

Analysis of Changes in PINK1 in Patients with Diabetic Nephropathy and Its Relationship with Serum Factors and Clinical Indexes

Dongmei Xu*, Zhihong Zeng, Beibei Wang, Dongyuan Tang, Jiexi Hu

Department of Endocrinology, Longquan People's Hospital, Longquan 323700, Zhejiang, China.

How to cite this paper: Dongmei Xu, Zhihong Zeng, Beibei Wang, Dongyuan Tang, Jiexi Hu. (2026) Analysis of Changes in PINK1 in Patients with Diabetic Nephropathy and Its Relationship with Serum Factors and Clinical Indexes. *International Journal of Clinical and Experimental Medicine Research*, 10(2), 91-95.

DOI: 10.26855/ijcemr.2026.03.005

Received: January 10, 2026

Accepted: February 6, 2026

Published: March 3, 2026

***Corresponding author:** Dongmei Xu, Department of Endocrinology, Longquan People's Hospital, Longquan 323700, Zhejiang, China.

Abstract

Objective: To investigate the changes in the protein kinase PINK1 in patients with diabetic nephropathy (DN) and to analyze its relationship with serum factors and clinical indicators. **Methods:** A total of 90 patients with DN treated between November 2023 and February 2025 were enrolled and randomly divided into three groups according to different treatment regimens, with 30 patients in each group. Patients receiving telmisartan alone were assigned to control group 1; those treated with metformin hydrochloride alone were assigned to control group 2; and patients in the observation group received combined treatment with metformin hydrochloride and telmisartan. Levels of PINK1, reactive oxygen species (ROS), renal function, and serum factors were compared among the three groups. Pearson correlation analysis was used to evaluate the relationships between PINK1 levels, serum creatinine, UACR, and serum factors in DN patients. **Results:** After intervention, levels of ROS, serum creatinine, UACR, interleukin-6 (IL-6), and tumor necrosis factor- α (TNF- α) were decreased, while PINK1 and interleukin-2 (IL-2) levels were increased in all three groups. The observation group showed significantly higher PINK1 mRNA and IL-2 levels compared with control group 1 and control group 2 ($P < 0.05$), while levels of ROS, IL-6, and TNF- α were significantly lower ($P < 0.05$). Pearson correlation analysis demonstrated that PINK1 levels were positively correlated with IL-2 ($P < 0.05$) and negatively correlated with IL-6 and TNF- α ($P < 0.05$). **Conclusion:** Combined treatment with metformin hydrochloride and telmisartan in DN patients can increase PINK1 and IL-2 levels and reduce ROS, serum creatinine, UACR, IL-6, and TNF- α levels. PINK1 is significantly correlated with serum factors and clinical indicators, which may provide guidance for clinical diagnosis and treatment.

Keywords

PINK1; diabetic nephropathy; correlation analysis; metformin hydrochloride; telmisartan

Diabetic nephropathy (DN) is a highly prevalent microvascular complication of diabetes mellitus and represents the leading cause of end-stage renal disease (ESRD) [1]. Guo Kelei et al. [2] reported that approximately 30%-40% of patients with diabetes develop DN, and about 30.0% of these patients progress to ESRD within 10 years after diagnosis, requiring dialysis or kidney transplantation to sustain life. Although current therapeutic strategies can delay disease progression, a large proportion of patients continue to experience progressive deterioration of renal function. Therefore, exploring the pathogenic mechanisms of DN and identifying novel therapeutic targets have become major research priorities. Previous studies [3] have shown that hyperglycemia-induced mitochondrial dysfunction is a central mechanism in the progression of DN. Under DN conditions, renal cells require large amounts of ATP to counteract

glucotoxicity, leading to prolonged mitochondrial overload, abnormal mitochondrial morphology, functional impairment, and defects in autophagic clearance. PINK1, a protein kinase expressed in various tissues—particularly in energy-demanding organs such as the brain and muscles—is primarily localized to the outer mitochondrial membrane. Although its precise biological functions have not been fully elucidated, it is hypothesized that PINK1 plays a protective role in maintaining mitochondrial integrity under conditions of cellular stress and excessive energy demand. Given the critical role of mitochondria in diabetic nephropathy, further investigation into the expression and clinical significance of PINK1 is warranted [4]. This study aimed to explore changes in PINK1 expression in patients with diabetic nephropathy and its relationship with serum factors, and the findings are reported as follows.

