CE: Continuing Education Article

NUTRITIONAL MANAGEMENT OF STAGE 5 CHRONIC KIDNEY DISEASE

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This continuing education article, which is based on the best available evidence, includes various learning activities aimed at developing your knowledge and understanding of the nutritional management of stage 5 chronic kidney disease. After reading this article and on completion of the learning activities you will have achieved 3 hours of learning in accordance with the EDTNA/ERCA criteria for continuing professional development.

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SUMMARY

Nutrition is a critical issue in the management of patients with stage 5 chronic kidney disease (CKD). Malnutrition is common among these patients and affects their survival and quality of life. A basic knowledge of the nutritional management of stage 5 CKD is essential for all members of the nephrology team to improve patient care. This paper demonstrates that the needs of haemodialysis patients are more complex than those receiving peritoneal dialysis.

KEY WORDS **Chronic kidney disease • Dialysis • Nutrition • Patient care team**

BIODATA

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AIM

The aim of this continuing education paper is to provide the reader with a basic understanding of the nutritional management of patients with stage 5 chronic kidney disease (CKD) undergoing haemodialysis (HD) or peritoneal dialysis (PD).

LEARNING OUTCOMES

After reading this continuing education paper the reader should be able to:

1. Understand the main causes of malnutrition in stage 5 CKD patients;
2. Identify the key components of the nutritional management of such patients;
3. Organise a referral of such patients to the dietician when needed.

NUTRITIONAL MANAGEMENT OF STAGE 5 CHRONIC KIDNEY DISEASE

Protein-energy malnutrition (PEM), i.e. a loss in lean body mass, which is partly dependent from increased protein catabolism, is common in patients with CKD undergoing dialysis (Siew & Ikizler 2010). PEM is, however, just one aspect of a syndrome known as the malnutrition–inflammation complex syndrome, which takes into account the association between chronic inflammation and nutritional status (Kalantar-Zadeh *et al*. 2003). On the other hand, overweight and obesity are becoming increasingly common in dialysis patients. Although many observational studies have shown that obesity might be associated with better outcomes in dialysis patients, the lack of a clear pathophysiological explanation and, most importantly, the absence of randomised controlled trials testing whether nutritional interventions resulting in weight gain can lead to greater survival, do not warrant modifications of current practice, but this may change in the future (Kalantar-Zadeh 2007).

Table 1 reports the main causes of malnutrition in dialysis patients.

The nutritional support of the dialysis patient aims to control the intake of some nutrients (phosphorus and potassium) and reduce the accumulation of metabolic wastes (urea) between dialysis sessions. This must be done by taking into account the dietary guidelines for the general population for aspects not directly related to renal disease and the preferences of the patient. The specific aims of nutritional support are:

Anorexia[a] caused by
Uraemic toxicity
Impaired gastric emptying
Inflammation with/without co-morbid conditions[a]
Emotional and/or psychological disorders
Dietary restrictions
Prescribed restrictions: low-potassium, low-phosphorous regimens
Social constraints: poverty, inadequate dietary support
Physical incapacity: inability to acquire or prepare food to eat
Nutrient losses during dialysis
Loss through haemodialysis membrane into dialysate
Adherence to haemodialysis membrane or tubing
Loss into peritoneal dialysate
Hypercatabolism caused by co-morbid illness
Cardiovascular disease[a]
Diabetic complications
Infection and/or sepsis[a]
Other co-morbid conditions[a]
Hypercatabolism associated with dialysis treatment
Negative protein balance
Negative energy balance
Endocrine disorders of uraemia
Resistance to insulin
Resistance to growth hormone and/or insulin-growth factor-1
Increased serum level of/or sensitivity to glucagon
Hyperparathyroidism
Other endocrine disorders
Acidaemia with metabolic acidosis
Concurrent nutrient loss with frequent blood losses

Table 1: Causes of wasting and protein-energy malnutrition in dialysis patients.
Adapted from Kalantar-Zadeh *et al* (2003).
[a]May be associated with inflammation.

1. To reduce the accumulation of metabolic wastes, fluids and electrolytes;
2. To prevent metabolic complications of CKD;
3. To replace nutrients lost with dialysis;
4. To promote a satisfactory nutritional status (EDTNA/ERCA 2002).

