is characterized by the presence of diffuse subepithelial immune complex deposits along the glomerular basement membrane [1]. The diagnosis of PMN traditionally relies on kidney biopsy, where typical membranous changes are demonstrated.

Despite diagnostic development, this kidney disease remains hard to predict in terms of its progression, and therefore, treatment strategies are not easily individualized [2]. Recent research has described serum anti-phospholipase A2 receptor antibodies in the pathogenesis of PMN. PLA2R is a podocyte-expressed transmembrane receptor whose antibodies have been described to be part of its pathogenesis [3]. Anti-PLA2R antibody levels are raised in correspondence with this disorder's presence and activity, hence may be helpful biomarkers for its diagnosis and prognosis.

Assessment of the predictive value of serum anti-PLA2R antibodies in disease courses may be important in PMN management [4]. The study aims to explore the relationship between anti-PLA2R antibody level and the course of the disease in PMN;

for example, how changes in Ab titers correlate with clinical outcomes. Precise knowledge of the dynamics of the illness will be instrumental in improving patient stratification for different treatments [5,6].

The clinical presentation, histological findings, and response to therapy in PMN represent traditional prognostic factors. These factors are usually very limited in providing information on the long-term natural course of the disease [7]. Serological markers such as anti-PLA2R antibodies could provide additional value to the predictive models of patient management and even offer a more personalized approach in treatment strategies.

This study is designed to utilize a cohort of PMN patients who have variable stages of disease to establish a role for anti-PLA2R antibodies in the prediction of disease course [8][9]. In particular, the goals are to determine whether the levels of these antibodies correlate with clinical outcome, assess their utility as prognostic indicators, and determine whether they might be useful in guiding therapeutic decisions [10].

The present study is an attempt to add to this body of literature by increasing knowledge of the predictive value of anti-PLA2R antibodies in order to optimize PMN management and improve patient outcomes [11][12].

## Methods

This was an observational study performed at a hospital to assess the role of serum anti–phospholipase A2 receptor antibodies in predicting the course of disease in primary membranous nephropathy.

**Study Area**: The study was conducted in the Department of Nephrology and Renal Transplantation, S.C.B. Medical College and Hospital, Cuttack, Odisha.

**Study Population:** The patients were admitted for the first time with nephrotic syndrome due to anti-PLA2R-associated primary membranous nephropathy in S.C.B. Medical College and Hospital, Cuttack between May 2021 and May 2023.

**Duration of Study:** The present study was carried out for two years.

**Sample Size:**

The sample size was decided in view of the prevalence of PMN and with a statistical power calculation. The ethical permission was sought from the Institutional Ethics Committee before commencing the study. Written informed consent was taken from all participants for the study, with an assurance of maintaining the confidentiality of their data.

**Inclusion Criteria:** Patients diagnosed to have primary membranous nephropathy associated with anti-PLA2R antibodies confirmed by renal biopsy.

**Exclusion Criteria:**

- Patients who were lost to follow-up in the first six months from diagnosis
- Patients with secondary membranous nephropathy
- Patients who refused to give written consent.

**Data Collection:** Baseline data and follow-up data were collected prospectively. Patients were evaluated at the time of diagnosis- baseline, and followed up for the period of study. Monthly clinical and biochemical evaluation was done. The data collected were as follows:

**Demographic Data:** Age, sex and pertinent clinical history.

**Clinical Parameters:** Blood pressure, pulse rate, temperature, respiration rate, total intake and output.

**Laboratory Investigations:** Complete blood count, liver function tests, which include serum aminotransferases, bilirubin, total protein/albumin, alkaline phosphatase; lipid profile; levels of serum sodium, potassium, calcium; urine routine and microscopy; 24-hour urine protein; spot urine protein-to-creatinine ratio; renal function tests, that is, serum urea and creatinine; anti-PLA2R antibody levels; renal biopsy report.