1. Materials and Methods

1.1 General Information

A total of 90 patients with diabetic nephropathy (DN) treated at our hospital between November 2023 and February 2025 were randomly divided into three groups according to different treatment regimens. There were no statistically significant differences in baseline characteristics among the three groups ($P > 0.05$), as shown in Table 1.

Table 1. Comparison of baseline characteristics among the three groups

Group	n	Sex (M/F)	BMI (kg/m ²)	Age (years)	Duration of diabetes (years)	DN stage (I–II / III–IV)	History of smoking and alcohol consumption (Yes/No)
Observation group	30	18/12	22.25±2.51	59.78±5.61	9.84±0.95	7/23	13/17
Control group 1	30	21/9	22.29±2.56	60.69±5.69	9.88±0.99	9/21	10/20
Control group 2	30	19/11	22.27±0.53	58.52±5.54	9.81±0.91	10/20	14/16
χ^2/F	/	0.679	0.003	1.130	0.041	0.757	1.193
P value	/	0.712	0.997	0.328	0.960	0.685	0.551

1.2 Inclusion and Exclusion Criteria

1.2.1 Inclusion criteria

- (1) Patients meeting the diagnostic criteria for type 2 diabetes mellitus according to the *Guidelines for the Integrated Traditional Chinese and Western Medicine Diagnosis and Treatment of Type 2 Diabetes* [5];
- (2) Age between 25 and 70 years, with a diabetes duration of ≥ 5 years;
- (3) Diagnosis of diabetic nephropathy in accordance with the *Chinese Consensus on Clinical Management of Diabetes Mellitus Complicated with Chronic Kidney Disease* [6], with DN stages I–IV.

1.2.2 Exclusion criteria

- (1) Patients with severe diseases within the previous 6 months, such as cerebrovascular accidents or myocardial infarction;
- (2) Use of metformin, angiotensin II receptor blockers (ARB), or angiotensin-converting enzyme inhibitors (ACEI) within 1 month prior to enrollment;
- (3) Patients with stage V diabetic nephropathy or a history of primary or secondary renal diseases;
- (4) Patients complicated with urinary tract infections, autoimmune diseases, or malignant tumors.

1.3 Methods

1.3.1 Treatment protocols

1.3.1.1 Control group 1

Patients were treated with telmisartan. Telmisartan tablets (Beijing Fu Yuan Pharmaceutical Co., Ltd.; National Drug Approval No. H20050996; specification: 40 mg) were administered at a dose of 80 mg once daily, taken orally with water before or after meals. For patients whose blood pressure was inadequately controlled with telmisartan 80 mg, telmisartan/hydrochlorothiazide tablets (Heilongjiang Furutang Pharmaceutical Co., Ltd.; National Drug Approval No. H201101157; each tablet containing telmisartan 40 mg and hydrochlorothiazide 12.5 mg) were administered at

a dose of 80/12.5 mg once daily. Renal function was closely monitored during treatment. For patients with mild to moderate hepatic impairment, the dose did not exceed 40/12.5 mg once daily.

1.3.1.2 Control group 2

Patients received metformin hydrochloride therapy. Treatment was initiated at a low dose and gradually increased according to the patient's condition. The initial dose was metformin hydrochloride (Shanghai Xinyi Tianping Pharmaceutical Co., Ltd.; National Drug Approval No. H31020246; specification: 0.25 g) at 0.5 g twice daily, or 0.85 g once daily taken with meals. The dose could be increased by 0.85 g every two weeks or by 0.5 g per treatment cycle, gradually reaching a total daily dose of 2.0 g in divided doses. The maximum recommended daily dose for adults is 2550 mg. For patients requiring strict glycemic control, 0.85 g could be administered three times daily. To improve tolerability, doses ≥ 2.0 g/day were recommended to be taken in divided doses with meals.

