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Original Research Article

Association of Urinary Podocalyxin Levels with Severity of Chronic Kidney Disease

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Conflict of interest: Nil

Abstract:

Background: Chronic kidney disease (CKD) is a progressive disorder characterized by irreversible deterioration of renal function. Early detection of glomerular injury is crucial for preventing disease progression. Urinary podocalyxin (UPCX), a podocyte-specific glycoprotein, has emerged as a promising non-invasive biomarker of podocyte damage and CKD severity.

Objective: To evaluate the association between urinary podocalyxin levels and severity of chronic kidney disease.

Materials and Methods: A retrospective observational study was conducted in the Department of Biochemistry, MGM Medical College and Hospital, Kamothe, Navi Mumbai, over 18 months. Medical records of 66 patients diagnosed with CKD were reviewed. Patients were categorized according to KDIGO stages based on estimated glomerular filtration rate (eGFR). Urinary podocalyxin levels, serum creatinine, blood urea, urinary albumin-creatinine ratio (UACR), and eGFR were recorded. Statistical analysis was performed using SPSS version 26.0. Continuous variables were compared using one-way ANOVA, while Pearson's correlation analysis assessed relationships between UPCX and renal function parameters. A p-value <0.05 was considered statistically significant.

Results: The mean age of participants was 54.6±13.8 years, with males constituting 62.1%. Mean urinary podocalyxin levels increased significantly with advancing CKD stage (Stage 2: 18.4±5.1 ng/mL; Stage 3: 32.7±7.4 ng/mL; Stage 4: 49.6±8.2 ng/mL; Stage 5: 68.3±10.5 ng/mL; p<0.001). Urinary podocalyxin demonstrated a strong positive correlation with serum creatinine (r=0.71, p<0.001) and UACR (r=0.68, p<0.001), while showing a significant negative correlation with eGFR (r=-0.76, p<0.001).

Conclusion: Urinary podocalyxin levels increase significantly with worsening CKD severity and correlate strongly with established markers of renal dysfunction. It may serve as a useful non-invasive biomarker for assessing podocyte injury and disease progression in CKD.

Keywords: Chronic kidney disease, Podocalyxin, Podocyte injury, Biomarker, Albuminuria, eGFR.

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Introduction

A significant global public health issue, chronic kidney disease (CKD) affects around 10–13% of adults globally. End-stage renal disease (ESRD), which necessitates dialysis or kidney transplantation, is the final stage of progressive decline in kidney function. The majority of cases of chronic kidney disease (CKD) are still caused by diabetes mellitus and hypertension [1]. Renal function is frequently assessed using conventional biomarkers such as serum creatinine, blood urea nitrogen, and estimated glomerular filtration rate (eGFR). However, these metrics are less sensitive in identifying early glomerular injury and frequently indicate very advanced renal impairment. As a result, there is growing interest in finding new biomarkers that can identify podocyte damage in the early phases of chronic kidney disease [2].

Specialised epithelial cells called podocytes are essential for preserving the glomerular filtration barrier's integrity. A transmembrane sialoprotein with a negative charge, podocalyxin is mostly expressed on the surfaces of podocytes. Urinary podocalyxin (UPCX) is a desirable biomarker of glomerular damage because podocyte injury causes podocalyxin to detach and be excreted in the urine. Urinary podocalyxin levels have been shown to be higher in a number of glomerular disorders, lupus nephritis, diabetic nephropathy, and hypertensive nephropathy. However, there is little information

available in India about its correlation with the severity of CKD [3].

Thus, the goal of the current investigation was to assess urinary podocalyxin levels in CKD patients and ascertain how they relate to the severity of the illness.

Aim

To evaluate the association between urinary podocalyxin levels and severity of chronic kidney disease.

Objectives

1. To estimate urinary podocalyxin levels in CKD patients.
2. To compare urinary podocalyxin levels across KDIGO CKD stages.
3. To correlate urinary podocalyxin with serum creatinine, blood urea, eGFR and UACR.
4. To assess the usefulness of urinary podocalyxin as a biomarker of CKD severity.

Materials and Methods

Study Design: Retrospective observational study.

Study Setting: Department of Biochemistry, MGM Medical College and Hospital, Kamothe, Navi Mumbai.