**Imaging Studies:** Abdominal and pelvic ultrasound, kidney, ureter, and bladder KUB ultrasound, chest X-ray PA view.

**Renal Biopsy and Serology:** Anti-PLA2R antibody levels by enzyme-linked immunosorbent assay ELISA in the Multidisciplinary Research Unit MRU Lab at S.C.B. Medical College and Hospital, Cuttack.

**Definition of Remission:** Complete Clinical Remission: Defined as proteinuria ≤0.3 g/24 h with serum albumin >3.5 g/dL.

**Partial Clinical Remission:** Defined as proteinuria between 0.3 and 3.5 g/day, with a decrease in proteinuria >50% from baseline.

**Statistical Analysis:**

Data were analyzed using SPSS software, version 17.0 (IBM, Chicago, IL, USA). Continuous variables were compared with independent sample t-tests or Mann–Whitney U tests, and categorical variables were compared by chi-square or Fisher's exact tests. Patients were divided into two subgroups according to the level of anti-PLA2R antibodies: low (<50 Ru/ml) and high (≥50 Ru/ml). Comparison between these two subgroups was

conducted and p-values <0.05 was considered to have statistically significant differences.

**Ethical Considerations:**

The study was approved by the institutional ethics committee of S.C.B. Medical College and Hospital. Written informed consent was taken from all participants before including them in the study. The confidentiality of patients' information was maintained throughout the study. The research work adhered to ethical standards and guidelines regarding the welfare and safeguarding of rights for the subjects. This is a structured methodology that guarantees overall assessment of the role of serum anti-PLA2R antibodies in predicting the disease course of primary membranous nephropathy and adheres to a rigorous approach to data collection, analysis, and ethical considerations.

**Results**

**Age Distribution of Study Population:** The study included 49 patients with biopsy-proven primary membranous nephropathy (MN). The age distribution of these patients is summarized in Table.1 and Figure.1. The majority of patients were in the 40-59 years age group (46.9%), followed by the 20-39 years group (40.8%). The youngest patient was 19 years old, while the oldest was 63 years old.

**Table 1: Age Distribution of Study Population with Primary MN**

| Age (years) | Frequency (n) | Percentage (%) |
|---|---|---|
| <20 | 3 | 6.1 |
| 20-39 | 20 | 40.8 |
| 40-59 | 23 | 46.9 |
| ≥60 | 3 | 6.1 |
| Total | 49 | 100 |

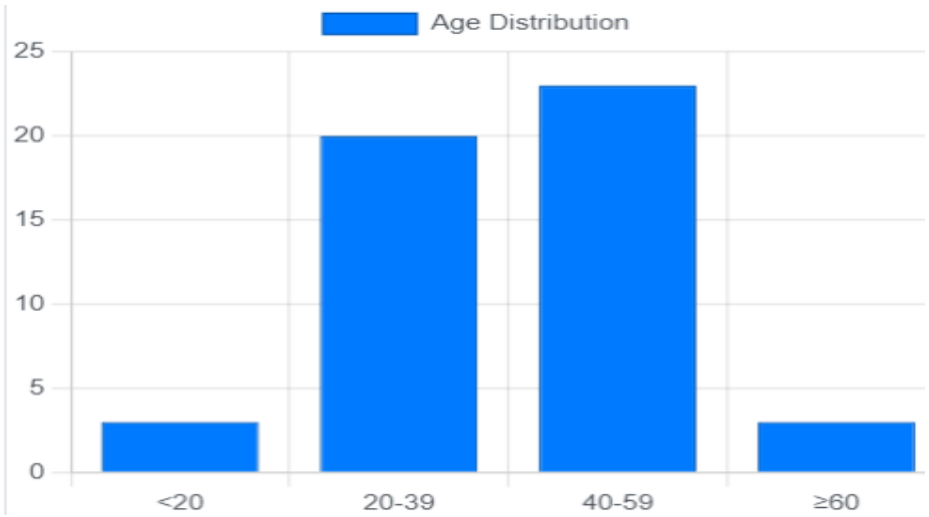


**Figure 1: Age Distribution of Study Population with Primary MN**

**Gender Distribution of Study Population:** The gender distribution of the study population is presented in Table.2 and Figure.2. A majority of the patients were male (69.4%), with a male-to-female ratio of 2.27:1.