1.3.1.3 Observation group

Patients received combined treatment with metformin hydrochloride and telmisartan. The dosage and treatment duration were the same as those used in control group 1 and control group 2. Treatment efficacy was evaluated after 3 months of therapy in all three groups.

1.3.2 Detection methods

Before and after intervention, PINK1 levels were measured using a PINK1 detection kit. Reactive oxygen species (ROS) levels were determined using biochemical assay kits. Levels of interleukin-2 (IL-2), interleukin-6 (IL-6), and tumor necrosis factor- α (TNF- α) were measured by chemiluminescence methods. Urinary albumin and serum creatinine were measured by a fully automatic biochemical analyzer; calculate the urinary albumin/creatinine ratio (UACR) and the estimated glomerular filtration rate (eGFR) [8].

1.4 Statistical Analysis

Statistical analyses were performed using SPSS version 28.0. Categorical variables, including sex, DN stage, and history of smoking and alcohol consumption, were analyzed using the χ^2 test and expressed as n (%). Continuous variables, including age, body mass index, PINK1, ROS, and inflammatory factors, were normally distributed and analyzed using the t-test, and are expressed as mean \pm standard deviation. Pearson correlation analysis was used to evaluate the relationships between PINK1 levels and serum factors, as well as clinical indicators in DN patients. A P value < 0.05 was considered statistically significant.

2. Results

2.1 Comparison of PINK1, ROS, and Serum Factors among the Three Groups

After intervention, levels of reactive oxygen species (ROS), interleukin-6 (IL-6), and tumor necrosis factor- α (TNF- α) were significantly decreased, while PINK1 and interleukin-2 (IL-2) levels were increased in all three groups. The observation group showed significantly higher PINK1 mRNA and IL-2 levels than control group 1 and control group 2 ($P < 0.05$), while ROS, IL-6, and TNF- α levels were significantly lower ($P < 0.05$). In addition, PINK1 mRNA and IL-2 levels in control group 1 were significantly higher than those in control group 2 ($P < 0.05$), whereas ROS, IL-6, and TNF- α levels were significantly lower than those in control group 2 ($P < 0.05$). The results are shown in Table 2.

Table 2. Comparison of PINK1, ROS, and Serum Factors among the Three Groups (mean \pm SD)

Group	n	PINK1 mRNA		ROS (U/L)		IL-2 (ng/L)	
		Before	After	Before	After	Before	After
Observation group	30	0.78 \pm 0.26	1.63 \pm 0.13 ^{#*Δ}	345.19 \pm 43.61	252.58 \pm 16.72 ^{#*} Δ	6.54 \pm 1.41	9.78 \pm 2.31 ^{#*Δ}
Control group 1	30	0.82 \pm 0.29	1.34 \pm 0.18 ^{#*}	347.64 \pm 44.83	276.73 \pm 19.65 ^{#*}	6.59 \pm 1.46	9.31 \pm 1.97 ^{#*}
Control group 2	30	0.80 \pm 0.28	1.12 \pm 0.22 [#]	343.65 \pm 42.98	297.39 \pm 23.63 [#]	6.51 \pm 1.38	8.89 \pm 1.62
t	/	0.156	60.276	0.063	36.983	0.024	152.832
P value	/	0.855	0.000	0.939	0.000	0.976	0.000

Notes: Compared with baseline within the same group, [#] $P < 0.05$; compared with control group 2, ^{*} $P < 0.05$; compared with control group 1, Δ $P < 0.05$.

