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LETTER

A study of the low-protein diet in delaying the course of chronic kidney disease

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Abstract

A low-protein diet (LPD) has become an important way to delay the progression of chronic kidney disease (CKD) and to delay the need for dialysis. A review of the literature reveals the low-protein diet's influence on the course of chronic kidney disease. An artificial low-protein food, wheat starch, for example, can not only increase the high-quality protein intake ratio, but can ensure adequate energy intake on a low-protein diet while meeting the nutritional needs of the body, effectively reducing the burden on the damaged kidneys. The purpose of this review is to provide a reference for the clinical implementation of diet and nutrition therapy in patients with chronic kidney disease.

Key words: CKD; Diet treatment; LPD; Wheat starch

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Introduction

Chronic kidney disease (CKD) has become one of the major diseases affecting public health worldwide (Guo et al, 2023). Chronic kidney disease is a metabolic disease mainly characterised by renal waste excretion and gradual loss of endocrine system function. It typically causes nausea, vomiting, loss of appetite and other symptoms in patients, and leads to further deterioration of renal function and renal failure, not only significantly reducing the quality of life, but also leading to serious adverse consequences such as malnutrition, elevated blood pressure, heart disease, stroke, and even premature death (Shi et al, 2012). As of 2017, the global prevalence of CKD was 9.1%, and the number of patients with chronic kidney disease worldwide reached 697.5 million (Collaboration et al, 2020). The World Kidney Day steering committee declared 2020 and 2021 as the years of CKD prevention and living well with CKD, respectively. These declarations underscore the paramount importance of primary CKD prevention, as well as secondary and tertiary interventions for early diagnosis and treatment to control the progression to end-stage kidney disease (ESKD) and its complications (Kalantar-Zadeh et al, 2020). As a disease closely related to lifestyle, the nutritional problems of patients with CKD cannot be ignored (Chinese Medical Doctor Association Nephrologist Branch, Chinese Association of Integrated Traditional and Western Medicine Renal Disease Professional Committee Nutrition Treatment Guidelines Expert Collaboration Group, 2021). Due to chronic progression, low cure rate, and poor prognosis, CKD represents a heavy burden on patients, families, and society, so delaying disease progression and preventing complications have become the focus of prevention and treatment.

Studies have confirmed that a long-term, high-protein diet can increase renal blood flow and increase glomerular pressure, so that the glomeruli remain in a state of hyperfiltration for a long time, resulting in increased urinary protein excretion, and leading to glomerular injury and sclerosis (Ko et al, 2017). Therefore, limiting protein intake can not only delay the progression of kidney disease and kidney replacement therapy, but also prevent protein-energy wasting (Mitch and Remuzzi, 2016; Bellizzi et al, 2017). A low-protein diet (LPD) in patients with chronic kidney disease can not only better control phosphate balance and correct metabolic acidosis, but also reduce albuminuria and control other complications such as dyslipidemia, albuminuria, and inflammation (Carrero et al, 2013).

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What is a low-protein diet

Based on U.S. Recommended Dietary Allowances (RDA), the Food and Nutrition Board of the Institute of Medicine of the National Academy of Sciences has defined a low-protein diet as providing < 0.8 g/kg of protein per day. The recommended dietary intake, based on the minimum daily requirement of 95% of the population, is 0.46 g/kg. This threshold is calculated primarily on the basis of the amount of 'high biological value' protein consumed. 'High biological value' protein is one that can provide all the necessary amino acids, contributes amino acids similar to those of human protein, has high bioavailability, and is easily digested and absorbed. On top of this daily minimum requirement, the RDA is increased by 30 percent to ensure dietary protein consumption and another 30 percent to ensure safety. This yields the RDA value of 0.77 g/kg of protein per day, or approximately 0.8 g/kg.