**Table 2: Gender Distribution of Study Population with Primary MN**

| Gender | Frequency (n) | Percentage (%) |
|---|---|---|
| Male | 34 | 69.4 |
| Female | 15 | 30.6 |
| Total | 49 | 100 |

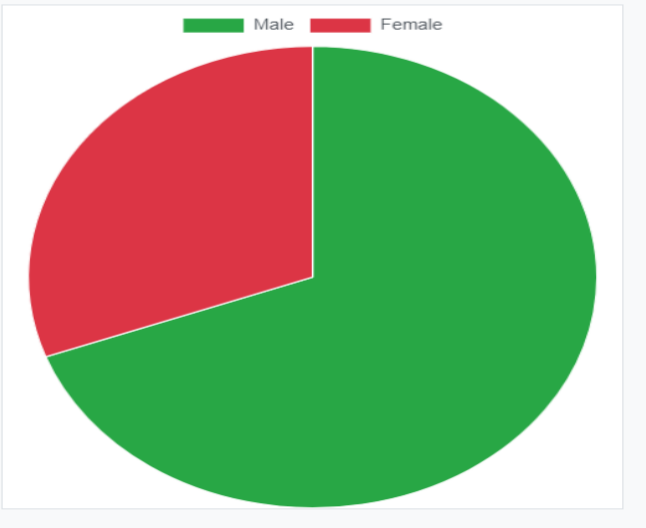


**Figure 2: Gender Distribution of Study Population with Primary MN**

**Distribution of Serum Creatinine:** Table.3 and Figure.3 illustrate the serum creatinine levels of the study population at baseline. Forty percent of patients had serum creatinine levels below 1 mg/dl, 28.6% had levels between 1-2 mg/dl, and 30.6% had levels greater than 2 mg/dl.

**Table 3: Distribution of Serum Creatinine of the Study Population with Primary MN**

| Serum Creatinine (mg/dl) | Frequency (n) | Percentage (%) |
|---|---|---|
| <1 | 20 | 40.8 |
| 1-2 | 14 | 28.6 |
| >2 | 15 | 30.6 |
| Total | 49 | 100 |

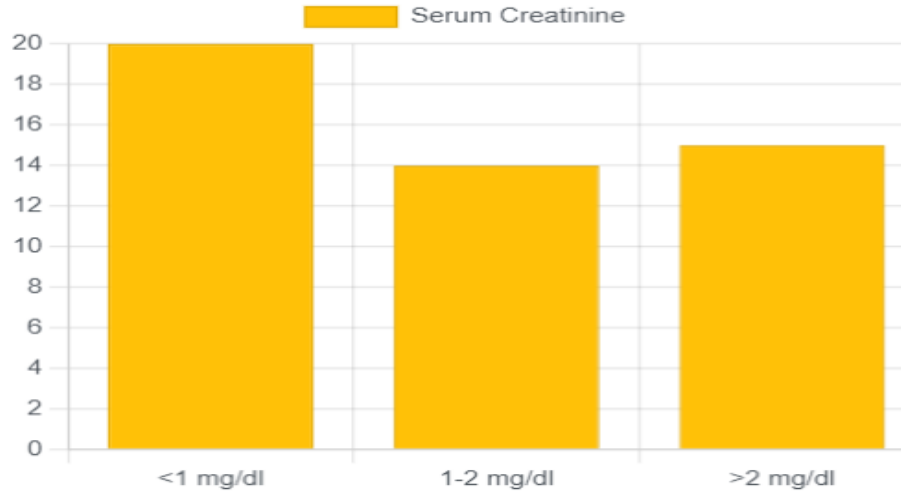


**Figure 3: Distribution of Serum Creatinine of the Study Population with Primary MN**

**Distribution of Serum Albumin:** As shown in Table.4 and Figure.4, more than half of the patients (51%) had serum albumin levels between 1-3 g/dl. About 45% had levels greater than 3 g/dl, and only 4.1% had levels below 1 g/dl.

