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ABOUT COVER

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Prospective Study

Risk factors for cognitive impairment in patients with chronic kidney disease

Xiao-Hui Wang, Yong He, Huan Zhou, Ting Xiao, Ran Du, Xin Zhang

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Abstract

BACKGROUND

Chronic kidney disease (CKD) patients have been found to be at risk of concurrent cognitive dysfunction in previous studies, which has now become an important public health issue of widespread concern.

AIM

To investigate the risk factors for concurrent cognitive dysfunction in patients with CKD.

METHODS

This is a prospective cohort study conducted among patients with CKD between October 2021 and March 2023. A questionnaire was formulated by literature review and expert consultation and included questions about age, sex, education level, per capita monthly household income, marital status, living condition, payment method, and hypertension.

RESULTS

Logistic regression analysis showed that patients aged 60-79 years [odds ratio (OR) = 1.561, $P = 0.015$] and ≥ 80 years (OR = 1.760, $P = 0.013$), participants with middle to high school education (OR = 0.820, $P = 0.027$), divorced or widowed individuals (OR = 1.37, $P = 0.032$), self-funded patients (OR = 2.368, $P = 0.008$), and patients with hypertension (OR = 2.011, $P = 0.041$) had a higher risk of cognitive impairment. The risk of cognitive impairment was lower for those with a college degree (OR = 0.435, $P = 0.034$) and married individuals.

CONCLUSION

The risk factors affecting cognitive dysfunction are age, 60-79 years and ≥ 80

years; education, primary school education or less; marital status, divorced or widowed; payment method, self-funded; hypertension; and CKD.

Key Words: Cognitive impairment; Cognitive dysfunction; Chronic kidney disease

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Core Tip: The prevalence of cognitive impairment in patients with chronic kidney disease (CKD) ranges from 10% to 40% depending on the method of cognitive impairment assessment and CKD stage. The risk factors affecting cognitive dysfunction were age, 60-79 years and ≥ 80 years; education, primary school education or less; marital status, divorced or widowed; payment method, self-funded; hypertension; and CKD.

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INTRODUCTION

Chronic kidney disease (CKD) is defined as chronic impairment of renal structure and function resulting from a variety of factors that have altered the structure and function of the kidneys for more than 3 mo. It is clinically manifested by an abnormal glomerular filtration rate (GFR) caused by abnormal case injury, abnormal blood or urine composition, or unexplained reduction in GFR (< 60 mL/min/1.73 m²) for more than 3 mo[1,2]. CKD has a large number of clinical causative factors, which are mainly divided into two categories: Primary and secondary. Secondary CKD commonly includes glomerulonephritis, tubular injury, hypertensive renal arteriosclerosis, chronic pyelonephritis, and so on, which can be divided into five stages according to GFR[3,4]. The clinical manifestations of CKD differ at different stages. Prior to CKD stage 3, the patient's clinical symptoms are not significant or are accompanied only by mild discomfort, such as fatigue, lumbar acid, or increased nocturnal urination. After CKD3, the clinical symptoms become more obvious, and renal function declines further, accompanied by hypertension, heart failure, hyperkalaemia, acid-base balance disorders, gastrointestinal disturbances, and impaired consciousness, *etc.* Some patients may develop anorexia, metabolic acidosis, or mild anaemia. And clinical studies have found that CKD stage 3 can be life-threatening in severe cases[5,6].

Cognitive impairment affects multiple cognitive domains, including orientation, attention, memory, calculation, analysis, comprehensive understanding, judgment, structural ability, and executive ability[7,8]. If a disorder occurs in one of the cognitive domains, it is named after the cognitive domain, such as memory, computing, or orientation disorders. If a disorder occurs in multiple cognitive domains, it is called an impairment. Cognitive impairment can range from mild to severe; severe impairment that impairs daily living and independence is typically referred to as dementia[9,10].