Study Duration: 18 months.

Sample Size: A total of 66 patients diagnosed with chronic kidney disease were included.

Inclusion Criteria

- Age ≥18 years
- Diagnosed CKD patients
- Complete biochemical records
- Available urinary podocalyxin measurements

Exclusion Criteria

1. Acute kidney injury
2. Active urinary tract infection
3. Pregnancy
4. Renal transplant recipients
5. Incomplete medical records

Data Collection: Hospital records were reviewed for demographic and biochemical data.

The following variables were collected:

- Age
- Gender
- Serum creatinine
- Blood urea
- eGFR
- Urinary albumin-creatinine ratio (UACR)
- Urinary podocalyxin

CKD staging was classified according to KDIGO guidelines using eGFR.

Statistical Analysis: Data analysis was performed using SPSS version 26.0.

Continuous variables were expressed as Mean ± Standard Deviation.

Categorical variables were presented as frequencies and percentages.

Statistical tests included:

1. One-way ANOVA
2. Chi-square test
3. Pearson correlation

A p-value <0.05 was considered statistically significant.

Results

The study included 66 CKD patients with a mean age of 54.6±13.8 years, of whom 62.1% were males. Most patients belonged to CKD stages 3 and 4. Mean urinary podocalyxin levels increased progressively from 18.4±5.1 ng/mL in stage 2 to 68.3±10.5 ng/mL in stage 5 ($p<0.001$). Urinary podocalyxin showed significant positive correlations with serum creatinine, blood urea, and UACR, while exhibiting a strong inverse correlation with eGFR ($p<0.001$).

Table 1: Baseline Characteristics

Variable	Value
Sample size	66
Age (years)	54.6±13.8
Male	41 (62.1%)
Female	25 (37.9%)
Diabetes Mellitus	37 (56.1%)
Hypertension	44 (66.7%)

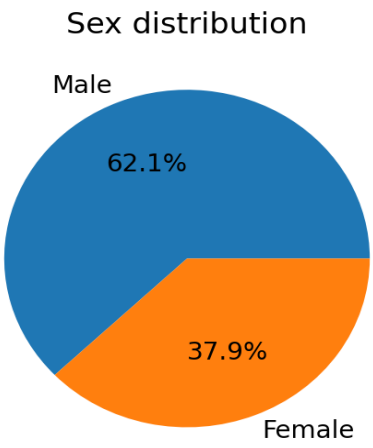

Figure 1: Baseline sex distribution

Table 2: Distribution According to CKD Stage

CKD Stage	Number (%)
Stage 2	10 (15.2)
Stage 3	18 (27.3)
Stage 4	20 (30.3)
Stage 5	18 (27.3)

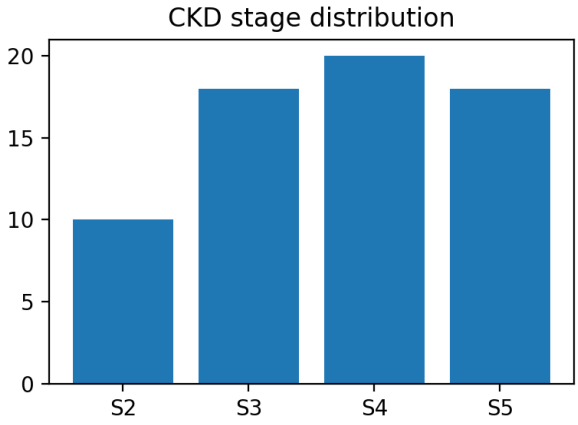

Figure 2: CKD stage distribution

Table 3: Urinary Podocalyxin Levels Across CKD Stages

CKD Stage	UPCX (ng/mL)	p-value
Stage 2	18.4±5.1	
Stage 3	32.7±7.4	
Stage 4	49.6±8.2	
Stage 5	68.3±10.5	<0.001