**Table 4: Distribution of Serum Albumin of the Study Population with Primary MN**

| Serum Albumin (g/dl) | Frequency (n) | Percentage (%) |
|---|---|---|
| <1 | 2 | 4.1 |
| 1-3 | 25 | 51.0 |
| >3 | 22 | 44.9 |
| Total | 49 | 100 |

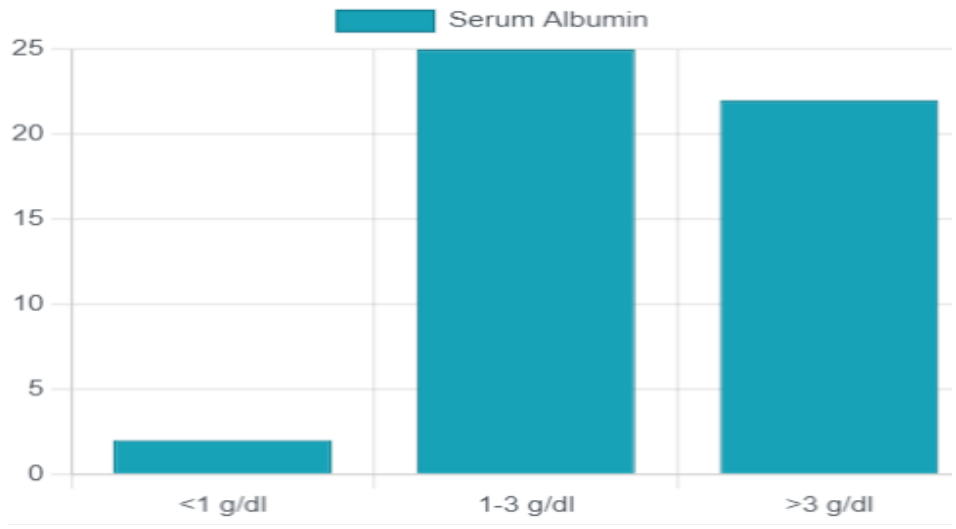


**Figure 4: Distribution of Serum Albumin of the Study Population with Primary MN**

**Levels of 24-hour Urine Protein:** Table.5 and Figure.5 show the distribution of 24-hour urine protein levels. Nearly 47% of patients had levels between 4-7.9 g/dl, 44.9% had levels below 4 g/dl, and 8.2% had levels greater than 8 g/dl.

**Table 5: Levels of 24-hour Urine Protein of the Study Population with Primary MN**

| 24-hour Urine Protein (g) | Frequency (n) | Percentage (%) |
|---|---|---|
| <4 | 22 | 44.9 |
| 4-7.9 | 23 | 46.9 |
| ≥8 | 4 | 8.2 |
| Total | 49 | 100 |


**Figure 5: Levels of 24-hour Urine Protein of the Study Population with Primary MN**

**eGFR Distribution:** The distribution of eGFR levels at baseline is summarized in Table.6 and Figure.6. Thirty-nine percent of patients had an eGFR greater than 90 ml/min/1.73m², 34.7% had eGFR less than 60 ml/min/1.73m², and 26.5% had eGFR between 60-90 ml/min/1.73m².