The dialysis modality affects the nutritional needs of CKD patients. For instance, PD patients have to decrease their energy intake because of the absorption of glucose from the dialysate. On the other hand, their protein requirements may be higher because of protein losses through the peritoneal membrane. The dietary demands of patients on HD are more complex than PD patients and this is confirmed throughout this paper, which concentrates more on the needs of HD patients.

	Haemodialysis	Peritoneal dialysis
DOQI	35 kcal/kg BW/day	35 kcal/kg BW/day
	30–35 kcal/kg BW/day if age ≥ 60 years	30–35 kcal/kg BW/day if age ≥ 60 years
		Consider energy provided by dialysate
ESPEN	35 kcal/kg IBW/day	35 kcal/kg IBW/day
		Fats 30–40% of total energy supply; complex carbohydrates 25–40%; simple sugars restricted
		Glucose absorption must be taken into account
EBPG	30–40 kcal/kg IBW/day	
	Adjusted to age, gender and physical activity level	
EDTNA/ERCA	35 kcal/kg IBW/day	35 kcal/kg IBW/day
	30 kcal/kg IBW/day in the elderly and patients with reduced activity	30 kcal/kg IBW/day in the elderly and patients with reduced activity
		Including calories from peritoneal absorption of glucose

Table 2: Suggested energy intake for the dialysis patient.
DOQI = Disease Outcomes Quality Initiative; ESPEN = European Society for Parenteral and Enteral Nutrition; EBPG = European Best Practice Guidelines; EDTNA/ERCA = European Dialysis and Transplant Nurses Association/European Renal Care Association; IBW = ideal body weight; HBV = high biological value. Adapted from: NKF 2000 (DOQI); Toigo *et al.* (2000) (ESPEN); EDTNA/ERCA 2002; Fouque *et al.* (2007) (EPBG).

Malnutrition in dialysis patients may assume the form of under- or over-nutrition. Under-nutrition results from a decreased energy or protein intake as compared to actual needs. However, the most common cause of under-nutrition in dialysis patients is the prescription of an overly restrictive dietary regimen, a practice that is unfortunately common among physicians (Locatelli *et al.* 2002). Prohibition of various foods are often unwarranted, leading to dietary monotony and may worsen the patient's nutritional status (EDTNA/ERCA 2002). The dietary prescription, made by a dietician specialised in renal disease (Wiggins & Harvey 2002) should always consider the preferences, needs and abilities of the patient (Gray & Gray 2002).

ENERGY

The energy requirements of a typical dialysis patient are similar to those of a healthy individual (Avesani *et al*. 2011). Such requirements can be estimated using a formula provided by guidelines on nutritional care of renal patients (Table 2). A careful dietary history, made by a renal dietician, is central to understanding the patient's nutritional needs and enables the identification of discrepancies between the prescribed and actual dietary intake.

The main cause of under-nutrition in dialysis patients is a low energy intake. As discussed above, this is often due to an overly restrictive dietary regimen. The role of psycho-social factors such as depression, solitude and an inability to prepare meals should also be considered. It must also be kept in mind that a low intake of energy stimulates protein catabolism, because in these conditions proteins are utilised for energy production. For PD patients, one can estimate that during a 6-hour peritoneal exchange, 60–75% of glucose reaches the general circulation. The energy obtained from this source must be considered while developing the dietary plan.

Suggestions for practice

Whether under- or over-nutrition is present, the dietary plan for stage 5 CKD patients should provide an adequate amount of energy to reach her/his ideal body weight. If under-nutrition is present, protein intake should be increased, as a general rule.

Some common causes of altered nutritional status in stage 5 CKD patients and possible solutions are:

1. Dentition problems: soft (cakes, mashed potatoes, rice, cous cous) or semi-liquid foods (soup, pudding, yogurt) should be suggested.
2. Taste disturbance: improve the taste of food by adding spices, garlic, onion, oil, vinegar, lemon.
3. Early satiety (due mostly to impaired gastric emptying) or lack of appetite: small and frequent meals should be recommended (biscuit, ice creams, snacks).
4. Diet too low in energy: add lipids (cream to milk or oil to bread, mayonnaise to sandwich) or carbohydrates (sugar, honey, jam, jelly, candies).
5. Diet too low in protein: add ground meat or cheese to soup, custard to croissant.
6. Fatigue (after a dialysis session), loneliness, lack of social support: ready food or food quickly cooked may be indicated.

Alternatively, there are specific supplements for patients on dialysis, in the form of powders (protein and carbohydrates)

reconstituted and added to food or supplements ready to drink.

