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Kidney Disease Outcomes Quality Initiative (K/DOQI™) Clinical Practice Guidelines for Nutrition in Chronic Renal Failure ADULT GUIDELINES

전남대학교 의과대학 내과학교실

최 기 철

A. Maintenance Dialysis

1. Evaluation of Protein-Energy Nutritional Status

GUIDELINE 1

Use of Panels of Nutritional Measures

Nutritional status in maintenance dialysis patients should be assessed with a combination of valid, complementary measures rather than any single measure alone. (*Opinion*)

- There is no single measure that provides a comprehensive indication of protein-energy nutritional status.
- Measures of energy and protein intake, visceral protein pools, muscle mass, other dimensions of body composition, and functional status identify different aspects of protein-energy nutritional status.
- Malnutirition may be identified with greater sensitivity and specificity using a combination of factors.

GUIDELINE 2

Panels of Nutritional Measures for Maintenance Dialysis Patients

For maintenance dialysis patients, nutritional status should be routinely assessed by predialysis or stabilized serum albumin, percent of usual body weight, percent of standard(NHANES II) body weight, subjective global assessment, dietary interviews and diaries, and nPNA. (*Opinion*)

- These parameters should be measured routinely(as indicated Table 1) because they provide a valid and clinically useful characterization of the protein-energy nutritional status of maitenance dialysis patients.

GUIDELINE 3

Serum Albumin

Serum albumin is a valid and clinically useful measure of protein-energy nutritional status in maintenance dialysis(MD) patients. (*Evidence*)

- The predialysis or stabilized serum albumin is a measure of visceral protein pool size.
- The serum albumin at the time of initiation of chronic dialysis therapy or during the course of maintenance dialysis is an indicator of future mortality risk.

Table 1. Recommended Measures for Monitoring Nutritional Status of Maintenance Dialysis Patients

Category	Measure	Minimum frequency of measurement
I. Measurements that should be performed routinely in all patients	• Predialysis or stabilized serum albumin	• Monthly
	• % of usual postdialysis(MHD) or post-drain (CPD) body weight	• Monthly
	• % of standard(NHANES II) body weight	• Every 4 months
	• Subjective global assessment(SGA)	• Every 6 months
	• Dietary interview and/or diary	• Every 6 months
	• nPNA	• Monthly MHD; every 3-4 months CPD
II. Measures that can be useful to confirm or extend the data obtained from the measures in Category I	• Predialysis or stabilized serum prealbumin	• As needed
	• Skinfold thickness	• As needed
	• Mid-arm muscle area, circumference, or diameter	• As needed
	• Dual energy X-ray absorptiometry	• As needed
III. Clinically useful measures, which, if low, might suggest the need for a more rigorous examination of protein-energy nutritional status	• Predialysis or stabilized serum	
	- Creatinine	• As needed
	- Urea nitrogen	• As needed
	- Cholesterol	• As needed
	• Creatinine index	

- A predialysis or stabilized serum albumin equal to or greater than the lower limit of the normal range(approximately 4.0 g/dL for the brom-cresol green method) is the outcome goal.
- Indivisuals with a predialysis or stabilized serum albumin that is low should be evaluated for protein-energy malnutrition.
- The presence of acute or chronic inflammation limits the specificity of serum albumin as a nutritional marker.

GUIDELINE 4

Serum Prealbumin

Serum prealbumin is a valid and clinically useful measure of protein-energy nutritional status in maintenance dialysis(MD) patients. (*Evidence and Opinion*)

- The predialysis or stabilized serum prealbumin is a measure of visceral protein pool size.
- The serum prealbumin level at the time of initiation of dialysis or during maintenance dialysis is an indicator of future mortality risk.
- An individual with predialysis or stabilized serum prealbumin less than 30 mg/dL should be evaluated for protein-energy malnutrition.
- The presence of acute or chronic inflammation limits the specificity of serum prealbumin as a nutritional marker.
- There is insufficient evidence to conclude that prealbumin is a more sensitive index of nutritional status than albumin.

GUIDELINE 5

Serum Creatinine and the Creatinine Index

The serum creatinine and creatinine index are valid and clinically useful markers of protein-energy nutritional status in maintenance dialysis (MD) patients. (*Evidence and Opinion*)

- The predialysis or stabilized serum creatinine and the creatinine index reflect the sum of

dietary intake of foods rich in creatine and creatinine(eg, skeletal muscle) and endogenous (skeletal muscle) creatinine production minus the urinary excretion, dialytic removal, and endogenous degradation of creatinine.