**Table 6: eGFR Distribution of the Study Population with Primary MN**

| eGFR (ml/min/1.73m²) | Frequency (n) | Percentage (%) |
|---|---|---|
| <60 | 17 | 34.7 |
| 60-90 | 13 | 26.5 |
| >90 | 19 | 38.8 |
| Total | 49 | 100 |

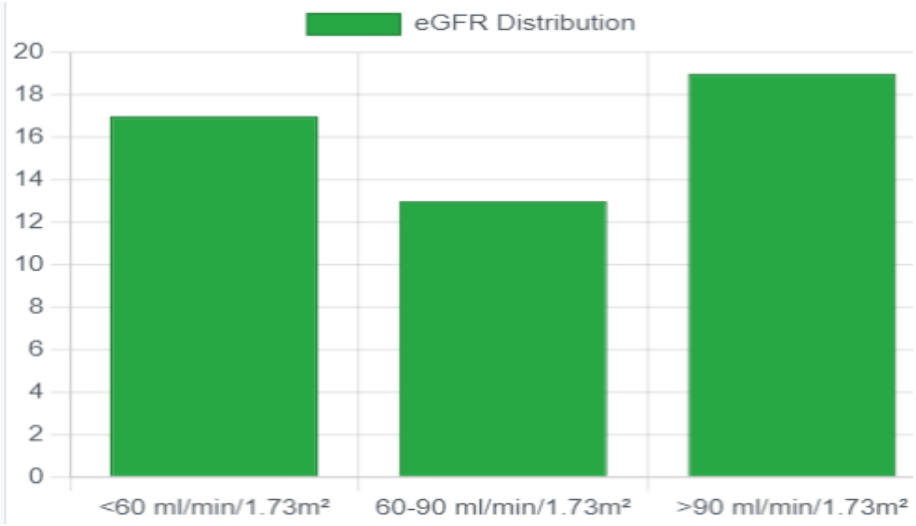


**Figure 6: eGFR Distribution of the Study Population with Primary MN**

**Anti-PLA2R Antibody Levels and Spontaneous Remission:** Table.7 and Figure.7 show the relationship between anti-PLA2R antibody levels and spontaneous remission among patients on conservative therapy. Patients with low anti-PLA2R antibody levels (<50 Ru/ml) had a higher rate of spontaneous remission (80%) compared to those with high anti-PLA2R antibody levels (>50 Ru/ml) (33%). This association was statistically significant ($p < 0.05$).

**Table 7: Anti-PLA2R Antibody Levels and Spontaneous Remission**

| Anti-PLA2R Level (Ru/ml) | Spontaneous Remission (SR) | No SR | Total | $\chi^2$-value | P-value |
|---|---|---|---|---|---|
| Low (<50) | 16 | 4 | 20 | 6.96 | 0.008 |
| High (>50) | 4 | 8 | 12 | | |
| Total | 20 | 12 | 32 | | |

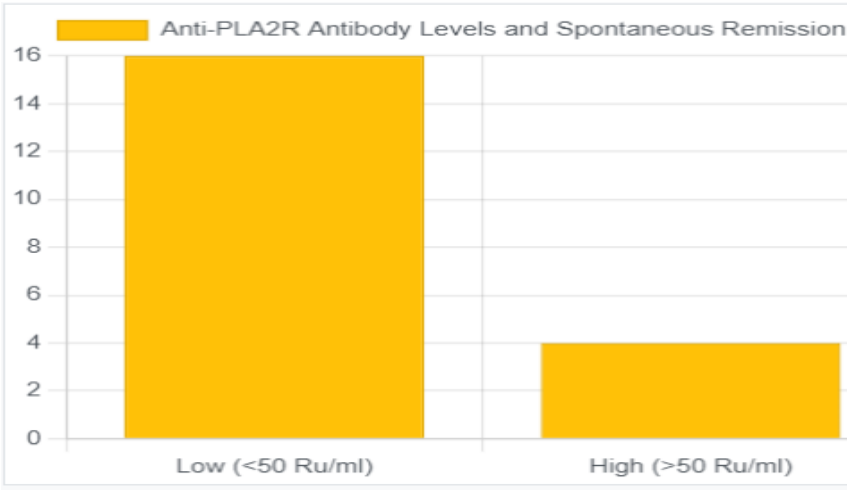


**Figure 7: Anti-PLA2R Antibody Levels and Spontaneous Remission**

**Anti-PLA2R Antibody Levels and Remission with Immunosuppression**

Table.8 and Figure.8 present the association between anti-PLA2R antibody levels and clinical remission among patients receiving immunosuppressive therapy. Patients with low anti-PLA2R levels had a higher remission rate (83.3%) compared to those with high anti-PLA2R levels (27.3%). This association was statistically significant ($p < 0.05$).