Previous studies have found a 10%-40% prevalence of concomitant cognitive dysfunction in patients with CKD by scoring cognitive function in patients with different CKD stages[11]. Studies have shown that cognitive impairment in CKD patients may be caused by different dialysis methods, GFRs, and other factors[12,13]. This study aimed to explore the risk factors for cognitive impairment in patients with CKD.

MATERIALS AND METHODS

Research contents

This is a prospective cohort study conducted among patients with CKD between October 2021 and March 2023. A questionnaire was formulated using literature review and expert consultation. The integrity of all returned questionnaires was checked before input and invalid questionnaires with logical contradictions or too many missing items were eliminated. Two hundred patients completed the questionnaire. The questionnaire included questions about age, sex, educational level, per capita monthly household income, marital status, living conditions, payment method, and hypertension.

Patient selection

The inclusion criteria were age > 18 years and willingness to cooperate with the investigation of dialysis for more than 3 mo. During the study period, patients were on good dialysis. No complications of heart failure, serious infections, malignancies, or other diseases, and no depression, other mental disorders, or long history of substance abuse, alcohol abuse, dementia, Parkinson's disease, or other neurodegenerative diseases were noted. During the external monitoring of peritoneal dialysis, patients did not take nervous system drugs or nutrition. All participants signed informed consent forms. The study was approved by the Medical Ethics Committee of our hospital. Patients who did not wish to continue

treatment at the hospital were excluded.

Materials

The Montreal Cognitive Assessment Scale is an effective and rapid screening tool for mild cognitive impairment. It targets seven cognitive domains including visuospatial and executive function, naming, attention, language, abstraction, delayed recall, and orientation[14,15]. It consists of 12 questions and 30 items. Each correct answer is worth 1 point, and an incorrect or skipped answer is worth 0 points. It takes approximately 10 min to complete the test. The total score on this scale is 30. A score of 26 points or more indicates normal cognitive function. A higher score indicates better cognitive function, and an additional point was added to the test results to correct for literacy bias.

Statistical analysis

All data were processed and analysed using R studio (4.1.0). Quantitative data are expressed as the mean \pm SD. The risk factors for cognitive impairment were analysed using binary logistic regression. $P > 0.05$ was considered statistically significant.

RESULTS

Based on the inclusion and exclusion criteria, 200 patients with CKD who underwent peritoneal dialysis in our hospital were included in the study.

Univariate analysis of CKD and cognitive dysfunction in patients undergoing peritoneal dialysis

Eighty-five (42.5%) out of 200 patients had cognitive impairment. Eighty-six patients who had CKD and were undergoing peritoneal dialysis were 60-79 years old. Among them, 40.70% had cognitive impairment. There were no statistically significant differences in the incidence of cognitive dysfunction among patients according to their marital status, residence status, payment methods, and hypertension ($P < 0.05$). Table 1 presents the detailed results.

Cognitive dysfunction in patients with CKD undergoing peritoneal dialysis: Multivariate logistic regression analysis

Cognitive impairment in patients with CKD undergoing peritoneal dialysis was used as the dependent variable, and age, education level, per capita monthly family income, marital status, residence status, payment method, and hypertension were used as the independent variables. Logistic regression analysis showed that patients with CKD undergoing peritoneal dialysis aged 60-79 years [odds ratio (OR) = 1.561, $P = 0.015$] and ≥ 80 years (OR = 1.760, $P = 0.013$) had a higher risk of cognitive impairment. Participants with middle and high school education (OR = 0.820, $P = 0.027$) had a higher risk as well. The risk of cognitive impairment was lower for those with a college degree or above (OR = 0.435, $P = 0.034$) than for those with primary school education or less. The risk of cognitive impairment was lower in married than in unmarried individuals (OR = 0.817, $P = 0.046$). The risk of cognitive impairment was higher in divorced and widowed individuals than in unmarried individuals (OR = 1.37, $P = 0.032$). Self-funded patients had a higher risk as well (OR = 2.368, $P = 0.008$). Patients with hypertension had a higher risk of cognitive impairment (OR = 2.011, $P = 0.041$). Table 2 presents the detailed results.