Evaluation
The simplest and most effective indicator of energy intake is body weight. Whether the patient has to maintain, lose or increase her/his weight will depend on her/his clinical status. Regular assessment of weight is the cornerstone to evaluating energy balance.

Unplanned weight loss should always be investigated. An unplanned weight loss greater than 10% occurring over 3 months or less has a negative prognostic value (Elia 2000). Of course, in a dialysis patient, oedema may be responsible for an increase in body weight. In this case, provided that anasarca (generalised oedema) is not present, measurement of arm circumference and skin folds (triceps and subscapular) can replace weight measurement for the assessment of nutritional status.

The energy needs of CKD patients are usually estimated on the basis of ideal body weight (IBW), which can be calculated from the body mass index (BMI). BMI is the ratio between weight (kg) and squared height (m^2) and is a predictor of cardio-metabolic disease in the general population. The ideal BMI for CKD patients ranges between 20 and 25 kg/m^2. A BMI $\leq$ 20 kg/m^2 indicates thinness while a patient with a BMI $\geq$ 25 kg/m^2 is considered overweight. Finally, a BMI $\geq$ 30 kg/m^2 indicates obesity. One has to be careful when calculating IBW from BMI. For instance, consider an obese patient with stage 5 CKD who has a BMI of 35 kg/m^2. Initially, one should set his 'ideal' BMI to 30 kg/m^2 and not to 25 kg/m^2, which would be preferable on theoretical grounds. The set-point of 25 kg/m^2 will be applied only when the patient has reached a BMI value of 30 kg/m^2. This is done in order to avoid an underestimation of energy and protein intake relative to actual weight (or overestimation if the patient is underweight) (NKF 2000).

PROTEINS
Renal disease is associated with impaired protein metabolism and population studies suggest that CKD patients tend to spontaneously decrease their protein intake (NKF 2000). Metabolic studies have shown that an average protein intake of 1.2 g/kg IBW/day is needed to maintain a neutral nitrogen balance in dialysis patients. A protein intake between 1.0 and 1.4 g/kg body weight/day is associated with the highest survival in epidemiological studies while values below 0.9 g/kg body weight/day are predictive of lower survival (Fouque *et al*. 2011). At least 50% of proteins should be of high biological value, i.e. they should provide essential aminoacids (NKF 2000; EDTNA/ERCA 2002). Table 3 gives the recommended protein intake for dialysis patients.

	Haemodialysis	Peritoneal dialysis
DOQI	1.2 g/kg IBW/day	1.2–1.3 g/kg IBW/day
	≥50% HBV	≥50% HBV
ESPEN	1.2 g/kg IBW/day	1.2–1.5 g/kg IBW/day
	≥50% HBV	≥50% HBV
		Greater intake if peritonitis
EBPG	At least 1.1 g/kg IBW/day	
	Balanced intake of high quality animal protein and vegetable protein source	
EDTNA/ERCA	1.1–1.2 g/kg IBW/day	1.0–1.2 g/kg IBW/day
		1.5 g/kg IBW/day if peritonitis
	≥50% HBV	≥50% HBV

Table 3: Suggested protein intake for the dialysis patient.
DOQI = Disease Outcomes Quality Initiative; ESPEN = European Society for Parenteral and Enteral Nutrition; EBPG = European Best Practice Guidelines; EDTNA/ERCA = European Dialysis and Transplant Nurses Association/European Renal Care Association; IBW = ideal body weight; HBV = high biological value. Adapted from: NKF 2000 (DOQI); Toigo *et al*. (2000) (ESPEN); EDTNA/ERCA 2002; Fouque *et al*. (2007) (EPBG).

Suggestions for practice
1. Animal foods (meat, fish, eggs, milk and its derivatives) should be present in the diet as they contain essential aminoacids, i.e. aminoacids that can only be obtained from the diet.
2. If a patient has dyslipidaemia, the consumption of fatty sources of proteins (e.g. sausages and cheese) should be reduced and visible fat should be removed from foods.
3. If the patient has an aversion to meat, other protein sources should be suggested (eggs and legumes) in order to avoid malnutrition.

