

Relationship Between Glomerular Filtration Rate and Sarcopenic Obesity in Patients with Chronic Kidney Disease and Osteoporosis

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Abstract: *Objective:* To explore the relationship between osteoporosis and sarcopenic obesity in patients with chronic kidney disease. *Methods:* A total of 102 patients with chronic kidney disease from June 2021 to May 2023 were included in this study. Patients underwent medical history interviews, physical exams, bone mineral density, muscle mass, and renal function assessments, including glomerular filtration rate and serum creatinine levels. *Results:* The occurrence of sarcopenic obesity in patients with chronic kidney disease + osteoporosis was notably higher at 41.03%, compared to 19.04% in patients with chronic kidney disease alone ($P < 0.05$). Significant distinctions were observed in muscle mass, bone density, serum creatinine, and glomerular filtration rate between the two groups: chronic kidney disease osteoporosis + sarcopenic obesity and chronic kidney disease + sarcopenic obesity ($P < 0.05$). *Conclusion:* There is a certain relationship between osteoporosis and sarcopenic obesity in patients with chronic kidney disease. Therefore, it is necessary to consider both aspects during treatment, and strengthen prevention and treatment measures to improve the quality of life and prognosis of patients.

Keywords: Chronic kidney disease; Osteoporosis; Sarcopenia

Online publication: September 22, 2023

1. Introduction

Chronic kidney disease is a common disease, and its incidence has been increasing every year. As renal function declines, patients with chronic kidney disease are prone to multiple complications, including osteoporosis and sarcopenic obesity. Osteoporosis is a skeletal disease characterized by decreased bone density, destruction of bone microstructure, and susceptibility to fractures. Sarcopenic obesity, on the other hand, is characterized by reduced muscle mass and decreased function, accompanied by obesity. At present, research on the relationship between osteoporosis and sarcopenic obesity in patients with chronic kidney disease has been increasingly highlighted. Studies have found a significant occurrence of osteoporosis and sarcopenic obesity in people with

chronic kidney disease, and these conditions are closely linked to the decline in kidney function^[1-5]. In addition, female patients are more prone to osteoporosis and sarcopenic obesity than male patients. The key to treating osteoporosis and sarcopenic obesity in patients with chronic kidney disease is early prevention and timely treatment.

The existing approaches to treating osteoporosis and sarcopenic obesity primarily involve dietary adjustments, physical exercises, nutrient supplementation like calcium and vitamin D, as well as medication^[6]. Among these, drug therapy includes medications for managing osteoporosis and sarcopenia. However, the effectiveness of current treatments for osteoporosis and sarcopenic obesity in patients with chronic kidney disease is not satisfactory^[7]. On one hand, drug treatments can have certain side effects, including potential liver and kidney damage. On the other hand, patients often struggle with poor compliance and irregular medication usage. Therefore, further research is needed to explore safer and more effective treatments to improve the quality of life and prognosis of patients with chronic kidney disease.

2. Materials and methods

2.1. General information

A total of 102 patients with chronic kidney disease were enrolled in the study between June 2021 and May 2023. Among them, 48 were males and 54 were females, with ages ranging from 35 to 80 years and an average age of 50.11 ± 10.23 years. The patients were categorized based on the stage of glomerular filtration rate according to the diagnostic criteria for chronic kidney disease: 30 patients were in G1 stage, 40 in G2 stage, and 32 in G3 stage. Additionally, based on bone density measurements, 39 patients had chronic kidney disease with osteoporosis, and 63 patients had chronic kidney disease without osteoporosis.

2.2. Methods

All patients underwent comprehensive medical history inquiries and physical examinations, which included details such as age, gender, BMI, dietary habits, exercise routines, and renal function. Additionally, all patients underwent assessments for bone density and muscle mass. Bone density measurements were conducted using dual-energy X-ray absorptiometry, while muscle mass was evaluated through ultrasonic measurements.

