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Commentary

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Relationship among Frailty, Muscle Volume, Protein Intake in Patients with Chronic Kidney Disease (CKD)

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Abstract

Maintenance of muscle mass and protein intake are closely related. Insufficient protein intake in each meal or a total of three meals causes a decrease in muscle mass. For the elderly, protein intake has been insufficient at breakfast and then a large amount of protein is necessary for stimulating muscle protein synthesis. Consequently, there is a need to more actively and consciously take protein in older age. There have been conflicting results concerning the effect of protein restriction diet on glomerular filtration rate (GFR) in patients with chronic kidney disease (CKD) from the data of various meta-analyses. A beneficial effect and also no significant effect was found. One of the perspectives suggested that protein restriction diet may make slower CKD progression in T1DM and non-DM subjects, but not for T2DM patients. However, further studies will be necessary in the future.

Keywords

Frailty, Sarcopenia, Renal Hyperfiltration (RHF), Glomerular Filtration Rate (GFR), Chronic Kidney Disease (CKD), Myofibrillar Protein Synthesis (MPS)

In recent years, the frailty of elderly people has been an important problem. Frailty has three aspects, physical, psycho-psychological, and social. Physical frailty is associated with an age-related reduction of muscle mass and function, which is sarcopenia. It may make the elderly physical impairment, entering nursing homes [1]. Furthermore, sarcopenia increased mortality in a comprehensive systematic review of thousands of cases in six countries [2]. This paper describes the findings related to muscle mass and protein intake.

Cohort studies have pointed out that high protein intake may reduce renal function [3]. This is partly because excess protein induces renal hyperfiltration (RHF) [4]. In a meta-analysis examining the inhibitory effect of renal function, when the renal function was evaluated by glomerular filtration rate (GFR), a low protein diet showed a significant inhibitory effect of 0.95 mL/min/1.73 m^2/year in the GFR reduction rate [5]. On the other hand, there is a meta-analysis that examined the effect of a low protein diet on the progression of renal disease. As a result, there was no difference in the risk of end-stage renal failure between a very strict low protein diet (0.3-0.4/kg/day)

and a protein intake higher than recommended (more than 0.8/kg/day) [6].

There have been conflicting results concerning the effect of protein restriction diet on GFR in patients with chronic kidney disease (CKD) from the data of various meta-analyses [5]. A beneficial effect [7] and also no significant effect [8] were found. The project was performed from 15 randomized controlled trials (RCTs) with 1965 cases [5]. The result showed that a protein restriction diet may make slower CKD progression in T1DM and non-DM subjects, but not for T2DM patients.

There was no unified view of the effects of high protein intake on renal function. The association was recently studied among high protein meals, declining renal function, and RHF [9]. Subjects (n=9226) were divided into four groups according to the daily amount of protein. As a result, the relative risk for RHF was 3.48 in the highest quartile in comparison with the lowest quartile groups. This suggested that high protein meal may increase the risk of RHF and decrease of renal function in the general population.

However, it should be noted for the statistical methods. Previously reported relationships between protein intake and decreased renal function have been observational studies such as cohort and cross-sectional studies. There was no intervention with high-protein diets, such as RCTs. Therefore, it is not possible to show the causal relationship of whether high protein intake reduces renal function [9]

Furthermore, there are several systematic reviews of intervention studies comparing high protein intake (1.6–2.0g/kg/day) with recommended protein intake (0.8–0.9g/kg/day) [10,11]. These studies have not shown a reduction in renal function due to high protein intake.

The difference between animal protein and vegetable protein may be also important. Recent reports indicate that red meat and processed meat are associated with an increased risk of developing renal disease. On the other hand, nuts, beans, and low-fat dairy products may conversely prevent the exacerbation of CKD [12]. There was a similar study with 63257 cases for 15.5 years. It showed that intake of red meat was dose-dependently associated with the risk of end-stage renal failure, but conversely, intake of egg, fish, chicken, and dairy products was involved in reducing the risk [13]. From these, it may be necessary to adjust the amount of protein intake according to the condition of diabetes or CKD. In contrast, healthy elderly people should not be warned about active protein intake. In particular, the protein intake should be adjusted considering the risk of developing malnutrition including flail in the elderly.

For the maintenance of skeletal muscle mass, appropriate protein-mediated stimulation would be needed for myofibrillar protein synthesis (MPS). When compared with younger and elder subjects, MPS has shown the plateau after protein ingestion of 0.24 and 0.40 g/kg/weight in both groups [14]. The result suggests that the elder showed reduced sensitivity for lower protein intake and higher protein intake relatively. Furthermore, nutritional management for adequate MPS is necessary for the maintenance of muscle mass with aging.

The amount of protein intake and also the distribution of three meals were evaluated in 194 senior subjects more than 75 years old [15]. The subjects showed frailty 15.4% and prefrailty 40.5%. The result showed frail subjects had significantly reduced protein in the morning (p=0.007) and increased protein at noon (p=0.024) in comparison with non-frailty and pre-frailty. It suggested that the distribution for protein intake would be different among non-, pre- and frailty groups. In particular, protein intake in breakfast would be possibly very important. From these results, even if the total amount of protein taken a day is sufficient, the problem would be the protein distribution in three meals. Such a situation may raise the concern that the rate of muscle protein synthesis will not increase sufficiently leading to sarcopenia in the long term.

According to the national survey, the estimated average requirement (EAR) for protein has been defined from the Dietary Reference Intakes, which was mainly to avoid deficiency of protein intake [16].

Statistically obtained EAR for adults and for elderly more than 70 was 0.72 g/kg/day and 0.85 g/kg/day, respectively. For the prevention of sarcopenia or frailty, protein intakes, and distribution were evaluated [17]. Half of the subjects did not show recommended sufficient values for the prevention of sarcopenia.

For a single meal, intake of protein was believed to be necessary at least more than 0.24 g/kg/weight in order to make a maximum of protein synthesis in the younger people. For this confirmation, a cross-sectional exam was performed for 266 healthy people with 21.4 years old [18]. There were two groups for the research. One group is the intake of enough protein at three meals a day, while another is not intake of these. As a result, the former group showed significantly higher total fat-free mass (FFM) than the latter (p=0.008). It suggests the importance of protein intake in all three meals for the maintenance of muscle mass. This finding indicates that lack of protein intake, especially at breakfast, leads to increased risk for decreased muscle mass. Since it has already been observed in young people, it will be necessary to reassess the actual protein intake methods in adults and elderly people.

In summary, muscle is important for maintaining health in the elderly. Maintenance of muscle mass and protein intake are closely related. Insufficient protein intake in each meal or a total of three meals causes a decrease in muscle mass. For the elderly, protein intake has been insufficient at breakfast and then a large amount of protein is necessary for stimulating muscle protein synthesis. Consequently, there is a need to more actively and consciously take protein in older age.

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