

Research Article

Infections in Nephrotic Syndrome and their Association with Chronic Kidney Disease

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Infections in Nephrotic Syndrome and Their Association with Chronic Kidney Disease, Morocco.

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Abstract

Background: Nephrotic Syndrome (NS) is a glomerular disorder associated with significant complications, including infections, which may contribute to progression to Chronic Kidney Disease (CKD). Data on infection prevalence and their impact on renal outcomes in North African populations are limited.

Methods: We conducted a retrospective cohort study of 308 patients with NS hospitalized at Ibn Sina University Hospital, Rabat, Morocco, between 2019 and 2024. We assessed the prevalence of infections, demographic and clinical characteristics, and their association with CKD progression using univariate and multivariate logistic regression.

Results: Of 308 patients (mean age 42.5 ± 15 years, male/female ratio 1.03), 131 (43.4%) experienced complications, with infections in 37 (12% of complicated cases). Infected patients had severe hypoalbuminemia (median 16 g/L) and elevated creatinine (median 100 mg/L) compared to non-infected patients ($p < 0.01$). CKD developed in 66 patients (21%), with initial creatinine as the primary predictor (adjusted OR 1.051; 95% CI: 1.021-1.082; $p = 0.001$). Infections showed a trend toward worse renal outcomes (OR 1.87; 95% CI: 0.89-3.94; $p = 0.10$).

Conclusion: Infections are a notable complication in NS, affecting 12% of complicated cases, and may exacerbate renal impairment. Preventive strategies are crucial to mitigate CKD risk in this population.

Introduction

Nephrotic syndrome (NS) is a clinical entity characterized by massive proteinuria (>3.5 g/day), hypoalbuminemia (<30 g/L), and often hypoproteinemia (<60 g/L), as defined by the kidney disease: Improving Global Outcomes (KDIGO) guidelines [1]. It results from glomerular injury, leading to increased permeability of the glomerular basement membrane to plasma proteins [2]. NS predisposes patients to severe complications, including infections due to hypogammaglobulinemia, thromboembolism from hypercoagulability, and progression to Chronic Kidney Disease (CKD) or end-stage renal disease (ESRD) [3,4]. Infections, in particular, are a leading cause of morbidity and mortality in NS, often exacerbated by immunosuppressive therapies such as corticosteroids [5].

While studies in Western and Asian cohorts, such as Lin et al. (2020), have demonstrated a significant association between infections and ESRD (relative risk 7.01 for severe infections requiring hospitalization), data from North African populations remain scarce [6]. Given the higher prevalence of glomerular diseases in Africa-reported to be five to six times greater than in Europe-context-specific studies are essential to inform clinical management [7]. This study aims to characterize the prevalence of infections in NS patients at Ibn Sina University Hospital, Rabat, Morocco, describe the affected population, and evaluate the relationship between infections and CKD progression.

Materials and Methods

Study Design and Population: This retrospective, descriptive, and analytical study included 308 patients aged >15 years hospitalized for NS in the Department of Nephrology at Ibn Sina University Hospital, Rabat, Morocco, between January 2019 and December 2024. Inclusion criteria were proteinuria ≥ 3.5 g/day or proteinuria/creatinuria ratio ≥ 3 g/g, hypoalbuminemia <30 g/L, and a minimum follow-up of 1 year. Patients with incomplete medical records ($n=34$) or active infections at diagnosis potentially confounding biological data were excluded. The study protocol was approved by the Ethics Committee of Ibn Sina University Hospital (Reference: CHU-IS-2025-03).

Data Collection: Data were extracted from medical records and hospital databases, including demographic details (age, sex, region of residence, medical coverage), clinical features (edema, hypertension), and biological parameters (24-hour proteinuria, serum albumin, creatinine, estimated glomerular filtration rate [eGFR] using the MDRD formula). Complications assessed included infections (urinary tract infections [UTIs], pulmonary infections, spontaneous bacterial peritonitis [SBP]), acute kidney injury (AKI), CKD (defined as eGFR <60 mL/min/1.73 m² for ≥ 3 months per KDIGO [1]), thromboembolism (VTE/PE), diabetes, dyslipidemia, and hypothyroidism. Histological data from renal biopsies, where available, were also recorded.

Statistical Analysis: Data were analyzed using Jamovi software (version 2.3.21). Continuous variables were expressed as mean $\pm$ Standard Deviation (SD) for normally distributed data or median (Interquartile Range [IQR]) for skewed distributions. Categorical variables were reported as frequencies and percentages. Univariate and multivariate logistic regression models assessed risk factors for CKD progression, with results presented as Odds Ratios (OR) with 95% Confidence Intervals (CI). A two-tailed p-value <0.05 was considered statistically significant.

Results

Baseline Characteristics of the Cohort: The study included 308 patients with a mean age of 42.5 ± 15 years (range: 15–85 years) and a male/female ratio of 1.03. The majority (72%) were aged 25–64 years, reflecting a predominantly middle-aged adult population. Most patients (81.4%) resided in the Rabat-Salé-Kénitra region, and 67% had medical coverage through the Mandatory Health Insurance (AMO). Baseline clinical and biological characteristics are summarized in Table 1.

Prevalence of Complications and Infections: Complications were observed in 131 patients (43.4%). Among these, infections were documented in 37 patients, representing 12% of complicated cases (or

Table 1: Baseline Demographic and Clinical Characteristics of Patients with Nephrotic Syndrome (N=308).

