Assessment of Body Protein: Energy Status in Chronic Kidney Disease

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Summary: The prevalence of protein-energy malnutrition progressively increases during the evolution of chronic kidney disease (CKD). As a consequence, it has been reported that 40% of patients present with symptoms of undernutrition at the entrance to chronic dialysis treatment. In patients established on maintenance hemodialysis, the prevalence of malnutrition varies from 20% to 60% according to which indicators of nutritional status are used. Protein-energy malnutrition is associated with an increase in overall and cardiovascular death risks both in CKD patients not yet on dialysis and in dialysis patients. Given the impact of protein-energy wasting on the outcome of CKD patients, screening malnutrition and monitoring protein-energy status appear of primary importance. Therefore, scientific and professional societies or foundations have developed guidelines for the assessment of nutritional status as well as for the treatment of malnourished CKD patients. Recently, an expert panel recommended the term *protein-energy wasting* for loss of body protein mass and fuel reserves. According to these recommendations, protein-energy wasting should be diagnosed if 3 characteristics are present (low serum levels of albumin, transthyretin, or cholesterol), reduced body mass (low or reduced body mass or fat mass or weight loss with reduced intake of protein and energy), and reduced muscle mass (muscle wasting or sarcopenia, reduced mid–arm-muscle circumference). The present article addresses the methods for assessing protein-energy status, their specificities regarding the CKD staging, and the criteria for choosing among these methods when managing the follow-up evaluation of CKD patients. The practical implications of nutritional parameters for the management of CKD patients are illustrated by a case presentation.

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Chronic kidney disease (CKD) is widespread throughout the world. Its estimated prevalence varies from 10% to 20% according to countries and tools used for CKD detection.[1-5] Similarly, the number of patients requiring chronic routine dialysis treatment is increasing continuously. In the United States, the number of patients treated by maintenance hemodialysis is expected to be more than 2 million by 2030.[6] The prevalence of malnutrition progressively increases during the evolution of CKD. As a consequence, it has been reported that 40% of patients present with symptoms of undernutrition at the entrance to dialysis.[7] In hemodialysis patients, the prevalence of protein-energy malnutrition, more correctly referred to as *protein-energy wasting*, varies from 20% to 60% according to which indicators of protein-energy wasting are used.[8]

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Protein-energy wasting is associated with an increase in overall and cardiovascular death risks both in CKD patients not yet on dialysis[9,10] and in chronic dialysis patients.[11-13] Given the prognostic impact of protein-energy wasting in CKD patients, screening for wasting and malnutrition and monitoring protein-energy status appear to be of primary importance. Therefore, scientific and professional societies and foundations have developed guidelines for the assessment of nutritional status as well as for the treatment of protein-energy wasted CKD patients.[14-19] Recently, an expert panel recommended the term *protein-energy wasting* for loss of body protein mass and fuel reserves. According to these recommendations, protein-energy wasting should be diagnosed if 3 characteristics are present (low serum levels of albumin, transthyretin, or cholesterol), reduced body mass (low or reduced body mass or fat mass or weight loss with reduced intake of protein and energy), and reduced muscle mass (muscle wasting or sarcopenia, reduced mid–arm-muscle circumference).[20] The present article addresses the methods for assessing protein-energy status, their specificities regarding the CKD staging, and the criteria for choosing among these methods when managing CKD patients. The practical implications of nutritional parameters for the management of CKD patients is illustrated by a case presentation.

METHODS FOR ASSESSMENT OF PROTEIN-ENERGY STATUS ASSESSMENT

According to the National Kidney Foundation Clinical Practice Guidelines for Nutrition in Chronic Renal failure,[14] nutritional status should be assessed with a combination of valid, complementary measures rather than any single measure alone. These measures include dietary intake assessment, anthropometry, serum proteins and cholesterol, urea and creatinine kinetics, subjective global assessment, and body composition measurements.

Dietary Records and Anthropometry

The assessment of dietary intake is of primary importance in CKD patients. Dietary interviews and 3-day records (including 1 dialysis day and 1 weekend day) have been recommended for maintenance hemodialysis patients.[14,15] They are the only way to quantify lipid and carbohydrate intakes. In stable conditions, protein intake also can be estimated by calculating the normalized protein nitrogen appearance (nPNA, see later).

Besides its obvious usefulness in the hemodialysis setting, the follow-up evaluation of body weight is of great interest to detect protein-energy wasting. Body mass index (BMI), which was reported as an independent marker of survival, should be measured regularly.[21,22] The relationships between BMI and survival even show a reverse epidemiology picture both in nondialyzed CKD patients and in dialysis patients.[10,23] Anthropometric parameters can be influenced by water retention. In the absence of edema, triceps skinfold thickness (TSF) reflects fat stores and arm-muscle circumference (arm circumference $-$ 3.14 $\times$ TSF), an indicator of muscle mass. TSF and arm-muscle circumference should be interpreted according to reference values specific for age and sex.[24]

Biological Assessment of Protein-Energy Status

Serum albumin and transthyretin (prealbumin) remain major tools for evaluating protein-energy status, although their concentrations also are dependent on such non nutritional parameters as liver function, hydration, and inflammatory status.[14] In hemodialysis patients, these proteins should be measured before a hemodialysis session. Serum albumin was shown to be correlated with multiple markers of protein-energy status such as nPNA, lean body mass, serum creatinine, transferrin, cholesterol, insulin-like growth factor-1 and transthyretin.[8,11,25,26]

The metabolism of serum transthyretin in CKD patients deserves some comments. As a matter of fact, CKD patients as compared with controls generally have higher serum transthyretin concentrations.[27] Data suggest that the major cause of increased serum transthyretin in CKD is the decrease in the renal degradation of retinol-binding protein. The