- Individuals with low predialysis or stabilized serum creatinine(less than approximately 10 mg/dL) should be evaluated for protein-energy malnutrition and wasting of skeletal muscle.
- A low creatinine index and, in the absence of substantial endogenous urinary creatinine clearance, a low serum creatinine concentration suggest low dietary protein intake(DPI) and/or diminished skeletal muscle mass and are associated with increased mortality rates.

GUIDELINE 6

Serum Cholesterol

Serum cholesterol is a valid and clinically useful marker of protein-energy nutritional status in maintenance hemodialysis patients. (*Evidence and Opinion*)

- Low or declining serum cholesterol concentrations are predictive of increased mortality risk.
- Hypocholesterolemia is associated with chronic protein-energy deficits and/or the presence of comorbid conditions, including inflammation.
- Individuals with low, low-normal(less than approximately 150 to 180 mg/dL), or declining serum cholesterol levels should be investigated for possible nutritional deficits.

GUIDELINE 7

Dietary Interviews and Diaries

Dietary interview and/or diaries are valid and clinically useful for measuring dietary protein and dietary energy intake in maintenance dialysis patients. (*Evidence and Opinion*)

GUIDELINE 8

Protein Equivalent of Total Nitrogen Apprearance(PNA)

PNA or PCR is a valid and clinically useful measure of net protein degradation and protein intake in maintenance dialysis(MD) patients. (*Evidence*)

- When nitrogen balance is zero in the steady state, the difference between nitrogen intake and total nitrogen losses is zero or only slightly positive(ie, up to about 0.5 g nitrogen/d because of unmeasured nitrogen losses). Hence, in the clinically stable patient, PNA provides a valid estimate of protein intake.
- The protein equvalent of total nitrogen appearance(PNA) can be estimated from interdialytic changes in urea nitrogen concentration in serum and the urea nitrogen content of urine and dialysate.
- Because both net protein breakdown under fasting conditions and dietary protein requirements are strongly influenced by body mass, PNA(or PCR) is often normalized to a function of body weight(Guideline 12).

GUIDELINE 9

Subjective Global Nutritional Assessment(SGA)

SGA is a valid and clinically useful measure of protein-energy nutritional status maintenance dialysis patients. (*Evidence*)

GUIDELINE 10

Anthropometry

Anthropometric measurements are valid and clini-

cally useful indicators of protein-energy nutritional status in maintenance dialysis patients. (*Evidence and Opinion*)

- These measures include percent usual body weight, percent standard body weight, body mass index(BMI), skinfold thickness, estimated percent body fat, and mid-arm muscle area, circumference, or diameter.

GUIDELINE 11

Dual Energy X-Ray Absorptiometry(DXA)

DXA is a valid and clinically useful technique for assessing protein-energy nutritional status. (*Evidence and Opinion*)

- Accurate data on body composition are helpful to assess long-term adequacy of protein-energy nutritional status.
- Whole body DXA provides an accurate method to assess body composition which is less influenced by the abnormalities in hydration status common in maintenance dialysis patients.

GUIDELINE 12

Adjusted Edema-Free Body Weight(aBW_{ef})

The body weight to be used for assessing or prescribing protein or energy intake is the aBW_{ef}. For hemodialysis patients, this should be obtained postdialysis. For peritoneal dialysis patients, this should be obtained after drainage of dialysate. (*Opinion*)

- The adjusted edema-free body weight should be used for maintenance dialysis patients who have an edema-free body weight less than 95 % or greater than 115% of the median standard weight, as determined from the NHANES II data.
- For individuals whose edema-free body weight is between 95% and 115% of the median standard weight, the actual edema-free body weight may be used.
- For DXA measurements of total body fat and fat-free mass, the actual edema-free body weight obtained at the time of the DXA measurement should be used.
- For anthropometric calculations, the postdialysis(for MHD) or post-drain(for CPD) actual edema-free body weight should be used.

2. Management of Acid-Base Status

GUIDELINE 13

Measurement of Serum Bicarbonate

Serum bicarbonate should be measured in maintenance dialysis patients once monthly. (*Opinion*)

GUIDELINE 14

Treatment of Low Serum Bicarbonate

Predialysis or stabilized serum bicarbonate levels should be maintained at or above 22 mmol/L. (*Evidence and Opinion*)

3. Management of Protein and Energy Intake

GUIDELINE 15

Dietary Protein Intake(DPI) in Maintenance Hemodialysis(MHD)

The recommended DPI for clinically stable MHD patients is 1.2 g/kg body weight/d. (*Evidence and Opinion*)

- At least 50% of the dietary protein should be of high biological value.