Evaluation
An increased serum urea level (normal range: 10–20 mg/dL) is always present in CKD. High values of serum urea in stage 5 CKD may indicate excessive protein intake, but high values are not easy to interpret as urea may also increase as a result of dehydration, inefficient dialysis and hypercatabolism (Table 1). The protein catabolic rate (PCR) can be employed to estimate protein intake, especially if normalised (nPCR) on body weight (NKF 2000).

Food	Proteins (g/100 g)
Low-fat meat	20
Sausages, bacon and wurstel	15
Salami, ham and speck	30
Fish	18
Rice and corn	8
Flour, pasta, crackers and twice-baked bread	12
Bread, croissant and cookies	8
Ripe cheese (e.g. Emmental)	30
Fresh cheese (e.g. mozzarella)	20
Pulses	25
Eggs	15
Fruit	0.5
Vegetable	2
Oil, butter	0

Table 4: Average protein content of common foods. Data are from the Food Composition Database published by the European Institute of Oncology (Salvini *et al*. 1998). Note that this table is not sufficiently comprehensive to be used with patients and is meant only to help you to familiarise yourself with the general procedure of calculating protein intake.

Time out activity

1. What method is used in your centre/unit to calculate IBW?
2. Calculate the BMI of one or more patients in your centre/unit.
3. Write down the food that you have eaten in a given day and calculate your protein intake for that day using Table 4, which gives the average protein content of some common foods. If you now divide the daily protein intake by your body weight in kg you will calculate your actual protein intake in g/kg body weight/day. How much protein do you eat? Please note that the table is not sufficiently comprehensive to be used with patients and is meant only to help you to familiarise with the general procedure of calculating protein intake.

PHOSPHORUS

Hyperphosphataemia is common in stage 5 CKD patients. A diet with the suggested quantity of protein for a CKD patient carries about 10–13 mg of phosphorus per gram of protein while a single dialysis session can remove up to 800 mg of phosphorous. The ensuing hyperphosphataemia is implicated in hyperparathyroidism, mineral bone disease and cardiovascular disease (NKF 2003). It should be noted that, while increasing protein intake will slightly increase serum phosphate, the survival benefit associated with an increase of proteins between 1.0 and 1.4 g/kg/body weight/day largely outweighs the slight risk of increased serum phosphate (Fouque *et al.* 2011). Table 5 gives the suggested dietary intake of phosphorus for stage 5 CKD patients. There are three basic strategies to control phosphate levels in stage 5 CKD patients: (1) select foods with high protein and low phosphorus content; (2) use phosphate binders and (3) intensify dialysis.

	Haemodialysis	Peritoneal dialysis
DOQI (NKF 2003)	Restricted to 800–1000 mg/day if serum phosphorus level >5.5 mg/dL	Restricted to 800–1000 mg/day if serum phosphorus level > 5.5 mg/dL
ESPEN	17 mg kg IBW	17 mg kg IBW
EBPG	800–1000 mg/day	–
EDTNA/ERCA	1000–1400 mg/day	1000–1400 mg/day

Table 5: Suggested phosphorus intake for the dialysis patient. Adapted from: NKF 2000 (DOQI); Toigo *et al.* (2000) (ESPEN); EDTNA/ERCA 2002; Fouque *et al.* (2007) (EPBG).

Suggestions for practice

Foods with a high content of phosphorus relative to protein are: eggs, shellfish, offal, milk, cheese, nuts and legumes (Cupisti *et al.* 2003). Consumption of these foods should be reduced or avoided according to the patient's preferences. Usual practice would allow 1–2 servings per day of these foods in controlled amounts and only as biochemistry required. Alternatively, smaller portions could be used, but suggestions on how to utilise them should be given to the patient individually in order to improve compliance. Phosphorous containing additives are common in processed foods, especially in meats, cheese, baked products and beverages, and the consumption of these foods has increased substantially in recent years (Benini *et al.* 2011).

Table 6 gives a partial list of commonly used food additives containing phosphorus. This 'hidden' phosphorus can easily double the dietary intake of phosphorus. Unfortunately, many food labels do not report phosphorus content, so educating the patient about reading labels and avoidance of foods with additives are presently the only available options to avoiding such 'hidden' phosphorus (Benini *et al.* 2011).

The main factors limiting compliance with phosphate binders are reported in Table 7. It is very important that patients are instructed on the oral intake of phosphate binders, their frequency and timing (before or during meals).

