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Nutrition for Chronic Kidney Disease, Stage 5

INTRODUCTION

INTRODUCTION

- Nutrition is a cornerstone of treatment for many diseases
- Diet is paramount in the treatment of all stages of CKD
- Diet for dialysis patients is complicated, multifaceted, and must be individualized to each patient's needs.
- Maximizing intake with adequate protein and calories while limiting fluid, sodium, potassium, and phosphorus
- Mortality rates for patients on dialysis (Stage 5) higher than the general population.

Protein Energy Wasting (PEW)

- Protein energy wasting (PEW) is a maladaptive metabolic state, well defined in end-stage renal disease (ESRD) patients.
- The International Society of Renal Nutrition and Metabolism (ISRNM) recommends use of the term "protein energy wasting" for loss of body protein mass and fuel reserves in patients with CKD and ESRD.
- PEW should be distinguished from malnutrition.
- The latter is due to inadequate intake of nutrients with intact adaptive metabolic responses

Protein Energy Wasting (PEW)

- PEW, or its extreme form, cachexia, is a dysfunctional state common in inflammatory conditions, which is resistant to nutritional supplementation.
- PEW occurs in 20 - 70% of adults treated with dialysis
- Quality of life is significantly affected by PEW, which is associated with :
    - Increased frailty
    - Decreased mobility
    - And psychological effects

Protein Energy Wasting (PEW)

- CKD patients with PEW have increased :
  - Morbidity, Mortality, And diminished quality of life.
- This dysfunctional metabolic state is characterized by :
  - Anorexia
  - Ineffective utilization of nutrients
  - Augmented muscle protein catabolism, which leads to loss of lean body mass

Protein Energy Wasting (PEW)

- A multitude of factors contribute to PEW, including :
  - Inflammation
  - Oxidative stress
  - Hormonal dysregulation
  - Resistance to the actions of insulin and growth hormone (GH)
  - Metabolic acidosis
- These factors trigger muscle breakdown through :
  - Activation of the ubiquitin proteasome system
  - Oxidation of branched-chain amino acids
  - And apoptosis

Pathophysiology of PEW in CKD patients is multifactorial and includes :

Insufficient nutrient intake is an integral component in the development and maintenance of PEW.

- Accumulation of uremic retention solutes or "toxins,"
- Low Testosterone levels
- Metabolic acidosis
- Inflammation
- Increase in inflammatory cytokines
- Oxidative stress
- Comorbidities
- Anorexia
- Decreased nutrient intake
- Nutrient insufficiency
- Energy expenditure
- Insulin resistance
- Growth hormone resistance
- Changes in taste
- Disruption of appetite sensing molecules, such as ghrelin and leptin.

Pathophysiology of PEW in CKD patients

- Anorexia is present in 30 - 40% of dialysis patients
- Hirako et al. demonstrated that patients with CKD prior to initiation of dialysis had
  - Gastric hypomotility
  - Impaired gastric myoelectrical activity
  - Delayed gastric emptying
- Other factors that can influence nutrient intake in CKD patients include:
  - Depression
  - Socioeconomic status
  - Altered mental status.

DIAGNOSIS OF PEW IN CKD

- Diagnosis of PEW in CKD patients is determined by four key categories:
- (1) Changes in biochemical indicators :
  - Albumin < 3.8 g per 100 Ml
  - Serum prealbumin
  - Serum cholesterol < 100 mg/dL
- (2) weight loss, decrease in total body fat, and low body weight
  - BMI < 23 kg/m2
  - Weight loss> 5% in3 months or >10% in 6 months
  - Fat mass loss > 10% of body weight

DIAGNOSIS OF PEW IN CKD

- (3) decrease in muscle mass
  - Loss of muscle mass > 5% in three months or > 10% in 6 months
  - Reduced midarm muscle circumference area
  - Creatinine appearance < 1 g/kg ideal body weight
- (4) low protein or energy intake
  - Dietary protein intake < 0.6 g/kg per day (CKD stage 2 to 5)
  - Dietary energy intake < 25 kcal/kg per day for ≥ 2 months

DIAGNOSIS OF PEW IN CKD

- At least three out of these four categories, with at least one criterion from each of these categories, should be satisfied to establish the diagnosis of PEW in CKD patients.
- Fulfillment of these criteria should be observed at least three times at intervals of 2- 4 weeks.
- The ISRNM recommends that at least one of the diagnostic criteria includes a biochemical indicator, such as S[Alb].

