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Review Article

Comparing Methods for Assessment of Nutritional Status in Hemodialysis Patients: A Review

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ABSTRACT

The global number of hemodialysis patients has an increasing trend and is still one of the most important protein-energy malnutrition with high morbidity and mortality. Therefore, proper assessment of nutritional status of these patients seems essential. In this review, we compared several methods of nutritional assessment in these patients. It was shown that subjective methods such as subjective global assessment (SGA) were widely used with good validity and accuracy. Malnutrition-inflammation score (MIS) as another common method evaluated the patient's physical and mental condition based on the level of inflammation. Mini Nutrition Assessment (MNA) as another method assessed the nutritional status of elderly hemodialysis patients, but the interpretation of the results is based on the specific conditions of renal patients. Assessment of body composition by bioelectrical impedance has been one of the most accurate nutritional assessment methods predicting the risk of malnutrition based on the amount of lean tissue loss in the body, but it requires advanced equipment and high financial cost. There are other assessment methods, such as normalized protein catabolic ratio (nPCR) that tries to determine malnutrition based on the amount of dietary protein intake, which is nearly the metabolized protein in the body. Using them alone or in combination with other methods was demonstrated to be beneficial.

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Introduction

Nowadays, chronic kidney disease has become a global health challenge as end stage renal disease (ESRD) patients must undergo hemodialysis (HD) until a successful kidney transplant is performed. The mortality rate in hemodialysis patients is higher than normal people for various reasons, while the most common causes of mortality in renal disease patients are malnutrition and cardiovascular diseases (1). Malnutrition is an important and common issue that affects 16-70% of dialysis patients (depending on the study population and assessment method). In dialysis patients, inadequate nutritional intake, compromised clinical well-being, underlying factors, and dialysis-related factors can lead to poor nutritional status. This malnutrition, in turn, can lead to dysfunction, increased risk of complications, poor quality of life, and a lower survival (2).

Therefore, identifying patients at risk of malnutrition in the early stages is very important in order to initiate interventions to improve nutritional

status, and for this reason, most guidelines have recommend assessment of the nutritional status of dialysis patients as the nutritional status of dialysis patients can change rapidly. Objective assessment of nutritional status in dialysis patients can be laborious, reasonably difficult, time consuming and therefore expensive. So, an accurate and reliable screening tool is needed to be used frequently in clinical practice (2).

An appropriate nutritional assessment tool should meet several basic criteria including (i) being associated with illness and mortality, (ii) indicating to changes in nutritional status over time, (iii) accurately diagnoses malnutrition, and (iv) evaluates the effect of nutritional interventions on the patient's condition (2). From various common methods for assessing nutritional status in dialysis patients, subjective global assessment (SGA), malnutrition-inflammation score (MIS), mini nutrition assessment (MNA), body composition assessment by bioelectrical impedance, and normalized protein catabolic ration (nPCR) were the most common mentioned ones. Here, we intended to review the aforementioned methods.

SGA

The SGA questionnaire is one of the tools proposed by the National Kidney Foundation to assess the nutritional status of dialysis patients and has been revised since 1993. In general, SGA is a fast and valid method of assessment that, despite the lack of biochemical markers, provides an overview of the patient's nutritional status (1). This questionnaire examines any changes in weight (during the last 2 weeks and 6 months), diet, gastrointestinal problems, functional capacity, and any metabolic needs related to the underlying diseases. Another part of this questionnaire is physical examination to evaluate the subcutaneous fat, muscle loss, and edema in the ankle/sacrum that should be performed by a skilled nutritionist. Each feature is individually marked as A, B, or C to indicate the degree of malnutrition. The SGA classification can also be converted to a number scale. A score below 10 is considered as good nutritional status. A score between 10 and 17 demonstrates a mild to moderate malnutrition status and a score above 17 denotes to a severe malnutrition (3, 4).

In a cross-sectional study conducted recently among hemodialysis patients of three dialysis centers in Ahvaz, Iran, the SGA questionnaire was used to screen and determine the prevalence of malnutrition among patients. It was found that 18.8% of patients suffered from mild to moderate malnutrition, and 10.9% of them had severe malnutrition. Also, there was a significant relationship between the SGA score and gender, serum albumin level and body mass index (BMI) as predictor risks of malnutrition (5). An applied 7-point SGA has been used to assess nutritional status of hemodialysis patient at Najah National University Hospital, Palestine reporting that about half of the population were malnourished, but with no positive correlation between SGA score and albumin concentration (1).