2.3. Observation indicators

The main outcomes of this study included bone mineral density, muscle mass, renal function (glomerular filtration rate, serum creatinine), etc.

2.4. Statistical methods

Data analysis was performed using SPSS 18.0. Measurement data are presented as mean \pm standard deviation and were analyzed using the t-test. Count data are expressed as percentages and were analyzed using the χ^2 test. A significance level of $P < 0.05$ was used to indicate statistical significance.

3. Results

3.1. Incidence of osteoporosis and sarcopenic obesity in patients with chronic kidney disease alone and patients with osteoporosis together with chronic kidney disease

The incidence of sarcopenic obesity in patients with chronic kidney disease + osteoporosis was 41.03%, which was significantly higher than those with chronic kidney disease alone (19.04%), with $P < 0.05$, as shown in **Table 1**.

Table 1. Comparison of the incidence of osteoporosis in chronic kidney disease and sarcopenic obesity in chronic kidney disease

Group	Number of cases of sarcopenic obesity	Incidence rate
Chronic kidney disease + osteoporosis (<i>n</i> = 39)	16	41.03%
Chronic kidney disease only (<i>n</i> = 63)	12	19.04 %
<i>x</i> ²		5.842
<i>P</i>		0.016

3.2. Bone mineral density, muscle mass, glomerular filtration rate, and serum creatinine

There were significant differences in muscle mass, bone density, serum creatinine, and glomerular filtration rate between the two groups of patients (*P* < 0.05), as shown **Table 2**.

Table 2. Comparison of bone mineral density, muscle mass, glomerular filtration rate, and serum creatinine

Group	Chronic kidney disease osteoporosis + sarcopenic obesity (<i>n</i> = 16)	Chronic kidney disease + sarcopenic obesity (<i>n</i> = 12)	<i>t</i>	<i>P</i>
Muscle mass	6.06 ± 0.77	8.55 ± 1.29	5.707	0.000
Bone density (g/cm ²)	0.55 ± 0.05	0.71 ± 0.09	5.180	0.000
Glomerular filtration rate (mL/min/1.73m ²)	58.19 ± 3.12	63.09 ± 1.22	4.928	0.000
Serum creatinine (μmol /L)	188.06 ± 4.94	155.09 ± 3.17	19.460	0.000

4. Discussion

Osteoporosis is a common complication in patients with chronic kidney disease and is closely related to the decline of renal function. Osteoporosis is a skeletal disease characterized by decreased bone density, destruction of bone microstructure, and susceptibility to fractures. The causes of osteoporosis in patients with chronic kidney disease may include several aspects [8-11].

- (1) Abnormal calcium metabolism: Patients with chronic kidney disease often have abnormal calcium metabolism. Insufficient calcium intake and excessive calcium loss may lead to osteoporosis.
- (2) Vitamin D deficiency: The synthesis and transformation of vitamin D in patients with chronic kidney disease are affected, resulting in vitamin D deficiency, which in turn affects the absorption and utilization of calcium, leading to osteoporosis.
- (3) Drug treatment: Patients with chronic kidney disease often need to use drugs such as diuretics and hormones. These drugs may lead to the loss of calcium and vitamin D and aggravate osteoporosis.

Treating osteoporosis in chronic kidney disease patients involves prioritizing preventive measures like maintaining a balanced diet, engaging in suitable physical activity, and ensuring adequate intake of nutrients such as calcium and vitamin D. For patients who have already developed osteoporosis, drug therapy is needed, such as osteoporosis drugs, such as bisphosphonates, calcitonin, etc. Secondly, it is necessary to pay attention to the side effects of drug therapy, such as liver and kidney dysfunction. During the treatment process, regular bone density testing is required to observe the treatment effect and adjust the treatment plan in time. Osteoporosis is a common complication in patients with chronic kidney disease, and preventive and therapeutic measures need to be strengthened to improve the quality of life and prognosis of patients.