It is traditionally believed that protein in animal foods is of 'high biological value', and therefore contains a complete range of amino acids. However, recent studies have found that soy protein also contains a complete range of essential amino acids. In spite of previous recommendations, it is not true that patients with chronic kidney disease should avoid soy products (Kalantar-Zadeh et al, 2020; Ikizler, 2020).

Soy also has other healthy nutritional aspects; its cholesterol content is much lower than fish, meat, eggs, and milk, and it is rich in unsaturated fatty acids, B vitamins, soy isoflavones, etc. In addition to possessing antioxidant properties, soy can reduce cholesterol, regulate gastrointestinal function and hormone levels, reduce the risk of cancer, and prevent hypertension, coronary heart disease, and atherosclerosis (EFSA Panel on Food Additives and Flavourings (FAF) et al, 2019). In contrast, the protein in cereals is often deficient in one or more essential amino acids, and therefore is commonly referred to as 'bad protein' (Passey, 2017).

Influence of low-protein diet on the course of chronic kidney disease

Chronic kidney disease patients generally have symptoms of protein-calorie malnutrition. Malnutrition can cause or aggravate immune dysfunction, infection, anaemia, cardiovascular disease, gastrointestinal disease, etc., whereas excessive protein intake will aggravate the deterioration of renal function.

Since CKD leads to decreased kidney function, toxins cannot be removed in a timely manner, resulting in the retention of 'uraemic toxins' (including phosphorus, urea, creatinine, phenols, etc.) (Bellizzi et al, 2016; Koppe et al, 2019; Garibotto et al, 2020). As toxins build up, anorexia and nausea occur, followed by a decrease in nutrient intake (Cupisti et al, 2018; Garibotto et al, 2020) and a gradual depletion of the body's stored protein and energy (Cupisti et al, 2018). In addition, uraemic toxins may also cause inflammation, which is more common in advanced CKD5 (Koppe et al, 2019).

When protein intake is restricted, uraemic toxin production is correspondingly reduced. Nutritional treatment of chronic kidney disease is not limited to reduction of protein intake, but also involves attention to electrolytes, protein quality, and energy intake. The goal is to slow the progression of renal insufficiency and albuminuria, correct metabolic acidosis and maintain CKD parameters at acceptable levels, and improve adherence to nutritional therapy (Verzola et al, 2020).

Artificial low protein – wheat starch foods

There is an increase in non-essential amino acids (NEAA) and a decrease in essential amino acids (EAA) in the blood of CKD patients. The plant proteins in rice, flour, and their products all contain more NEAA, resulting in low bioavailability, decomposition into nitrogen-containing products in the body, and excretion through the kidney, thus increasing the burden on the kidney and aggravating renal failure. China's dietary pattern is based on plant food. Although the amount of protein in the staple foods, rice or flour,

is relatively low, it is still the main source of dietary protein due to the large amount of food eaten every day.

Wheat starch is obtained from the extraction and separation of plant protein from wheat, and after the separation, the protein content decreases from 9.9% to less than 0.6%. The reduced protein intake due to the utilisation of wheat starch can be supplemented with protein with high biological value, thus increasing the intake of EAA.

An adequate intake of carbohydrates can reduce the need to use protein for energy; that is, carbohydrates have a protein-sparing effect. Therefore, using a low-protein wheat starch diet for patients with CKD, can on the one hand help to improve the high quality protein intake ratio, and on the other hand ensure adequate energy intake on a low-protein diet. This has, have the effect of sparing protein and effectively reducing the burden on the damaged kidneys; it is also conducive to restoration of kidney function and meeting the nutritional needs of the body. Dietary adjustment in chronic renal failure is very complex, and involves adjusting the intake of multiple nutrients through lifestyle changes. These changes need to be maintained for many years, which leads to a sharp decline in the quality of life of patients and makes it more difficult for patients to adhere to the treatment diet. Patients often display low compliance with the low-protein diet (Cianciaruso et al, 2007).