Additive	Identifier
Phosphoric acid	E 338
Sodium phosphate	E 339
Potassium tripolyphosphate	E 340
Calcium phosphate	E 341
Magnesium phosphates	E 343
Diphosphates	E 450
Triphosphates	E 451
Polyphosphates	E 452
Ammonium phosphatides	E 442
Sodium aluminium phosphate, acidic	E 541

Table 6: Some additives containing phosphorus (http://www.understandingfoodadditives.org).

Barriers to use of phosphate binders
Large number of pills
Need water to ingest pills
Gastrointestinal side effects (constipation, diarrhoea, abdominal pain)
Timing of consumption (should be taken before or during meals)
Type of meal (should be taken with foods richest in phosphorus)

Table 7: Barriers to use of phosphate binders (Kariyawasam 2009).

Category	Mechanisms	Medical/Behavioural interventions
Intake	Excess intake of phosphorus	Encourage dietary adherence
Absorption	Vitamin D supplementation stimulates intestinal phosphorus absorption	Decrease dose or use less hyperphosphatemic vitamin D analogue
Removal	Under prescription of phosphate-binders	Increase prescription of phosphate-binders
	Non-adherence to phosphate-binders	Encourage medication adherence
	Inadequate dialysis dose	Increase dialysis dose
	Lack of residual renal function	Increase dialysis dose
Release	Severe hyperparathyroidism	Medication to suppress parathyroids or surgical removal
	High protein catabolic rate	Ensure adequate caloric intake, and address any underlying cause of catabolism
Acidosis		Administer bicarbonate

Table 8: Medical and behavioural approaches to hyperphosphataemia (Sehgal et al. 2008).

Table 8 summarises medical and behavioural approaches to the treatment of hyperphosphataemia (Sehgal *et al.* 2008).

Evaluation

In stage 5 CKD, serum phosphate levels should be maintained between 3.5 and 5.5 mg/dL (1.13–1.78 mmoL/L). If hyperphosphataemia is present, diet, intake of phosphate-binders, and the dialytic dose should be evaluated (Kariyawasam 2009).

	Haemodialysis	Peritoneal dialysis
DOQI	N/A	N/A
ESPEN	<1 mEq/kg /day	<1 mEq/kg /day
EBPG	<1 mEq/kg IBW/day or 50–70 mmoL/day	
EDTNA/ERCA	2000–2500 mg/day	2000–2500 mg/day

Table 9: Suggested potassium intake for the dialysis patient. DOQI = Disease Outcomes Quality Initiative; ESPEN = European Society for Parenteral and Enteral Nutrition; EBPG = European Best Practice Guidelines; EDTNA/ERCA = European Dialysis and Transplant Nurses Association/European Renal Care Association; N/A = Not available. Adapted from: NKF 2000 (DOQI); Toigo *et al.* (2000) (ESPEN); EDTNA/ERCA 2002; Fouque *et al*. (2007) (EPBG).

Time out activity

1. Read the following articles for more detailed information on phosphate control: Cupisti *et al* (2003) and Benini *et al.* (2011).
2. Read the nutrition labels of some foods and look for the additives listed in Table 6. In Europe, each additive is coded by a number preceded by the letter 'E'. Discuss this topic with your patients.

POTASSIUM

Control of dietary potassium is important to prevent hyperkalaemia between dialysis sessions. The kidney excretes 90% of dietary potassium and the intestinal excretion of potassium is increased during CKD, as a compensatory mechanism. For this reason, constipation may favour hyperkalaemia while diarrhoea may be responsible for hypokalaemia because of potassium loss. Dialytic efficiency is central to the maintenance of an acceptable potassium level and the use of a potassium-enriched dialysate should be avoided, if not strictly necessary. Table 9 gives the suggested dietary intake of potassium for stage 5 CKD patients. Among foods, an excessive consumption of fruits and vegetables may lead to hyperkalaemia. Drugs that may induce hyperkalaemia include steroids, ACE-inhibitors and potassium-sparing diuretics. Loss of intracellular potassium is promoted by acidosis and hyperglycaemia (NKF 2009). CKD patients should not use a salt substitute as part of a low-sodium diet as this will often increase the intake of potassium and the risk of hyperkalaemia. It should also be pointed out that

Washing
Cut foods in pieces before washing
Wash with abundant water
Keep in water for some time
Cooking
Peel skin off before cooking (potatoes, carrots)
Cook in abundant water
Change cooking water
Cook in small pieces
Squeeze water out after cooking
Other
Fruits: prepare a fruit salad; cut fruits in small pieces and wait some time before consumption; use fruit syrup (do not consume the syrup)
Vegetables: pre-boiled or picked in oil, vinegar or brine

Table 10: Techniques to reduce the potassium content of food (http://www.uptodate.com/contents/patient-information-low-potassium-diet).

food additives may contain significant quantities of 'hidden' potassium (Sherman & Mehta 2009).