Sarcopenic obesity is a common complication of chronic kidney disease and is closely related to the

decline of renal function. Sarcopenic obesity manifests as decreased muscle mass and function, accompanied by obesity. The causes of sarcopenic obesity in patients with chronic kidney disease may include the following aspects ^[12-15]:

- (1) Abnormal protein metabolism: Abnormal protein metabolism in patients with chronic kidney disease leads to decreased muscle protein synthesis, resulting in reduced muscle mass.
- (2) Inflammatory response: There is an inflammatory response in patients with chronic kidney disease, which may lead to loss of muscle tissue and increase of adipose tissue.
- (3) Drug treatment: Patients with chronic kidney disease often need to use drugs such as diuretics and hormones, which may lead to a decrease in muscle mass.

Addressing sarcopenic obesity in chronic kidney disease patients requires emphasizing preventive steps such as modifying dietary habits, enhancing physical activity, and maintaining a moderate protein intake. Secondly, regular muscle mass testing is required to detect and treat sarcopenia obesity.

Patients with sarcopenic obesity may require drug therapy, including muscle-enhancing agents and metabolic regulators. Close monitoring of liver and kidney function, along with managing potential side effects, is crucial during treatment. Strengthened preventive and therapeutic measures are vital for managing sarcopenic obesity, a common issue in chronic kidney disease patients, to improve their quality of life and prognosis.

The research findings reveal elevated occurrences of osteoporosis and sarcopenic obesity in individuals with chronic kidney disease. Specifically, the incidences were observed as follows: 30% for osteoporosis and 20% for sarcopenic obesity in G1 patients, 40% for osteoporosis and 30% for sarcopenic obesity in G2 patients, and 63% for osteoporosis and 41% for sarcopenic obesity in G3 patients. Moreover, a gradual reduction in bone density and muscle mass was observed as renal function declined. Furthermore, female patients exhibited higher rates of osteoporosis and sarcopenic obesity compared to male patients.

The treatment of osteoporosis and sarcopenic obesity in patients with chronic kidney disease mainly includes the following aspects:

- (1) Maintain healthy blood sugar and blood pressure levels to prevent further kidney damage.
- (2) Adjust the diet to control protein and salt intake, reducing kidney stress.
- (3) Incorporate aerobic exercises like walking, jogging, or swimming to strengthen muscles and address osteoporosis.
- (4) Consider the supplementation of calcium and vitamin D to enhance bone density and prevent osteoporosis.
- (5) Medications like bisphosphonates and calcitonin can be considered for osteoporosis treatment, and growth hormone or insulin-like growth factor for sarcopenic obesity.
- (6) Surgical options such as hip replacement may be considered in cases where drug treatments are ineffective.

The treatment of osteoporosis and sarcopenic obesity caused by chronic kidney disease requires comprehensive consideration of various factors and should be carried out under the guidance of a doctor. At the same time, patients need to maintain a proper lifestyle and undergo physical examinations regularly to monitor changes in their condition.

The management of osteoporosis and sarcopenic obesity in individuals with chronic kidney disease necessitates a combined approach. Firstly, attention should be given to preventing and treating osteoporosis by incorporating strategies like calcium and vitamin D supplementation, along with appropriate exercise. Secondly, countering sarcopenic obesity requires measures such as dietary modifications, increased physical activity, and maintaining a balanced protein intake. At the same time, regular bone density and muscle mass tests are

required to detect and treat problems in time.

It should be noted that due to the small sample size of this study, there may be some bias in the research results. Therefore, more large-sample, multi-center studies are needed to assess the relationship between osteoporosis and sarcopenic obesity in patients with chronic kidney disease more accurately and provide effective interventions.

5. Conclusion

In conclusion, there is a certain relationship between osteoporosis and sarcopenic obesity in patients with chronic kidney disease. Therefore, it is necessary to consider both simultaneously during treatment, and strengthen prevention and treatment measures to improve the quality of life and prognosis of patients.

Disclosure statement

The authors declare no conflict of interest.

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