**Table 8: Anti-PLA2R Antibody Levels and Remission with Immunosuppression**

| Anti-PLA2R Level (Ru/ml) | Remission | No Remission | Total | $\chi^2$-value | P-value |
|---|---|---|---|---|---|
| Low (<50) | 5 | 1 | 6 | 4.89 | 0.02 |
| High (>50) | 3 | 8 | 11 | | |
| Total | 8 | 9 | 17 | | |

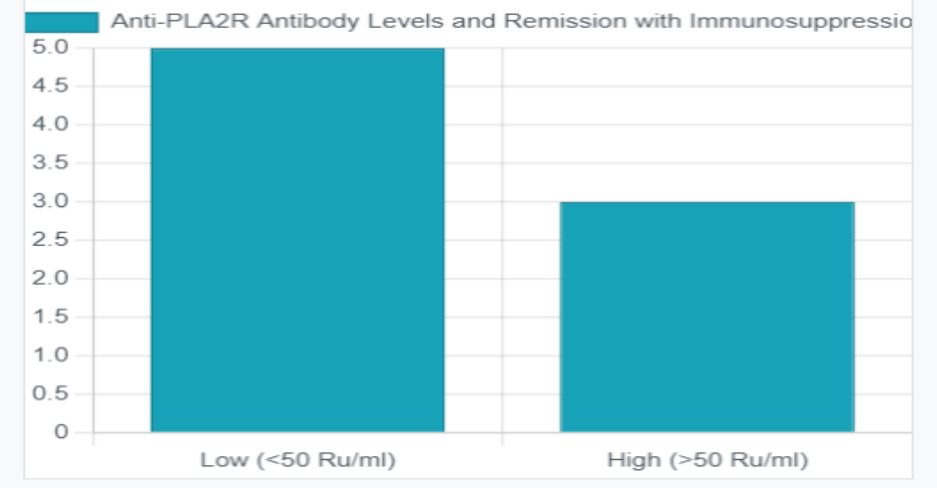


**Figure 8: Anti-PLA2R Antibody Levels and Remission with Immunosuppression**

**Clinical Presentation:** Table.9 and Figure.9 detail the clinical presentation of patients at the time of diagnosis. The majority (89.8%) presented with nephrotic syndrome, while 6.1% presented with acute kidney injury (AKI) and 4.1% with chronic kidney disease (CKD).

**Table 9: Clinical Presentation of Study Population with Primary MN**

| Clinical Presentation | Frequency (n) | Percentage (%) |
|---|---|---|
| Nephrotic Syndrome | 44 | 89.8 |
| AKI | 3 | 6.1 |
| CKD | 2 | 4.1 |
| Total | 49 | 100 |