DIAGNOSIS OF PEW IN CKD

- Circulating levels of albumin and prealbumin are strong predictors of mortality in CKD and dialysis patients, but can be affected by inflammation
- Hypoalbuminemia may reflect low levels of nutrition or inflammation.
- Low levels of serum prealbumin, or transthyretin, can also be a measure used for diagnosis in dialysis patients
- Serum cholesterol level less than 100 mg/dL is also a biochemical indicator of PEW.

Insufficient nutrient intake

- Malnutrition affects 40%–70% of all dialysis patients and significantly increases mortality risk.
- Reasons for malnutrition in dialysis patients include:
  - Complications from kidney failure: uremia, fatigue, weakness, nausea, and vomiting.
  - Patients do not eat secondary to poor appetite, dietary monotony, and lack of physical/financial support.
  - Complications from various comorbid conditions such as DM and CV disease also affect dietary intake
  - Poor intake related to inadequate dialysis

Insufficient nutrient intake

- Under dialyzed patients experience decreased taste acuity and anorexia resulting in insufficient dietary energy and protein intake
- In patients who are adequately dialyzed, dietary restrictions and fluid limitations may impair oral intake.
- Appetite stimulants (megace, prednisone) and antidepressants with an appetite enhancing side effect (remeron) may be used in some settings
- Use is controversial and clinical trials predicting long-term positive outcomes are limited.
- Use should be monitored closely and dosing should be adjusted and tapered carefully to avoid negative side effects

Calorie & Protein Needs

- Calorie guidelines based on the established weight range from 30 to 35 calories/kg/day for CHD and 25–35 cal/kg/day for PD.
- PD calories should include calories absorbed from the dialysis solutions.
- Once the energy goal is established, an intake of approximately 1.2 g/protein/kg per day is recommended for hemodialysis patients according to current K/DOQI guidelines.

Calorie & Protein needs

- Protein needs for PD patients may be slightly higher because of increased protein losses ranging from 1.2 to 1.3 g/kg/d
- Has recommended a goal albumin for all dialysis patients of 4 g/dL.
- Amino acid losses are estimated at 8–12 g per CHD treatment

TREATMENT OF PEW IN CKD

- Treatment of PEW begins with early identification of the etiologic factors causing nutrient insufficiency and muscle catabolism.
- Treatment of PEW includes
  - Changing diet
  - Adding nutritional supplements
  - Incorporating both aerobic and resistance exercise
  - Pharmacological therapy for metabolic acidosis, insulin, and GH resistance
  - As well as administration of anabolic steroids

DIET PRESCRIPTION: FLUIDS

- Fluid restriction varies with the type of dialysis.
- Typically, CHD dialysis goals are <3% of dry or target weight between treatments.
- Many patients just starting CHD have residual urine output that allows for a more liberal fluid prescription.
- The usual fluid restriction is 1000 mL/day plus urine output.
- Included in the fluid restriction are all foods or beverages that are liquid at room temperatur

DIET PRESCRIPTION : FLUIDS

- Dialysis patients who are diabetic appear to have greater thirst. Suspected causes include :
- Poor glucose control, sodium shifts associated with the dialysis treatment, or high dietary intake of sodium.
- Educating patients about all sources of fluid, including ice chewing, is paramount to controlling fluid weight gain between treatments.
- Cardiomyopathy and other cardiovascular diseases may make it hard for some patients to tolerate even small amounts of fluid removal.

DIET PRESCRIPTION : FLUIDS

- Fluid intake will need to be adjusted to accommodate patients' individual needs.
- Fluid weight-removal goals are individualized based on the patient's intake and dialysis prescription.
- Patient education and follow-up are needed to ensure that the patient understands the risk of ongoing fluid overload.
- There is significant cardiovascular stress created from attempting to remove excessive fluid in a defined treatment time of 3–5 h for CHD.
- For the more-frequent dialysis modalities PD, SDD, and NHD, it is not always necessary to restrict fluid intake unless it exceeds the maximum that can be removed during the treatment regimen.

DIET PRESCRIPTION : SODIUM

- Sodium restriction is determined by the patient's fluid and hypertensive state.
- Hypotensive patients may benefit from additional dietary sodium, and normotensive patients may need only a healthy dietary limitation of 2400 mg/day
- Dietary Reference Intake guidelines recommend further limiting Na to <1500 mg/day for people with chronic diseases such as diabetes, hypertension, and kidney disease
- Convenience foods, table salt, fast foods, enhanced meats, canned vegetables, and other highly processed foods are the greatest sources of sodium for dialysis patients.