MIS

International Society of Renal Nutrition and Metabolism (ISRNM) suggested another tool for assessing the nutritional status of hemodialysis patients by utilizing laboratory serum markers, including albumin and transferrin levels. MIS was illustrated to be highly correlated with common problems such as coronary artery disease, hospitalization, and mortality. Another important feature of this questionnaire is that it examines mental health and depressive disorders as well, and it has a good correlation with quality of life (6).

This questionnaire contains 4 sections (nutrition history, physical examination, BMI, and laboratory values) and 10 components. The first 3 parts of the questionnaire are similar to 5 components of the SGA questionnaire and two laboratory markers including albumin and serum transferrin levels were included in the fourth section. Four intensity levels from 0 (normal) to 3 (severe malnutrition) were considered for each component. The sum of all components was scored from 0 (normal) to 30 (severe malnutrition), and finally a higher MIS score indicated more severe forms of malnutrition and inflammation (3, 4).

One of the disadvantages of this questionnaire is that it does not specify the exact threshold for diagnosing no-risk, high-risk, and severe malnutrition (7). Also, MIS has been shown to be an appropriate and effective tool for evaluating malnutrition in hemodialysis patients, but it needs more investigation to determine the exact cut off for assessment (8). In a cross-sectional study that evaluated 60 hemodialysis patients in terms of nutritional status and anthropometric indexes, the MIS questionnaire was used and it was shown that 12.6% of the population suffered from malnutrition. It was also concluded that there was a significant relationship between handgrip strength (HGS), 1 frequency maximum (1RM) leg extension and even body weight with MIS score (9).

MNA

The number of hemodialysis patients is increasing worldwide for people over 65 years old. The US Kidney Information System has reported that the prevalence and incidence of dialysis in the age groups of 65-75 years and more than 75 years is higher than the other age groups, and similar findings have

been obtained from a cohort study in Europe. The results of a study on dialysis patients also showed that based on the levels of pre-albumin, albumin, creatinine, blood urea nitrogen (BUN), and lean body mass (LBM), the prevalence of malnutrition in people over 65 years of age was higher than younger people. Therefore, early detection of protein-energy malnutrition (PEM) is very important in the dialysis older adults (7).

MNA is a simple, non-invasive, and inexpensive tool for assessing nutritional status in the elderly. It contains 18 questions that are classified into four sections. The first part measures 4 anthropometric indicators (BMI, midarm-muscle circumference, calf circumference, and weight loss rate during the last 3 months). The second part continues with 6 questions about lifestyle (medications, acute illnesses, neuropsychiatric disorders, activity level, and the presence of bed sores or skin ulcers). The third part estimates the amount of food intake, and finally, in the last part, two questions are asked according to the person's personal opinion. The questions are about whether the amount of food consumed is enough for the patient, and whether he feels healthy or not. At the end, the total score of less than 17 indicates malnutrition, between 17 and 23.5 reveals at risk of malnutrition, and more than 24 denotes to good nutritional status (10). In general, SGA and MIS questionnaires are used to assess the nutritional status of adults with kidney disease, but the MNA questionnaire is still used in non-renal elderly and its validity needs to be examined (7).

In 2006, a study was conducted on 137 dialysis patients, while MNA and SGA were used to assess their nutritional status. MNA was not a reliable method for diagnosing moderate malnutrition in hemodialysis patients without inflammatory conditions when compared to SGA. In fact, the index underestimated the nutritional status, and people with good nutritional status and with SGA could be diagnosed with moderate malnutrition through MNA. The reason for this result is that most of the questions in the MNA questionnaire were concerned with personal opinion, and the patient may not remember them completely and correctly. Another reason is that, MNA is a suitable tool for checking the nutritional status of patients who do not have food restrictions. However, in ESRD patients, this method cannot be effective due to dietary restrictions (10).

A cohort study was recently conducted in 2020 on 216 dialysis patients over 18 years of age to assess malnutrition using the MNA questionnaire and the mortality rate in these patients was followed for 2 years. It was clearly stated that the MNA questionnaire could be a suitable tool for screening nutrition in dialysis patients. However, there were differences in evaluating the results of these studies. First, people who did not obtain adequate scores for good nutritional status, they were divided into two groups of low and high risk for malnutrition. Second, due to the limitations of dialysis patients in receiving fruits and vegetables as well as fluids, the scores required for good nutritional status reduced from 24 to 22. This score was labeled as MNA-LF-ESKD (MNA-LF-end stage kidney disease) (2).