DISCUSSION

This study found that 42.50% of patients with CKD undergoing peritoneal dialysis had cognitive impairment, which was higher than the results of a previous study[16]. This may be due to the decrease in the incidence of cognitive impairment in 26.00% of participants who were < 60 years old. Patients with normal cognitive function can better fulfill doctors' orders. During peritoneal dialysis, patients can be asked about their medication status and feelings, which is conducive to its safety. Patients with cognitive impairments may be confused about their medication status. Caregivers must confirm that patients have a reasonable understanding of the treatment, which seriously affects their quality of life.

This study suggests that the age of incidence for cognitive impairment in patients with chronic renal disease and undergoing peritoneal dialysis was 60-79 years (OR = 1.561, $P = 0.015$). Patients aged ≥ 80 years (OR = 1.760, $P = 0.013$) had a higher risk of developing cognitive impairment than patients aged < 60 years. The incidence of cognitive impairment increased with age. Studies have shown that the prevalence of cognitive impairment increases by a factor of one per five years of age[17,18]. The effectiveness of dopamine neurotransmission is reduced and the number of circulating endothelial progenitor cells decreases, which affects patients' cognitive function[19,20].

The results of this study showed that educational level is one of the factors affecting cognitive dysfunction in patients with CKD undergoing peritoneal dialysis. The risk of cognitive impairment was lower in those with primary school education or less, which is consistent with the results of previous studies indicating that the level of education has a positive effect on cognitive function[21].

The risk of cognitive impairment in married patients was lower than that in unmarried patients (OR = 0.817, $P = 0.046$), while the risk of cognitive impairment in divorced or widowed patients was higher than that in unmarried patients (OR = 1.137, $P = 0.032$), possibly because married patients receive better care and social support during peritoneal dialysis and studies have shown that social support is positively correlated with cognitive function[22].

Table 1 Univariate analysis of cognitive dysfunction in chronic kidney disease patients undergoing peritoneal dialysis

		Number	Patients with cognitive impairment	χ^2 value	P value
Age (yr)	< 60	50	13 (26.00%)	11.825	0.03
	60-79	86	35 (40.70%)		
	≥ 80	64	37 (57.81%)		
Sex	Female	97	46 (47.42%)	1.868	0.172
	Male	103	39 (37.86%)		
Education level	Primary school or less	60	36 (60.00%)	13.816	0.001
	Junior and senior high schools	98	39 (39.80%)		
	Junior college or above	42	10 (23.81%)		
Per capita monthly household income	Less than 3000 yuan	37	23 (62.16%)	11.543	0.003
	3000-6000 yuan	96	43 (44.79%)		
	> 6000 yuan	67	19 (28.36%)		
Marital status	Unmarried	27	11 (40.74%)	23.747	< 0.001
	Married	132	43 (32.58%)		
	Divorced or widowed	41	31 (75.61%)		
Living condition	Living alone	57	33 (57.89%)	8.757	0.013
	Living with children	42	18 (42.86%)		
	Conjugal residence	101	34 (33.66%)		
Payment method	Insurance	143	36 (25.17%)	61.63	< 0.001
	Self-funded	57	49 (85.96%)		
Hypertension	Yes	68	37 (45.41%)	5.982	0.014
	No	132	48 (36.36%)		

Table 2 Multivariate regression analysis of cognitive dysfunction in patient with chronic kidney disease undergoing peritoneal dialysis by logistic

	Reference group	Comparative group	Regression coefficient	Standard error	Wald χ^2 value	P value	OR	95%CI
Age	< 60	60-79	1.185	0.821	4.741	0.015	1.561	1.518-4.182
		≥ 80	1.235	0.764	4.886	0.013	1.76	1.218-2.881
Educational level	Primary school or below	Junior and senior high schools	0.735	0.855	4.842	0.027	0.82	0.218-0.881
		Junior college or above	0.403	0.236	5.636	0.034	0.435	0.273-0.764
Marital status	Unmarried	Married	0.845	0.214	1.241	0.046	0.817	0.423-0.985
		Divorced or widowed	1.134	0.138	4.312	0.032	1.137	1.001-6.013
Payment method	Self-funded	Insurance	1.185	0.31	8.864	0.008	2.368	1.608-4.486
		Insurance	1.621	0.288	27.572	0.001	2.011	1.211-5.432

OR: Odds ratio; CI: Confidence interval.