DIET PRESCRIPTION : POTASSIUM

- Potassium (K) intake for patients on CHD is usually restricted to 2–3 g/day.
- Patients on the more-frequent dialysis modalities may not require restriction or may only need to restrict K on their days off dialysis.
- Patients with low-normal serum levels may not need to limit K.
- Patients who have low potassium levels should be encouraged to increase potassium intake to avoid symptoms such as muscle cramping.

DIET PRESCRIPTION : POTASSIUM

- Monthly laboratory test results can guide decisions on optimal K intake.
- Some patients may need to restrict more during their longest interdialytic period and may eat more freely during the week.
- The sources of hidden potassium in processed foods continue to grow as lower sodium goals are embraced

DIET PRESCRIPTION : POTASSIUM

- The goal for K, is typically 3.5–6 mEq/L for CKD patients.
- Hyperkalemia may present as:
  - General muscle weakness
  - Difficult ambulation
  - Bradycardia and can be life threatening
  - However, many patients are asymptomatic.

Hyperkalemia

- Treatment goals include determining the cause of hyperkalemia.
- Nondietary causes include :
  - Hemolysis of lab sample
  - Inadequate dialysis
  - High K concentration in dialysate
  - Catabolism
  - Hyperglycemia
  - Insulin deficiency in diabetics
  - Acidosis
  - Interactions with drugs including ACEI and beta blockers.

DIET PRESCRIPTION : POTASSIUM

- Dietary sources of high potassium are potatoes, tomatoes, oranges, nuts, and any products containing KCl.
- One teaspoon of salt substitute as NOSalt contains 664 mg potassium
- Potatoes and other tuberous root vegetables (e.g., yucca, batata, eddo, yampi, and yams) are a significant part of the diet for many persons.
- The potassium content of these vegetables can be reduced by double cooking.
- The vegetables should be peeled and sliced, covered in water, brought to a boil, cooked 5–10 min, and then drained. Fresh water should be added to the cooking pot, brought to a boil for the second time, and the vegetable cooked until it is soft and tender

VITAMINS AND MINERALS

- In hemodialysis, vitamin needs are increased because of the loss of B vitamins.
- All patients should be on a renal multivitamin to ensure adequate vitamin replacement in addition to dietary intake.
- Vitamin replacement is typically one renal vitamin per day after dialysis.
- Patients doing more frequent hemodialysis may need additional supplementation due to higher losses with increased dialysis time, and therefore, removal of water-soluble vitamins
- Over-the-counter multivitamins are contraindicated in CKD Stage 5 because of the risk of toxicity from excessive fat-soluble vitamins, particularly vitamin A

VITAMINS AND MINERALS

- Vitamin C should not be supplemented beyond the reference daily intake (RDI) due the risk of oxalic stone development.
- Newer renal vitamins contain zinc and/or nutritional vitamin D and may be appropriate for use in some patients.
- Use of herbal supplements and over-the-counter nutritional supplements should be evaluated closely.
- Since vitamins, minerals and herbs are cleared through the kidney, it is reasonable to recommend limiting or avoiding use of supplementation when kidney function is impaired.

VITAMINS AND MINERALS

- Calcium intake should be limited to <2000 mg of elemental calcium/day from all sources:
  - Dialysate
  - Calcium-based phosphate binders
  - Calcium supplements
  - And Diet
- Dairy products can be consumed in small amounts depending on the patient's dietary prescription.
- Consumption of calciumfortified foods should be limited.
- Calcium blood levels should be maintained within the normal range

VITAMINS AND MINERALS

- Phosphorus intake is limited in conjunction with recommended protein intake.
- Typical restriction is 10–12 mg/g of protein or 800–1000 mg/day; however, the use of daily dialysis liberalizes any restrictions
- Organic phosphorus was the greatest concern and source of phosphate intake.
- In 1990, inorganic phosphorus made up approximately 400 mg of dietary phosphorus intake/day.
- Although there are no comprehensive study results available, inorganic phosphorus intake is now estimated to approach 1500–2000 mg/day.