Conclusions

Chronic kidney disease has become a public health problem that seriously jeopardies human health. Reasonable dietary treatment can effectively delay the development of CKD, and LPD is the key to dietary treatment.

A LPD must ensure adequate energy intake, which is mainly obtained from carbohydrates, fats, and proteins. Insufficient energy intake will cause protein decomposition in body tissues, increase the production of nitrogen-containing wastes, and increase the burden on the kidney. Only by ensuring adequate energy intake can the progression of kidney disease be delayed on the while adhering to a low-protein diet. Adequate energy intake can also prevent malnutrition, meet physiological needs, save protein, and reduce the burden on the kidney. According to the 2020 KDOQI guidelines, the recommended daily energy intake is estimated at 25–35 kcal/kg (Ikizler et al, 2020). This figure is lower than the 30-35 kcal/kg daily intake required for healthy individuals, and is a result of the recognition that CKD patients are older and that the correction of anaemia and acidosis is now more effective than when thresholds were previously set, at least partially balancing the hypercatabolic state of advanced CKD (Fouque et al, 2007).

At present, medical personnel do not pay enough attention to adjuvant nutritional therapy, nurse education is not in place, the communication and cooperation between the nutrition department and clinical are insufficient, and diet quality is poor with few varieties; these have become important factors affecting the implementation of nutritional dietary therapy. The implementation of multi-department cooperative management is conducive to improving the compliance of hospitalised patients with CKD, is essential for disease control and rehabilitation, and promotes the further improvement of nutrition management (Jiang et al, 2018). In addition, well-controlled LPD has a positive effect on non-dialysis stage CKD and is nutritionally and metabolically safe (Wang and Sun, 2018). Dietitians should always keep in touch with patients, solicit the opinions of patients on the treatment diet, evaluate the nutritional status of patients, encourage patients, win the trust of patients, and cooperate with the treatment.

Key points

- This study aims to investigate the effect of a low-protein diet on the course of chronic kidney disease.
- Replacing some staple foods with wheat starch can effectively reduce the intake of plant protein and delay the progression of chronic kidney disease.
- This study has an important role in promoting the development of nutritional therapy for chronic kidney disease.
- This study systematically collected domestic and foreign literature on the effects of a low-protein diet on the course of chronic kidney disease and summarised these literatures in detail.

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Author contributions

HFD and XJD were responsible for the design of work, drafting and revision of content, and approval of the version to be published.

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References

Bellizzi V, Bianchi S, Bolasco P et al. A Delphi consensus panel on nutritional therapy in chronic kidney disease. J Nephrol. 2016;29(5):593–602. https://doi.org/10.1007/s40620-016-0323-4

Bellizzi V, Conte G, Borrelli S et al. Controversial issues in CKD clinical practice: position statement of the CKD-treatment working group of the Italian Society of Nephrology. J Nephrol. 2017;30(2):159–170. https://doi.org/10.1007/s40620-016-0338-x

Carrero JJ, Stenvinkel P, Cuppari L et al. Etiology of the protein-energy wasting syndrome in chronic kidney disease: a consensus statement from the International Society of Renal Nutrition and Metabolism (ISRNM). J Ren Nutr. 2013;23(2):77–90. https://doi.org/10.1053/j.jrn.2013.01.001

Chinese Medical Doctor Association Nephrologist Branch, Chinese Association of Integrated Traditional and Western Medicine Renal Disease Professional Committee Nutrition Treatment Guidelines Expert

Collaboration Group. Clinical Practice guidelines for nutritional treatment of chronic kidney disease in China. Chin Med J. 2021;101(8):539–559. https://doi.org/10.3760/cma.j.cn112137-20201211-03338

Cianciaruso B, Pota A, Pisani A et al. Metabolic effects of two low protein diets in chronic kidney disease stage 4-5–a randomized controlled trial. Nephrol Dialysis Transplantation. 2007;23(2):636–644. https://doi.org/10.1093/ndt/gfm576