Suggestions for practice

To avoid dietary restrictions impacting too much on a patient's nutritional status and quality of life, the patient should be instructed on the following strategies:

1. choose foods low in potassium;
2. reduce portion sizes and/or frequency of consumption of potassium-rich foods;
3. use cooking procedures that favour demineralisation (Table 10).

Boiling vegetables in large volumes of water reduces their mineral content and may be a useful adjunct to a diet low in potassium. The boiled water should not be reutilised because it contains the minerals lost during cooking. Microwave and steam cooking of vegetables should be avoided as foods retain their minerals. Because these techniques induce loss of nutrients other than potassium, the patient's nutritional status should be continuously evaluated in order to ensure nutritional adequacy (EDTNA/ERCA 2002).

Evaluation

Check that the serum potassium level is within normal range. If hyperkalaemia is present, not only should the dietary intake be investigated but also the use of potassium-sparing drugs, the degree of dialytic efficiency and the presence of hypercatabolism.

	Haemodialysis	Peritoneal dialysis
DOQI	N/A	N/A
ESPEN	60–100 mEq/day	60–100 mEq/day
EBPG	80–100 mEq/day	
EDTNA/ERCA	1800–2500 mg/day	1800–2500 mg/day

Table 11: Suggested sodium intake for the dialysis patient. DOQI = Disease Outcomes Quality Initiative; ESPEN = European Society for Parenteral and Enteral Nutrition; EBPG = European Best Practice Guidelines; EDTNA/ERCA = European Dialysis and Transplant Nurses Association/European Renal Care Association; N/A = Not available. Adapted from: NKF 2000 (DOQI); Toigo *et al*. (2000) (ESPEN); EDTNA/ERCA 2002; Fouque *et al*. (2007) (EPBG).

SODIUM AND FLUIDS

In stage 5 CKD there is a substantial decrease of sodium excretion, which may be responsible for an increase in extracellular water. Such expansion is responsible for hypertension while a too rapid removal of sodium during dialysis is associated with hypotension and arrhythmias. As noted above, CKD patients should not use a salt substitute as it may increase the risk of hyperkalaemia.

Suggestions for practice

Bread, baked products, precooked foods and sausages are the most common sources of sodium in a western diet besides salt added to foods. Sodium content is often reported on food labels. As a general rule, foods containing less than 0.5 g of sodium/100 g can be considered low in sodium. The food industry provides a large range of low-sodium foods that can be employed to control sodium intake in dialysis patients. Spices and aromatic herbs may replace sodium to enhance taste and appetite. In order to maintain control of fluid intake, it can be suggested to drink from a single bottle; to use small glasses; to refresh the mouth with ice cubes or small pieces of fruits or vegetables (not in excess of the dietary allowance). Tables 11 and 12 outline suggested sodium and fluid intake for dialysis patients.

Evaluation

An acceptable weight gain between dialysis sessions should be 1.5–2.0 kg or 4% of body weight (Fouque *et al.* 2007).

VITAMINS

The loss of water soluble vitamins associated with dialysis is partly counteracted by the loss of renal function, which decreases their catabolism. Dietary manipulation, even if aimed at controlling potassium and sodium intake, may lead to

	Haemodialysis	Peritoneal dialysis
DOQI	N/A	N/A
ESPEN	500–800 mL/day + daily urine output (taking into account the fluid content of foods)	500–800 mL/day + residual urinary volume (taking into account the fluid content of foods)
EBPG	Intradialytic weight gain < 4–4.5% of dry body weight	
EDTNA/ERCA	500 mL + daily urine output – includes only foods that are liquid at room temperature and those with high fluid content	800 mL + daily urine output – includes only foods that are liquid at room temperature and those with high fluid content

Table 12: Suggested fluid intake for the dialysis patient.
DOQI = Disease Outcomes Quality Initiative; ESPEN = European Society for Parenteral and Enteral Nutrition; EBPG = European Best Practice Guidelines; EDTNA/ERCA = European Dialysis and Transplant Nurses Association/European Renal Care Association; N/A = Not available. Adapted from: NKF 2000 (DOQI); Toigo *et al*. (2000) (ESPEN); EDTNA/ERCA 2002; Fouque *et al*. (2007) (EPBG).

clinically relevant losses of some vitamins. Routine supplementation of vitamins involved in iron and calcium metabolism is common in dialysis patients; other vitamins should be prescribed only when necessary (EDTNA/ERCA 2002).