The high burden of cognitive impairment in hemodialysis and CKD patients has only recently been recognized. Recent studies have described a strong grading relationship between GFR and cognitive function in patients with CKD[23-25]. Elias *et al*[26] believed that the mechanism of association between CKD and cognition may be similar to that of hypertension or diabetes. We believe that there is a need for more research, including multiple cognitive tests, measures of everyday cognitive ability related to patients' understanding of the disease and treatment, and more research on epidemic and episodic dementia outcomes.

This study also found that hypertensive patients had a higher risk of cognitive dysfunction (OR = 2.011, $P = 0.041$). Peritoneal dialysis patients may experience vasculopathy during treatment, and hypertensive patients may experience altered cerebral blood flow and cerebrovascular changes, and ischemia and hypoxia may damage brain cells, leading to cognitive dysfunction[27].

CONCLUSION

By analyzing 200 patients with CKD undergoing peritoneal dialysis, we found that the risk factors affecting cognitive dysfunction include age, 60-79 years and ≥ 80 years; education, primary school education or less; marital status, divorced or widowed; payment method, self-funded; hypertension; and CKD. Medical staff should assess the cognitive function of patients at the right time and pay regular attention to changes in the patients' cognitive function.

ARTICLE HIGHLIGHTS

Research background

Chronic kidney disease (CKD) patients have been found to be at risk of concurrent cognitive dysfunction in previous studies, which has now become an important public health issue of widespread concern.

Research motivation

Studies have shown that cognitive impairment in CKD patients may be caused by different dialysis methods and glomerular filtration rates.

Research objectives

This object of this study is to explore the risk factors for cognitive impairment in patients with CKD.

Research methods

We conducted the prospective cohort study between October 2021 and March 2023 in renal internal medicine. A questionnaire was formulated by the method of literature and expert consultation. The questionnaire included questions about age, sex, education level, per capita monthly household income, marital status, living condition, payment method, and hypertension.

Research results

Two hundred patients with CKD undergoing peritoneal dialysis at the hospital were included in this study. Logistic regression analysis showed that patients with CKD undergoing peritoneal dialysis aged 60-79 years [odds ratio (OR) = 1.561, $P = 0.015$] and ≥ 80 years (OR = 1.760, $P = 0.013$) had a higher risk of cognitive impairment. Participants with middle and high school education (OR = 0.820, $P = 0.027$) had a higher risk of cognitive impairment. However, the risk of cognitive impairment was lower for those with a college degree or more (OR = 0.435, $P = 0.034$) than for those with primary school education or less. The risk of cognitive impairment was lower in married than in unmarried individuals (OR = 0.817, $P = 0.046$). The risk of cognitive impairment was higher in divorced and widowed individuals than in unmarried individuals (OR = 1.37, $P = 0.032$). Self-funded patients a higher risk of cognitive impairment (OR = 2.368 $P = 0.008$). Individuals with hypertension had a higher risk of cognitive impairment (OR = 2.011, $P = 0.041$).

Research conclusions

The risk factors affecting cognitive dysfunction include age, 60-79 years and ≥ 80 years; education, primary school education or less; marital status, divorced or widowed; payment method, self-funded; hypertension; and CKD, which gradually decreases with continuous peritoneal dialysis.

Research perspectives

Medical staff should assess the cognitive function of patients at the right time and pay regular attention to changes in the patients' cognitive function.

FOOTNOTES

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