Table 2 Continued

Group	n	IL-6 (pg/mL)		TNF- α (ng/L)	
		Before	After	Before	After
Observation group	30	8.43 \pm 2.31	5.72 \pm 1.05 ^{#*Δ}	10.16 \pm 5.64	6.41 \pm 2.53 ^{#*Δ}
Control group 1	30	8.55 \pm 2.36	6.13 \pm 1.24 ^{#*}	10.19 \pm 5.61	7.39 \pm 3.71 ^{#*}
Control group 2	30	8.07 \pm 2.34	7.26 \pm 1.75 [#]	9.98 \pm 5.58	7.67 \pm 4.06 [#]
t	/	0.002	50.126	0.003	258.651
P value	/	0.998	0.000	0.997	0.000

Notes: Compared with baseline within the same group, [#]P < 0.05; compared with control group 2, ^{*}P < 0.05; compared with control group 1, Δ P < 0.05.

2.2 Comparison of Renal Function Among the Three Groups

The renal function of the three groups was improved after intervention; the serum creatinine and UACR in the observation group were lower than those in control group 1 and control group 2 (P < 0.05); the eGFR was higher than that in control group 1 and control group 2 (P < 0.05); the serum creatinine and UACR in control group 1 were lower than those in control group 2 (P < 0.05); the eGFR was higher than that in control group 2 (P < 0.05). The results are presented in Table 3.

Table 3. Comparison of renal function among the three groups

Group	Number of cases	Serum creatinine (μ mol/L)		UACR (mg/g)		eGFR (mL/(min \cdot 173m ²))	
		Before intervention	After the intervention	Before intervention	After the intervention	Before intervention	After the intervention
observation group	30	137.56 \pm 19.62	118.41 \pm 10.62 ^{#*Δ}	310.61 \pm 2.16	235.12 \pm 1.21 ^{#*Δ}	50.45 \pm 4.59	60.71 \pm 6.42 ^{#*Δ}
Control Group 1	30	139.41 \pm 20.31	124.51 \pm 12.41 ^{#*}	297.65 \pm 2.19	248.8 \pm 1.45 ^{#*}	49.18 \pm 4.45	57.64 \pm 5.71 ^{#*}
Control Group 2	30	136.72 \pm 19.43	129.87 \pm 13.53 [#]	304.58 \pm 2.14	273 \pm 1.64 [#]	51.32 \pm 4.48	54.93 \pm 4.86 [#]
t	/	0.145	6.578	0.008	34.503	0.027	3.309
P	/	0.865	0.000	0.992	0.000	0.973	0.041

Notes: Compared with baseline within the same group, [#]P < 0.05; compared with control group 2, ^{*}P < 0.05; compared with control group 1, Δ P < 0.05.

2.3 Relationship between PINK1 and Serum Factors in DN Patients

Pearson correlation analysis showed that PINK1 levels in patients with diabetic nephropathy were positively correlated with IL-2 (P < 0.05) and negatively correlated with ROS, IL-6, and TNF- α (P < 0.05). The results are presented in Table 4.

Table 4. Correlation between PINK1 and Serum Factors in DN Patients (r, P)

Correlation	ROS	IL-2	IL-6	TNF- α
r	-0.436	0.504	-0.452	-0.353
P value	0.028	0.019	0.025	0.031

3. Discussion

The progression of diabetic nephropathy (DN) is closely associated with hyperglycemia-induced mitochondrial dysfunction. As a key regulatory protein, PINK1 plays an important role in mitochondrial autophagy. Clinically, changes in PINK1 expression can be used to analyze and identify the central role of mitochondrial autophagy in the pathogenesis of DN [7]. In the present study, levels of ROS, IL-6, and TNF- α were reduced, while PINK1 and IL-2 levels were increased after intervention in all three groups. Compared with the other two groups, the observation group

showed significantly higher PINK1 mRNA and IL-2 levels ($P < 0.05$), as well as significantly lower ROS, IL-6, and TNF- α levels ($P < 0.05$). These findings indicate that effective therapeutic intervention in DN patients can increase PINK1 expression, attenuate inflammatory responses, and provide a basis for evaluating treatment prognosis.