GUIDELINE 16

Dietary Protein Intake(DPI) for Chronic Peritoneal Dialysis(CPD)

The recommended DPI for clinically stable CPD patients is 1.2 to 1.3 g/kg body weight/d. (*Evidence*)

- Dietary protein intake should be no less than 1.2 g/kg/d.
- Unless a patient has demonstrated adequate protein nutritional status on a 1.2 g protein/kg/d diet, 1.3 g protein/kg/d should be prescribed.
- At least 50% of the dietary protein should be of high biological value.

GUIDELINE 17

Daily Energy Intake for Maintenance Dialysis Patients

The recommended daily energy intake for maintenance hemodialysis or chronic peritoneal dialysis patients is 35 kcal/kg body weight/d for those who are less than 60 years of age and 30 to 35 kcal/kg body weight/d for individuals 60 years or older. (*Evidence and Opinion*)

- Energy expenditure of patients undergoing maintenance hemodialysis or continuous ambulatory peritoneal dialysis is similar to that of normal, healthy individuals.
- Metabolic balance studies of people undergoing maintenance hemodialysis indicate that a total daily energy intake of about 35 kcal/kg/d induces neutral nitrogen balance and is adequate to maintain serum albumin and anthropometric indices.
- Because individuals more than 60 years of age tend to be more sedentary, a total energy intake of 30 to 35 kcal/kg is acceptable.

4. Nutritional Counseling and Follow-Up

GUIDELINE 18

Intensive Nutritional Counseling With Maintenance Dialysis(MD)

Every MD patient should receive intensive nutritional counseling based on an individualized plan of care developed before or at the time of commencement of MD therapy. (*Opinion*)

- A plan of care for nutritional management should be developed before or during the early phase of MD care and modified frequently based on the patient's medical and social conditions.
- The plan of care should be updated at least every 3 to 4 months.
- Nutrition counseling should be intensive initially and provided thereafter every 1 or 2 months and more frequently if inadequate nutrient intake or malnutrition is present or if adverse events of illnesses occur that may cause deterioration in nutritional status.

GUIDELINE 19

Indications for Nutritional Support

Individuals undergoing maintenance dialysis who are unable to meet their protein and energy requirements with food intake for an extended period of time should receive nutrition support. (*Evidence and Opinion*)

- The period of inadequate intake after which nutritional support should be instituted ranges from days to 2 weeks, depending on the severity of the patient's clinical condition, degree of malnutrition(if any), and the degree of inadequacy of their nutritional intake.
- Before considering nutrition support, the patient should receive a complete nutritional as-

sessment.

- Any potentially reversible or treatable condition or medication that might interfere with appetite or cause malnutrition should be eliminated or treated.
- For nutrition support, the oral diet may be fortified with energy and protein supplements.
- If oral nutrition(including nutritional supplements) is inadequate, tube feeding should be offered if medically appropriate.
- If tube feedings are not used, intradialytic parenteral nutrition(IDPN; for hemodialysis) or intraperitoneal amino acids(IPAA; for peritoneal dialysis) should be considered if either approach in conjunction with existing oral intake meets the protein and energy requirements.
- If the combination of oral intake and IDPN or IPAA does not meet protein and energy requirements, daily total or partial parenteral nutrition should be considered.
- The dialysis regimen should be regularly monitored and modified to treat any intensification of the patient's uremic state that is caused by superimposed illness or increased protein intake.

GUIDELINE 20

Protein Intake During Acute Illness

The optimum protein intake for a maintenance dialysis patient who is acutely ill is at least 1.2 to 1.3 g/kg/d. (*Opinion*)

- Acutely ill maintenance hemodialysis patients should receive at least 1.2 g protein/kg/d.
- Acutely ill chronic peritoneal dialysis patients should receive at least 1.3 g protein/kg/d.

GUIDELINE 21

Energy Intake During Acute Illness

The recommended energy intake for maintenance dialysis patients who is acutely ill is at least 35 kcal/kg/d for those who are less than 60 years of age and at least 30 to 35 kcal/kg/d for those who are 60 years of age or older. (*Evidence and Opinion*)

5. Carnitine

GUIDELINE 22

L-Carnitine for Maintenance Dialysis Patients

There are insufficient data to support the routine use of L-carnitine for maintenance dialysis patients. (*Evidence and Opinion*)

- Although the administration of L-carnitine may improve subjective symptoms such as malaise, muscle weakness, intradialytic cramps and hypotension, and quality of life in selected maintenance dialysis patients, the totality of evidence is insufficient to recommend its routine provision for any proposed clinical disorder without prior evaluation and attempts at standard therapy.
- The most promising of proposed applications is treatment of erythropoietin-resistant anemia.