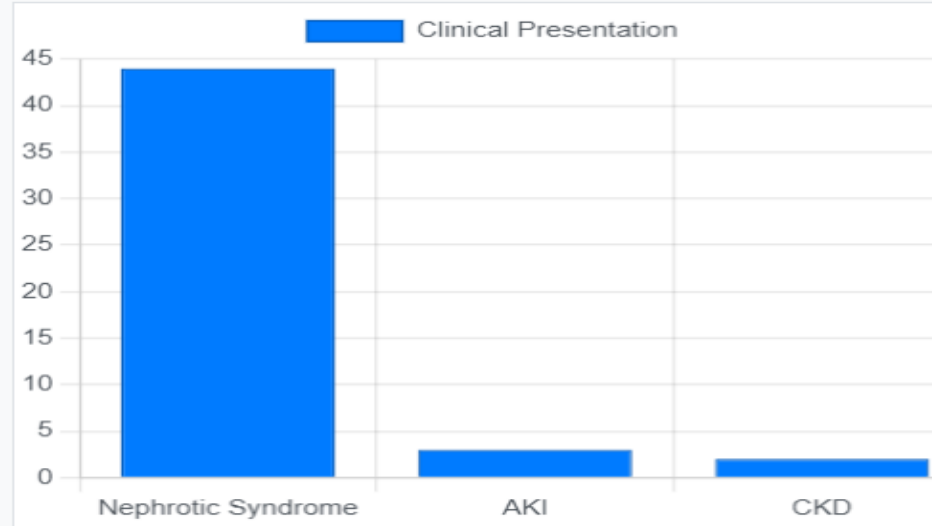


**Figure 9: Clinical Presentation of Study Population with Primary MN**

**Associated Comorbidities:** Table.10 provides data on associated comorbidities. Hypertension was the most common comorbidity, present in 45.9% of patients, followed by diabetes mellitus (24.5%) and systemic lupus erythematosus (8.2%).

**Table 10: Associated Comorbidities in Study Population with Primary MN**

| Comorbidity | Frequency (n) | Percentage (%) |
|---|---|---|
| Hypertension | 22 | 45.9 |
| Diabetes Mellitus | 12 | 24.5 |
| Systemic Lupus Erythematosus | 4 | 8.2 |
| No Comorbidity | 11 | 22.4 |
| Total | 49 | 100 |

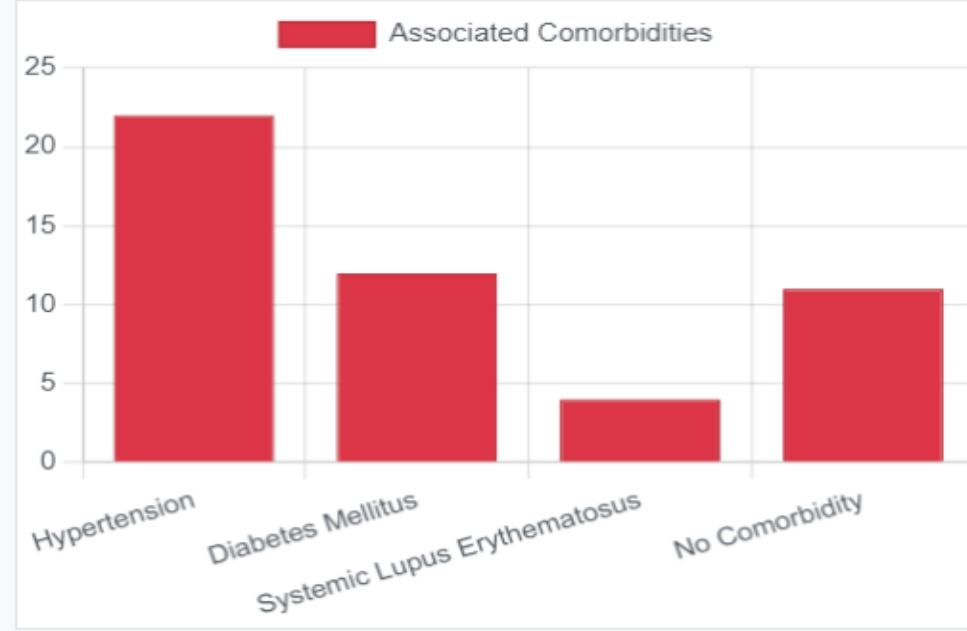


**Figure 10: Associated Comorbidities in Study Population with Primary MN**

## Discussion

Therefore, the present study attempts to elucidate the utility of anti-PLA2R antibodies for predicting outcomes in primary MN. Our data show a strong correlation between anti-PLA2R levels and several clinical parameters that may provide useful insights for the condition in its approaches to management and prognosis [13].