VITAMINS AND MINERALS

- Inorganic phosphorus is not attached to protein and is therefore absorbed at 100% versus approximately 60% for organic phosphorus.
- Inorganic phosphorus is a food additive, enhancer, and preservative
- There are no labeling guidelines and the amounts may vary significantly.
- The use of convenience or enhanced foods leads to a much higher phosphorus intake than is recommended for CKD

Vitamin Recommended Amount/Day

- Vitamin C 60–100 mg
- Thiamin (B1) 1.5 mg
- Riboflavin (B2) 1.7 mg
- Niacin 20 mg (as niacinamide)
- Pyridoxine (B6) 10 mg
- Cobalamin (B12) 6 mcg
- Folic acid 1 mg
- Pantothenic acid 5–10 mg
- Biotin 150 mcg
- Zinc 12.5 mg

Daily Nutrient and Fluid Needs for Adults Undergoing Conventional Hemodialysis

Nutrients	Recommendations
Energy	30–35 kcal/kg
Protein	≥ 1.2 g/kg
Sodium	1500–2400 g
Potassium	2–3 g
Fluids mL	Urine output plus 1000
Calcium	≤2 g including binder load
Phosphorus	10–12 mg/g/protein
Ascorbic acid	60–100 mg
Pyridoxine	5–10 mg
B12	3 µg

Nutrients	Recommendations
Folic acid	1–5 mg
No A or K	
Zinc	15 mg
Riboflavin	1.8–2.0 mg
Niacin	20 mg
Thiamin	1.5–2.0 mg
Biotin	20–30 µg
Vitamin E	10–15 IU
Pantothenic acid	10 mg
Iron Individualized	
Active vitamin D	As needed to treat MBD
Nutritional vitamin D	Replete to normal lab value for D3

PHOSPHORUS

- Phosphorus levels are difficult to control in ESRD through dietary restrictions only.
- Phosphate binders are necessary to maintain acceptable blood serum levels.
- Typical binders include calcium carbonate, calcium acetate, magnesium carbonate, lanthanum carbonate, and sevelamer carbonate.
- Aluminum hydroxide is a very effective binder, but it is rarely used because of the potential for aluminum toxicity.

IRON

- Iron deficiency is a frequent concern in patients receiving dialysis.
- Causal factors include gastrointestinal loss, blood draws, bleeding at the dialysis access site, and blood collection in the hemodialyzer membrane.
- There is also increased demand for iron during erythropoietin therapy.
- Some patients are able to maintain adequate serum levels through diet and oral supplements
- However, the majority of patients require parenteral iron therapy.

Higher Phosphorus Foods

Food	Portion	Amount of Phosphorus(mg)
Almonds	22	133
Baked beans	1 Cup	258
Black-eyed peas, frozen, boiled	1 Cup	208
Bran cereal, 100%	1/2 Cup	344
Cheese sauce	1/2 Cup	278
Couscous	1 Cup	294
Ice cream, chocolate	1 Cup	170
Ice cream, vanilla	1 Cup	138
Lima (butter) beans, boiled	1/2 Cup	110

Higher Phosphorus Foods

Food	Portion	Amount of Phosphorus(mg)
Milk, 2%	1 cup	229
Peanuts, oil roasted	1 cup	572
Peanut butter, creamy smooth	2 Tbsp	115
Split peas, boiled	1 cup	194
Sunflower seeds	1 oz	322
Taco	1 large	313
Trail mix with chocolate, nuts, and seeds .	1/2 cup	283
Whole wheat bread	1 slice	59
Yogurt, low-fat-fruit flavor	8 oz	270

SUMMARY

- Maintaining proper nutrition in the dialysis patient requires a patient-centered team approach.
- Socioeconomic status, mental and physical cognitive levels, and comorbid conditions all play a role in the maintenance of a patient's nutritional status.
- To determine the best course of action for each patient, an individualized care plan must be established along with measurable goals as soon as CKD is recognized.
- Interventions can include dietary nutritional supplementation and appetite stimulants.

SUMMARY

- Use of appetite stimulants is controversial and clinical trials predicting long-term positive outcomes are limited.
- Use should be monitored closely and dosing should be adjusted and tapered carefully to avoid negative side effects
- They can improve nutrition outcomes quickly.
- In extreme cases of malnutrition, patients may require short- or long-term use of intradialytic parenteral nutrition or home total parenteral nutrition.

SUMMARY

- The correction of social and/or economic barriers through assistance programs such as Meals On Wheels or home health care providers can be beneficial.
- In some cases, placing the patient in assisted living or nursing facilities will provide the best outcome.
- Regardless, a patient who is failing nutritionally will not survive if not treated aggressively and correctly.
- Focusing on the total nutrition picture, prioritizing goals and helping the patient and family understand the need for changes to the diet will ultimately prove the most valuable to the dialysis patient.