Bioelectrical Impedance Analysis (BIA)

Assessing the nutritional status of hemodialysis patients may be a bit difficult and complicated due to frequent changes in body hydration status and the presence of comorbidities and inflammation. Recent studies have examined the association between body composition and mortality and concluded that low adipose tissue is a sign of malnutrition in chronic kidney disease as adipose tissue plays a protective role against death in hemodialysis patients (11). One of the important methods for assessing nutritional status in HD patients is BIA (12).

In general, BIA is performed immediately after dialysis and the resulting information includes intracellular fluid, extracellular fluid, body fat mass (FM), and fat free mass (FFM), and the condition of edema. In addition, to calculate body fat mass index (FMI), the weight of adipose tissue in kilograms can be divided by height squared in meters. Also, to calculate fat free mass index (FFMI), the weight of lean tissue in kilograms must be divided by height squared in meters. It was shown that BIA method can be used as a valid tool to measure FM, FFM, FMI and FFMI in dialysis patients and then to assess their nutritional status, especially through changes in lean tissue (12).

In a recent cross-sectional study of 42 hemodialysis patients with a mean age of 55.8 years, it was found that using the BIA method to assess the nutritional status could be as accurate as using the dual-energy x-ray absorptiometry (DEXA) method for assessing patients, that is a gold standard introduced by the National Kidney Organization. However, DEXA can be used in clinical settings and its use is limited (11). Jayanama *et al.* conducted a study with the aim of comparing BIA and DEXA method in assessing the nutritional status of hemodialysis patients and evaluated their associations. They reported that both methods had a high correlation with each other and could be applied for maintenance hemodialysis patients (12).

nPCR

Dietary protein needs are higher in dialysis patients for various reasons, including the loss of

amino acids during dialysis and the specific anabolic and catabolic states caused by uremia, inflammation, oxidative stress, and exposure to dialysis equipment. Normally, the amount of protein catabolized by kidney in a normal-weight person is considered to be equal to the amount of protein received by him/her through diet in a day and is called nPCR. The following equation can be used to calculate nPCR (13).

nPCR in g/kg per day=0.22+(0.036× interdialytic (ID) rise in BUN midweek×24)/ID interval (h). ID is the interval between two hemodialysis sessions, and the rate of increase in BUN during this period is obtained by subtracting the BUN after the last dialysis session from the BUN before this dialysis and is expressed in mg/dL. If the remaining urine at this time was more than 100 mL, this amount must be added to the above equation to increase the validity and accuracy: Urinary urea nitrogen (g)×150/ ID interval (h)×weight (kg) (13). Another equation for determining nPCR was shown to be: nPCR=(0.0136×[Kt/V×([predialysis BUN+postdialysis BUN]/2)])+0.251, that uses Kt/V (the urea uptake index during dialysis) and the average BUN during the week (14).

Applying nPCR method along with albumin level can be a suitable way for nutritional evaluation of dialysis patients. It was shown that serum albumin level higher than 3.5 g/dL and nPCR higher than 1 g/kg/day can demonstrate better nutritional status and lower mortality rate in these patients. However, judgment would no longer be based solely on serum albumin, which can be affected by the inflammatory status (15). In 2020, a study conducted on 88,330 hemodialysis patients using nPCR method to evaluate protein intake and nutritional status of the hemodialysis patients. The results revealed that low nPCR increased the risk of all-cause mortality in hemodialysis patients, even in patients with normal albumin and serum cholesterol levels (16).

Conclusion

Due to various complications of malnutrition in HD patients, assessing nutritional status in this group is essential and there are various methods of assessment in this regard. SGA and MIS methods are the most common methods to evaluate the malnutrition in dialysis patients as they are very easy, less expensive and fast and also in terms of the validity of the results, they are closer to reality. For this reason, they have been used in most authoritative studies. The MNA method has been used in the past to assess malnutrition in the elderly, but it should be noted that if it used to evaluate the nutritional status of the older adults undergoing dialysis, the results should be interpreted based on the condition of the kidney patients.

Methods such as BIA and DEXA are costly and need advanced equipment, and perhaps that's why they are not widely used in research studies and clinical practices, but they are very valid and accurate and both methods can show the patient's nutritional status well. Methods such as nPCR and normalized protein equivalent of total nitrogen appearance (nPNA) and try to determine a person's nutritional status based on the amount of protein they receive and both can be calculated via related equations, but we must have accurate information from the patient's dialysis sessions. Generally, using nPCR along with other indicators can be suggested.

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Conflict of Interest

None declared.

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