B. Advanced Chronic Renal Failure without Dialysis

GUIDELINE 23

Panels of Nutritional Measures for Nondialyzed Patients

For individuals with CRF(GFR <20 mL/min) protein-energy nutritional status should be evaluated

by serial measurements of a panel of markers including at least one value from each of the following clusters : (1) serum albumin; (2) edema-free actual body weight, percent standard(NHANES II) body weight, or subjective global assessment (SGA); and (3) normalized protein nitrogen appearance(nPNA) or dietary interviews and diaries. (*Evidence and Opinion*)

- It is recommended that serum albumin and actual or percent standard body weight and/or SGA be measured every 1 to 3 months.
- Dietary interviews and diaries and/or nPNA should be performed every 3 to 4 months.
- For patients with more advanced CRF(ie, GFR ≤15 mL/min), concomitant illness, inadequate nutrient intake, deteriorating nutritional status, or frank malnutrition, more frequent monitoring may be necessary.

GUIDELINE 24

Dietary Protein Intake for Nondialyzed Patients

For individuals with chronic renal failure(GFR < 25 mL/min) who are not undergoing maintenance dialysis, the institution of a planned low-protein diet providing 0.60 g protein/kg/d should be considered. For individuals who will not accept such a diet or who are unable to maintain adequate DEI with such a diet, an intake of up to 0.75 g protein/kg/d may be prescribed. (*Evidence and Opinion*)

- When properly implemented and monitored, low-protein, high-energy diets maintain nutritional status while limiting the generation of potentially toxic nitrogenous metabolites, the development of uremic symptoms, and the occurrence of other metabolic complications.
- Evidence suggests that low protein diets may retard the progression of renal failure or delay the need for dialysis therapy.
- At least 50% of the dietary protein should be of high biologic value.
- When patients with CRF consume uncontrolled diets, a decline in protein intake and in indices of nutritional status is often observed.

GUIDELINE 25

Dietary Energy Intake(DEI) for Nondialyzed Patients

The recommended DEI for individuals with chronic renal failure(CRF; GFR <25 mL/min) who are not undergoing maintenance dialysis is 35 kcal/kg/d for those who are younger than 60 years old and 30 to 35 kcal/kg/d for individuals who are 60 years of age or older. (*Evidence and Opinion*)

- Energy expenditure of nondialyzed individuals with CRF is similar to that of healthy individuals.
- Metabolic balance studies of such individuals indicate that a diet providing about 35 kcal/kg/d engenders neutral nitrogen balance and maintains serum albumin and anthropometric indices.
- Because individuals more than 60 years of age tend to be more sedentary, a lower total energy intake of 30 to 35 kcal/kg/d is acceptable.

GUIDELINE 26

Intensive Nutritional Counseling for Chronic Renal Failure(CRF)

The nutritional status of individuals with CRF should be monitored at regular intervals. (*Evidence*)

- A spontaneous reduction in dietary protein intake(DPI) and a progressive decline in indices of nutritional status occur in many non-

dialyzed patients with CRF.

- The presence of protein-energy malnutrition at the initiation of maintenance dialysis is predictive of future mortality risk.
- Interventions that maintain or improve nutritional status during progressive renal failure are likely to be associated with improved long-term survival after commencement of maintenance dialysis.
- Because evidence of protein-energy malnutrition may develop before individuals require renal replacement therapy, regular monitoring(eg, at 1- to 3-month intervals) of the patient's nutritional status should be a routine component of the care for the patient with CRF.
- Nutritional status should be assessed more frequently if there is inadequate nutrient intake, frank protein-energy malnutrition, or the presence of an illness that may worsen nutritional status.

GUIDELINE 27

Indications for Renal Replacement Therapy

In patients with chronic renal failure(eg, GFR < 15 to 20 mL/min) who are not undergoing maintenance dialysis, if protein-energy malnutrition develops or persists despite vigorous attempts to optimize protein and energy intake and there is no apparent cause for malnutrition other than low nutrient intake, initiation of maintenance dialysis or a renal transplant is recommended. (*Opinion*)

REFERENCE

1) Am J Kidney Dis 35(Suppl 2):S1-S140, 2000