NUTRITIONAL ASSESSMENT

A careful bio-psycho-social evaluation of the patient is a prerequisite for nutritional planning. Such evaluation requires a contribution from all members of the nephrology team (nephrologist, nurse, dietician, psychologist and social worker) and is essential to promote compliance not only with the dietary regimen, but also with the overall treatment.

The nutritional status of the patient should be reassessed every 3–6 months and the dietary regimen should be modified according to changes in patient preferences and clinical status. The routine assessment of nutritional status involves:

1. evaluation of dietary intake;
2. nutritional anthropometry (measurement of body dimensions sensitive to nutrition such as weight, BMI, circumferences and skin folds);
3. laboratory examinations.

Dietary intake is evaluated by the dietician using a dietary history, repeated interviews or food diaries. Measurement of weight (actual and dry), height and waist circumference should be performed in all patients. In selected cases, arm circumference and the two most accessible skin folds (triceps and biceps) can be evaluated. These measurements are especially useful in the presence of oedema. Among the laboratory examinations, the most important are serum urea, albumin, potassium, phosphate, serum calcium and nPCR (NKF 2009). Subjective global assessment (SGA) of nutritional status may be useful for screening purposes, but it is not equivalent to an assessment of nutritional status as it lacks longitudinal validation (Steiber *et al.* 2004). Screening instruments, which are increasingly employed in hospitals to screen for hospital malnutrition, are the Malnutrition Universal Screening Tool (MUST) and the Nutritional Risk Score (NRS) (Kondrup *et al.* 2003). These tools are not specific for CKD patients, but may be useful at a first screening for under-nutrition.

Time out activity

Clinical vignette: Andrew is a 74-yr-old male who has stage 5 CKD, weighs 64 kg and has a BMI of 24 kg/m^2. He has a haemoglobin of 9.5 g/dL, a blood urea nitrogen of 97 mg/dL, a serum creatinine of 11.5 mg/dL and a serum phosphate of 7 mg/dL. His KT/V is 1 and his dietary recall reveals a total energy intake of 1950 kcal/day, a protein intake of 62 g/day, a phosphate intake of 1160 mg/day and a potassium intake of 1950 mg/die. He does not take his prescribed phosphate binder regularly because of intestinal bloating.

What are the possible causes of Andrew's hyperphosphataemia?

CONCLUSION

Patients with CKD have to cope with complex modifications to their diet and lifestyle. It is important that all members of the nephrology team collaborate in evaluating the efficacy of the diet and refer the patient to the dietician when necessary. A renal dietician is central to the nutritional management of CKD patients as she/he will integrate the results of the medical and dietary histories with the nutritional assessment and develop the dietary plan considering the attitudes and preferences of the patient (Gray & Gray 2002). In some countries specialist renal dietitians are not always available, but it is necessary to ensure that specialist dietary advice can be accessed either from a knowledgeable dietitian or nephrologist.

Nurses are in the forefront in patient education, support, screening and information reinforcement. As nurses are

involved in evaluating the efficacy of the treatment and reinforcing all prescriptions including the dietary prescription, it is essential that they have an understanding of basic nutritional principles to stimulate discussions and understanding with patients. Multidisciplinary team work is the keyword for a successful approach to the long-lasting process of adaptation imposed by CKD, which includes important modifications to diet and lifestyle.

Key Learning Points

- Malnutrition is common among CKD patients and affects their survival and quality of life;
- Nutritional support of the dialysis patient aims to control the intake of some nutrients and reduce the accumulation of metabolic wastes between dialysis sessions;
- Nutritional assessment is the cornerstone for nutritional planning and requires the contribution of all members of the nephrology team.
- Dietary prescription should be made by a dietician considering the preferences, needs and abilities of CKD patients

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FP wrote the first draft of manuscript, MP, GB, ALF and MMC revised it. MMC provided the final language check.

CONFLICT OF INTEREST
No conflict of interest has been declared by the authors.

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