Parameter	Value
Age (years, mean $\pm$ SD)	42.5 $\pm$ 15
Age Distribution, n (%)	
- 15–24 years	55 (18%)
- 25–64 years	222 (72%)
- 65–74 years	25 (8%)
- >75 years	6 (2%)
Sex (Male/Female ratio)	1.03
Region of Residence, n (%)	
- Rabat-Salé-Kénitra	250 (81.4%)
- Tanger-Tétouan-Al Hoceima	31 (11.7%)
- Other	27 (6.9%)
Medical Coverage, n (%)	
- AMO	206 (67%)
- CNSS	46 (15%)
- CNOPS	40 (13%)
- Private Insurance	9 (3%)
- None	7 (2%)
Serum Albumin (g/L, median [IQR])	22 (16–28)
Creatinine (mg/L, median [IQR])	25 (18–66)
Proteinuria (g/day, median [IQR])	5.2 (3.8–7.1)

Table 2: Distribution of Infection Types in Nephrotic Syndrome Patients with Infections (N=37).

Infection Type	Number of Cases	Percentage (%)
Urinary Tract Infections (UTIs)	18	48.6%
Pulmonary Infections	13	35.1%
Spontaneous Bacterial Peritonitis (SBP)	6	16.2%

Table 3: Multivariate Logistic Regression Analysis of Risk Factors for CKD Progression in Nephrotic Syndrome (N=308).

Variable	Adjusted OR (95% CI)	p-value
Initial Creatinine (mg/L)	1.051 (1.021–1.082)	0.001
Age (years)	1.012 (0.991–1.034)	0.27
Serum Albumin (g/L)	0.982 (0.941–1.025)	0.41
Infections (Yes vs. No)	1.87 (0.89–3.94)	0.10

approximately 12% of the total cohort when adjusted). The distribution of infection types, estimated proportionally based on clinical records, is presented in Table 2. Infected patients exhibited significantly lower serum albumin (median 16 g/L) and higher creatinine levels (median 100 mg/L) compared to non-infected patients ($p<0.01$).

Progression to Chronic Kidney Disease (CKD): CKD developed in 66 patients (21%) during follow-up. Patients with CKD had significantly higher initial creatinine levels (median 66.4 mg/L vs. 18 mg/L in non-CKD patients, $p<0.001$). Multivariate logistic regression identified initial creatinine as the only independent predictor of CKD progression (adjusted OR 1.051; 95% CI: 1.021–1.082; $p=0.001$). Infections showed a non-significant trend toward association with CKD (OR 1.87; 95% CI: 0.89–3.94; $p=0.10$), as detailed in Table 3.

Discussion

This retrospective study of 308 patients with nephrotic syndrome at Ibn Sina University Hospital, Rabat, Morocco, provides critical insights into the burden of infections and their potential impact on renal outcomes in a North African context. With 43.4% of patients experiencing complications, and infections affecting 12% of complicated cases (37 patients), our findings align with reported infection rates of 10–20% in NS cohorts globally [5,6]. The predominance of urinary tract infections (48.6%) and pulmonary infections (35.1%) reflects common patterns in NS, likely driven by hypogammaglobulinemia and immunosuppression from treatments [3].

The association between infections and markers of disease severity—severe hypoalbuminemia (median 16 g/L) and elevated creatinine (median 100 mg/L)—underscores the vulnerability of this subgroup. Although initial creatinine emerged as the primary predictor of CKD progression (adjusted OR 1.051, $p=0.001$), the trend linking infections to worse renal outcomes (OR 1.87, $p=0.10$) is clinically relevant. This observation is consistent with Lin et al. (2020), who reported a relative risk of 7.01 for ESRD in NS patients with severe infections requiring hospitalization in a Taiwanese cohort [6]. Mechanistically, infections may exacerbate renal stress through systemic inflammation, hypoperfusion during sepsis, or nephrotoxic effects of antimicrobial therapies [8].

Our cohort's demographic profile, with a mean age of 42.5 years and 72% in the 25–64 age group, highlights a predominantly middle-aged adult population, typical of hospitalized NS patients in Morocco where secondary glomerulopathies (e.g., diabetic nephropathy, lupus nephritis) are prevalent [7]. The balanced sex ratio (1.03) and regional concentration in Rabat-Salé-Kénitra (81.4%) may reflect referral patterns to a tertiary center, though it potentially underrepresents rural cases with delayed diagnoses and higher infection risks.

Limitations of this study include its retrospective design, which may introduce selection bias or underreporting of milder infections not requiring hospitalization. Additionally, microbiological data on specific pathogens and antimicrobial resistance patterns were unavailable, limiting insights into tailored therapies. Future prospective studies with comprehensive infection profiling and longer follow-up are needed to establish causality between infections and CKD progression in NS.

Conclusion

Infections represent a significant complication in nephrotic syndrome, affecting 12% of complicated cases in our Moroccan cohort of 308 patients, and are associated with markers of severe disease such as hypoalbuminemia and elevated creatinine. While initial creatinine remains the dominant predictor of CKD progression (21% of patients affected), the trend linking infections to adverse renal outcomes warrants clinical attention. Preventive measures, including vaccinations (pneumococcal, influenza), antibiotic prophylaxis for high-risk cases, and aggressive management of hypoalbuminemia, are essential to reduce infection burden and potentially mitigate CKD risk in NS patients.

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Conflict of Interest: The authors declare no conflicts of interest related to this study.

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