Age distribution was such that the majority of patients in the cohort belonged to the age group of 40-59 years, in further support of the already established epidemiological pattern that primary MN usually affects adults in this age group[14][15]. Male predominance in gender distribution was again keeping in line with previous literature, which suggested greater incidence of MN in males, indicating hormonal or genetic factors in the susceptibility and progression of the disease[16][17].

Our study on the baseline serum creatinine levels has revealed that almost one-third of patients had an elevated baseline creatinine, and therefore, they presented with significant renal impairment at the time of diagnosis [18]. Hence, this finding points toward the need for early detection and intervention to possibly attenuate chronic damage to the kidneys. Serum albumin was rather variable, in correspondence with the degree of nephrotic syndrome, a hallmark of MN. Low levels of serum albumin in some patients may be associated with the severity of proteinuria and might mean a worst stage of disease at the diagnosis time [19].The 24-hour urine protein levels ranged broadly, thus underlining the variability in disease severity among patients. Furthermore, this variability in proteinuria underlines the need for individual treatment strategies tailored according to patient profiles. The distribution of eGFR levels supported the idea that MN could result in significant renal impairment, with a significant proportion of patients showing reduced eGFR [20,21]. One of the most important findings from this study is that anti-PLA2R antibody levels are associated with spontaneous remission in patients on conservative therapy. The average spontaneous remission rate for those whose anti-PLA2R level was low was high compared to others, which showed that the anti-PLA2R antibody could be a prognostic factor for treatment prognosis [22]. This will provide an important clue for the direction in which treatment decision making should go, as well as what to tell patients in their expectations from any particular treatment. This large difference of remission rates between patients with low and high levels of anti-PLA2R holds a lot of prognostic potential.

Patients with low levels of anti-PLA2R antibodies had even higher remission rates than the group with high levels when these patients were on immunosuppressive therapy. This further establishes that anti-PLA2R antibodies could delineate the treatment response and, by extension, the type and level of immunosuppression. The association observed between anti-PLA2R levels and clinical outcomes emphasizes the need for antibody testing to be included as part of the routine practice management of primary MN [23]. The major clinical presentation of our cohort was nephrotic syndrome, similar to the classical presentation of idiopathic MN. The relatively small number of patients with AKI or CKD at presentation perhaps indicates early intervention to prevent the progression to a more severe form of renal impairment. We also found that the common comorbidity in patients with primary MN are hypertension, diabetes mellitus, and systemic

lupus erythematosus [24]. These are consistent with previous literature on comorbidities associated with MN and reiterate calls for more holistic management strategies concerning not only the primary disease itself but also its associated conditions [25].

In summary, our study is relevant to predict the implication of anti-PLA2R antibodies on primary membranous nephropathy clinical outcomes. The observed association between the anti-PLA2R levels and clinical parameters underlines the potential of these antibodies in possibly reclassifying guidelines for treatment regarding better patient management. Further research is needed in regard to more validation in larger cohorts and unraveling the mechanisms underlying the observed associations.

## Conclusion

In the research entitled "Predicting the Role of Serum Anti-Phospholipase A2 Receptor Antibody in the Outcome of Primary Membranous Nephropathy," we demonstrated that serum anti-PLA2R antibody levels were highly significantly associated with the clinical outcome in primary membranous nephropathy patients. It is suggested from our results that lower anti-PLA2R antibody levels might predict better outcomes, either spontaneously by conservative treatment or by remission in response to immunosuppressive treatment.

These results indicate that anti-PLA2R antibody level measurement has the potential to be a useful tool for designing treatment strategies and monitoring disease progression. Our study also showed variable severity of diseases, emphasizing that treatment in each case should be planned based on individual factors like serum creatinine, serum albumin, and urine protein levels. By introducing anti-PLA2R antibody testing into clinical practice, doctors can improve the management of primary membranous nephropathy and hence the outcome of patients with this disorder, by optimizing therapeutic strategies. Further studies should be conducted to confirm these results and to clarify which mechanisms underlie these associations.

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