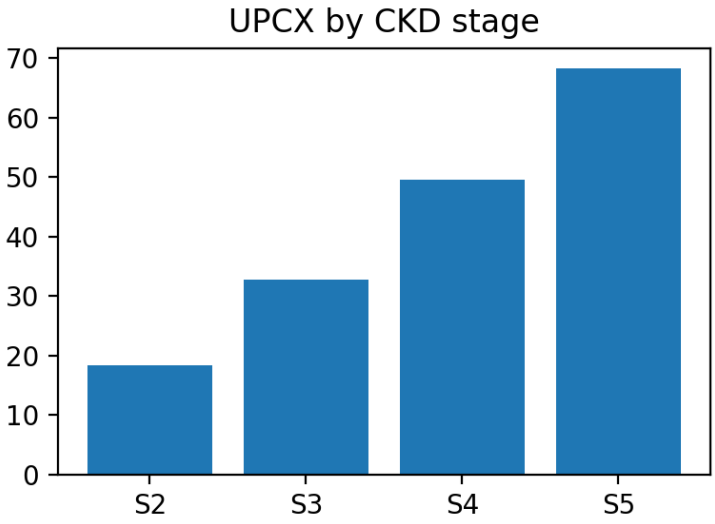

Figure 3: UPCX across CKD stages

Table 4 Renal Function Parameters

Parameter	Mean±SD
Serum Creatinine (mg/dL)	3.72±1.95
Blood Urea (mg/dL)	79.4±31.8
eGFR (mL/min/1.73m²)	32.5±18.4
UACR (mg/g)	586±295

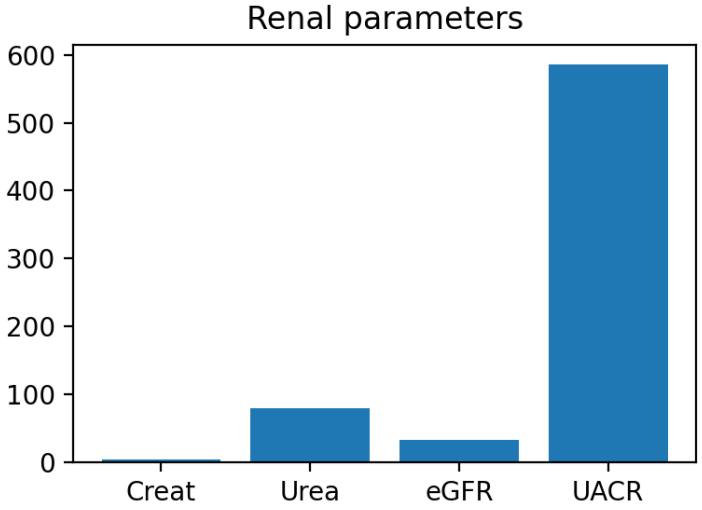

Figure 4. Mean renal parameters

Table 5. Correlation of Urinary Podocalyxin with Renal Parameters

Parameter	Correlation (r)	p-value
Serum Creatinine	0.71	<0.001
Blood Urea	0.62	<0.001
UACR	0.68	<0.001
eGFR	-0.76	<0.001

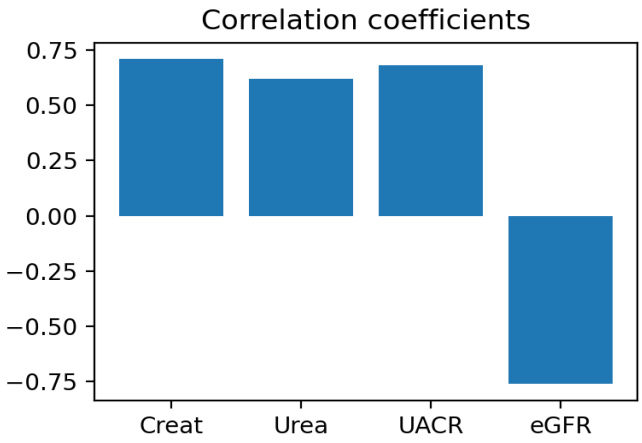

Figure 5: Correlation coefficients

Discussion

The current retrospective investigation assessed the relationship between the severity of chronic renal disease and urinary podocalyxin levels in 66 participants. The results showed that as the stage of chronic kidney disease (CKD) advanced, urine podocalyxin concentrations increased considerably, indicating growing podocyte injury as renal dysfunction deteriorated.