The underlying mechanisms may be explained as follows. Metformin, as a commonly used antidiabetic drug, can be administered either alone or in combination with other agents. In patients with type 2 diabetes mellitus—particularly those with hyperinsulinemia or obesity—metformin effectively lowers blood glucose levels when dietary control alone is insufficient, reduces the adverse effects of hyperinsulinemia, and contributes to weight reduction. Telmisartan, a highly selective angiotensin II receptor blocker, is associated with relatively few adverse effects and is considered a first-line agent for the treatment of DN. Clinical evidence indicates that telmisartan provides effective blood pressure control and exerts renoprotective effects, thereby improving renal function in DN patients [8].

In this study, Pearson correlation analysis demonstrated that PINK1 levels in DN patients were positively correlated with IL-2 ($P < 0.05$) and negatively correlated with ROS, serum creatinine, UACR, IL-6, and TNF- α ($P < 0.05$). These results suggest that PINK1 levels increase markedly after treatment and are closely associated with oxidative stress and inflammatory serum factors. Therefore, enhanced monitoring of PINK1 expression may assist in guiding clinical diagnosis and treatment and in predicting patient prognosis.

In summary, combined treatment with metformin hydrochloride and telmisartan in patients with diabetic nephropathy contributes to increased levels of PINK1 and IL-2 and decreased levels of ROS, IL-6, and TNF- α , improves renal function level, with significant correlations observed between PINK1 and serum factors. The PINK1–ROS–eGFR signaling pathway plays an important role in the occurrence and progression of diabetic nephropathy, and PINK1 may serve as a potential biomarker for the diagnosis and staging of diabetic nephropathy.

Funding

This paper is supported by the Lishui Municipal Science and Technology Program (Project No.: 2023SJZC083).

References

- [1] Wei R, Peng L, Liang F, et al. Expression of PINK1/Parkin mRNA and its diagnostic value in patients with diabetic nephropathy complicated by upper urinary tract infection. *Chin J Nosocomiol.* 2023;33(20):3061-3065.
- [2] Guo K, Li Y, Xuan C, et al. Yiqi Yangyin Huazhuo Tongluo formula alleviates podocyte injury in diabetic nephropathy mice by regulating miR-21a-5p/FoxO1/PINK1-mediated mitophagy. *J South Med Univ.* 2025;45(1):27-34.
- [3] Liu C, Zhang J, Wang S, et al. Research progress on the protective effects of astragaloside IV on diabetic nephropathy based on podocyte protection. *Chin Med Inf.* 2024;41(7):61-67.
- [4] Tong X, Jia W, Wang X, et al. Guidelines for the integrated traditional Chinese and western medicine diagnosis and treatment of type 2 diabetes mellitus. *Jilin J Tradit Chin Med.* 2024;44(10):1117-1127.
- [5] Chinese Society of Endocrinology, Chinese Alliance for Specialized Treatment of Endocrine and Metabolic Diseases. Chinese consensus on the clinical management of diabetes mellitus complicated with chronic kidney disease. *Chin J Endocrinol Metab.* 2024;40(6):455-461.
- [6] Sun L, Li L. “Renal triad”: treatment strategies for type 2 diabetes mellitus complicated with chronic kidney disease. *Chin Med J.* 2025;105(12):867-871.
- [7] Zhang L, Wang G, Qiu Y, et al. Clinical observation of modified Qingxin Lianzi decoction in the treatment of diabetic nephropathy stage III–IV with qi and yin deficiency syndrome. *Chin J Integr Tradit West Nephrol.* 2024;25(9):778-782.
- [8] Wang H, Han M, Dong S, et al. A systematic review and meta-analysis of randomized controlled trials on the treatment of diabetic nephropathy with the chinese patent medicine shenshuaining. *Chin J Integr Tradit West Nephrol.* 2023;24(3):238-245.