Collaboration G, Tran K, Yamada T. Global, regional, and national burden of chronic kidney disease, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet. 2020;395(10225):709–733. https://doi.org/10.1016/S0140-6736(20)30045-3

Cupisti A, Brunori G, Di Iorio BR et al. Nutritional treatment of advanced CKD: twenty consensus statements. J Nephrol. 2018;31(4):457–473. https://doi.org/10.1007/s40620-018-0497-z

EFSA Panel on Food Additives and Flavourings (FAF), Younes M, Aquilina G et al. Re-evaluation of phosphoric acid–phosphates–di-, tri-and polyphosphates (E 338–341, E 343, E 450–452) as food additives and the safety of proposed extension of use. EFSA J. 2019;17(6):e05674. https://doi.org/10.2903/j.efsa.2019.5674

Fouque D, Vennegoor M, Ter Wee P et al. EBPG guideline on nutrition. Nephrol Dial Transplantation. 2007;22(Supplement 2):ii45–ii87. https://doi.org/10.1093/ndt/gfm020

Garibotto G, Picciotto D, Saio M et al. Muscle protein turnover and low-protein diets in patients with chronic kidney disease. Nephrol Dialysis Transplantation. 2020;35(5):741–751. https://doi.org/10.1093/ndt/gfaa072

Guo J, Zhang G, Yan F, et al. Research status of epidemiology and risk factors of chronic kidney disease. J China Medical Guide. 2023;20(13):50–53. https://doi.org/10.20047/j.issn1673-7210.2023.13.11

Ikizler TA, Burrowes JD, Byham-Gray LD et al. KDOQI clinical practice guideline for nutrition in CKD: 2020 update. Am Kidney Dis. 2020;76(3):S1–S107. https://doi.org/10.1053/j.ajkd.2020.05.006

Jiang B, He Y, Zhu H et al. Multi - sectoral cooperation to improve compliance with nutritional and dietary treatment in patients with chronic kidney disease. J Traditional Chin Med Manage. 2018;26(3):46–47. https://doi.org/10.16690/j.cnki.1007-9203.2018.03.017

Kalantar-Zadeh K, Joshi S, Schlueter R et al. Plant-dominant low-protein diet for conservative management of chronic kidney disease. Nutrients. 2020;12(7):1931. https://doi.org/10.3390/nu12071931

Ko GJ, Obi Y, Tortorici AR et al. Dietary protein intake and chronic kidney disease. Current Opinion Clin Nutr Metabolic Care. 2017;20(1):77–85. https://doi.org/10.1097/MCO.0000000000000342

Koppe L, Cassani de Oliveira M, Fouque D. Ketoacid analogues supplementation in chronic kidney disease and future perspectives. Nutrients. 2019;11(9):2071. https://doi.org/10.3390/nu11092071

Mitch WE, Remuzzi G. Diets for patients with chronic kidney disease, should we reconsider? BMC Nephrol. 2016;17(1):80. https://doi.org/10.1186/s12882-016-0283-x

Passey C. Reducing the dietary acid load: how a more alkaline diet benefits patients with chronic kidney disease. J Renal Nutr. 2017;27(3):151–160. https://doi.org/10.1053/j.jrn.2016.11.006

Shi Z, Zhou P, Zhang C. Prevalence of chronic kidney disease in China: a cross-sectional survey. Lancet. 2012;380(9838):214–216. https://doi.org/10.1016/S0140-6736(12)61211-2

Verzola D, Picciotto D, Saio M et al. Low protein diets and plant-based low protein diets: do they meet protein requirements of patients with chronic kidney disease? Nutrients. 2020;13(1):83. https://doi.org/10.3390/nu13010083

Wang Y, Sun J. Progress in the use of low protein diets without dialysis in the treatment of chronic kidney disease. Chinese General Practice. 2018;21(33):4144–4148. https://doi.org/10.12114/j.issn.1007-9572.2018.00.003