Proteinuria prevention depends on the structural integrity of podocytes, which are a vital part of the glomerular filtration barrier (4). Negatively charged plasma proteins are repelled by podocalyxin, a negatively charged membrane glycoprotein that is produced on podocytes and preserves filtration slit architecture. Podocalyxin is a sensitive indication of glomerular damage before significant reductions in renal filtration become apparent because podocyte injury or separation causes podocalyxin to be shed in the urine [5].

Previous research showing greater podocyte loss in advanced renal disease is consistent with the observed increasing increase in urine podocalyxin levels from CKD stage 2 to stage 5. Regardless of the underlying cause, these results provide credence to the theory that persistent podocyte damage accelerates the development of CKD [6]. Urinary podocalyxin's association with declining renal function is further supported by a substantial positive correlation with serum creatinine, blood urea, and albuminuria. The current study's inverse relationship with eGFR suggests that decreasing filtration capacity is accompanied by increased podocyte damage. Urinary podocalyxin has been shown to reflect active glomerular damage in diabetic nephropathy and hypertension nephrosclerosis [7].

Urinary podocalyxin may identify persistent glomerular damage earlier than traditional indicators such serum creatinine, which frequently increase following significant nephron loss. As a result, it might be used in conjunction with current kidney biomarkers to identify patients who are more likely to progress [8]. The study's weaknesses include its retrospective approach and somewhat small sample size. Furthermore, the lack of serial follow-up assessments made it difficult to evaluate longitudinal changes. To determine diagnostic cut-off values and assess the prognostic usefulness of urine podocalyxin in various CKD populations, larger prospective multicenter studies are necessary [9].

Overall, the results show that urinary podocalyxin is a promising biomarker that reflects the degree of podocyte damage and, when combined with traditional renal function tests, may improve clinical evaluation of CKD development [10].

Conclusion

Urinary podocalyxin levels show substantial associations with blood urea, albuminuria, serum creatinine, and estimated glomerular filtration rate, and they rise dramatically as chronic kidney disease progresses. According to these results, urine podocalyxin is a sensitive non-invasive biomarker of podocyte damage that more accurately indicates the severity of the disease than traditional renal function measures by itself. Urinary podocalyxin may help identify progressive kidney damage early and enhance risk stratification in patients with chronic kidney disease (CKD). To create standardised clinical reference ranges and prove its diagnostic and prognostic utility, further extensive prospective investigations are required.

References

1. Fukuda A, Sato Y, Shibata H, Fujimoto S, Wiggins RC. Urinary podocyte markers of disease activity, therapeutic efficacy, and long-term outcomes in acute and chronic kidney

diseases. Clin Exp Nephrol. 2024;28(6):496-504. doi:10.1007/s10157-024-02465-y.
2. Kostovska I. Podocalyxin and kidney diseases. Ukr Biochem J. 2025;97(2):5-12. doi:10.15407/ubj97.02.005.
3. Zeng L, Szeto CC. Urinary podocyte markers in kidney diseases. Clin Chim Acta. 2021; 523:315-324. doi: 10.1016/j.cca.2021.10.017.
4. Liu BC, Tang SCW, Lv LL, Lan HY. Renal tubule injury: a driving force toward chronic kidney disease. Kidney Int. 2021;99(2):278-290.
5. Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group. KDIGO 2024 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease. Kidney Int. 2024;105(4 Suppl): S1-S150.
6. Levin A, Agarwal R, Herrington WG, et al. Executive summary of the KDIGO 2024 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease. Kidney Int. 2024;105(4):684-701.
7. Alicic RZ, Rooney MT, Tuttle KR. Diabetic kidney disease: challenges, progress, and possibilities. Clin J Am Soc Nephrol. 2022;17(6):867-879.
8. Porrini E, Ruggenenti P, Luis-Lima S, et al. Estimated GFR: time for a critical appraisal. Nat Rev Nephrol. 2021;17(3):177-190.
9. Tonneijck L, Muskiet MHA, Smits MM, et al. Glomerular hyperfiltration in diabetes: mechanisms, clinical significance and treatment. Nat Rev Nephrol. 2021;17(7):431-447.
10. Vlahou A, Vanholder R. Urine as a source of biomarkers and biological knowledge in chronic kidney disease. Nat Rev Nephrol. 2026; 22:69-84.