20

Nutrition for Patients With Renal Disorders

TRUE	FALSE	
○	○	**1** Early in the course of chronic renal disease, limiting protein may help to preserve kidney function.
○	○	**2** Foods high in protein tend to be high in phosphorus.
○	○	**3** Milk is an excellent source of high biologic value protein for people with pre-end stage renal disease.
○	○	**4** All people with renal impairments need to limit their sodium intake.
○	○	**5** People with chronic renal disease tend to have accelerated atherosclerosis and may benefit from eating more monounsaturated fat.
○	○	**6** Dialysis causes protein requirements to increase about 50% above normal.
○	○	**7** People receiving peritoneal dialysis absorb calories from the dialysate.
○	○	**8** People who have gained more than 2 pounds between dialysis treatments have eaten too many calories.
○	○	**9** People with calcium oxalate renal stones should avoid calcium.
○	○	**10** The most effective nutritional intervention for renal stones is to increase fluid intake.

UPON COMPLETION OF THIS CHAPTER, YOU WILL BE ABLE TO

- Discuss the nutrient recommendations for pre-end stage renal disease (ESRD), ESRD, acute renal failure, and nephrotic syndrome.
- Describe what those nutrient recommendations mean in terms of teaching clients what to eat.
- List ways to promote dietary compliance.
- Describe nutritional interventions for renal stones.

Nitrogenous Wastes: wastes produced from nitrogen, namely ammonia, urea, uric acid, and creatinine.

Rennin: an enzyme secreted by the kidneys in response to a reduced blood flow that stimulates the release of aldosterone.

The kidneys perform many vital endocrine and exocrine functions. They maintain normal blood volume and composition by reabsorbing needed nutrients and excreting wastes through the urine. Urinary excretion is the primary method by which the body rids itself of excess water, nitrogenous wastes, electrolytes, sulfates, organic acids, toxic substances, and drugs. The kidneys help to regulate acid–base balance by secreting hydrogen ions to increase pH and excreting bicarbonate to lower pH. The kidneys are involved in blood pressure regulation through the action of rennin and in red blood cell production through the action of erythropoietin. Because vitamin D is converted to its active form in the kidneys, they have an important role in maintaining normal metabolism of calcium and phosphorus.

This chapter discusses nutrient recommendations for pre-end stage renal disease (ESRD), ESRD, posttransplant, acute renal failure (ARF), and nephrotic syndrome. Nutrition recommendations for preventing and treating kidney stones are presented.

RENAL DISEASE

Erythropoietin: a hormone secreted by the kidneys that stimulates the bone marrow to produce red blood cells.

Active Form of Vitamin D: 1,25-dihydroxycholecalciferol.

Renal damage and subsequent loss of renal function profoundly affect metabolism, nutritional requirements, and nutritional status. As urine output decreases, fluid and electrolytes accumulate in the blood. The retention of nitrogenous wastes leads to uremic syndrome. Acidosis occurs because the kidneys are unable to excrete excess acid produced through normal metabolic processes. Reabsorption of some nutrients is impaired, which causes them to be lost in the urine. GI absorption of some minerals, such as calcium and iron, is impaired. Impaired synthesis of renin, erythropoietin, and vitamin D can lead to high blood pressure, anemia, and bone demineralization, respectively. Certain peptide hormones, such as insulin, parathyroid hormone, and glucagon, are not adequately inactivated, which contributes to altered metabolism. Accelerated atherosclerosis increases the risk of congestive heart failure, myocardial infarction, and further renal damage. Poor intake related to dietary restrictions, anorexia, alterations in taste, nausea, vomiting, stomatitis, depression, or anxiety is common. In addition, nutrients may be lost secondary to drug therapy, dialysis, or renal transplantation. In short, the disruption to homeostasis is profound.

Renal damage can occur secondary to kidney disorders such as glomerulonephritis, polycystic kidney disease, obstructive kidney stones, or congenital kidney malformations. Diabetes is the leading cause of renal failure in the United States. Hypertension and hypercholesterolemia also increase the risk of renal disease. Some people diagnosed with early renal disease may never progress to irreversible late stage disease. Lifestyle changes, including diet, can slow the progress of the disease when initiated early.

Nutrition Therapy

Nutrition therapy has an integral role in the management of renal disease. Its lofty goals are to:

Uremic Syndrome: a cluster of symptoms related to the retention of nitrogenous substances in the blood such as fatigue, decreased mental acuity, muscle twitches, cramps, anorexia, unpleasant nausea, vomiting, diarrhea, itchy skin, gastritis, and GI bleeding.

- Reduce renal workload to delay or prevent further kidney damage
- Restore or maintain optimal nutritional status
- Control the accumulation of uremic toxins such as urea, phosphorus, sodium, and sometimes potassium

The optimal interventions needed to meet these objectives vary among individuals and according to the nature, severity, and stage of the disease. Generally, diet modifications are made in response to symptoms and laboratory values and, therefore, require frequent monitoring and adjustment. Alterations in the intake of protein, calories, sodium, fluid, potassium, phosphorus, calcium, and other vitamins and minerals are necessary initially or eventually. The diet is both complex and dynamic. Table 20.1 summarizes the nutrient recommendations in chronic renal disease discussed here.

Pre–End Stage Renal Disease

Pre-ESRD, a predialysis condition, is characterized by an increase in serum creatinine levels secondary to a decline in renal function. The goals of nutrition therapy are to (1) help preserve remaining renal function; therefore, the focus is on limiting the intake of protein and phosphorus; and (2) control risk factors such as blood glucose levels and hypertension as appropriate. Potassium is usually not a concern until urine output is less than 1 L/day. A sample menu appears in Box 20.1.

Protein

Pre-end Stage Renal Disease: the period of renal failure when renal function is impaired but not to the degree where dialysis or transplant is required. Also known as renal insufficiency.

Protein restriction is the cornerstone of nutrition therapy for pre-ESRD. Studies show that protein restriction can slow the progression of renal disease, although the optimal level of dietary protein has not been determined. In theory, less protein intake generates less urea, so BUN levels decrease and symptoms of uremia, such as nausea and vomiting, improve.

A narrow margin of error exists with regard to protein intake. Whereas too much protein increases BUN levels and the symptoms of uremia, too little protein results in body protein catabolism (which increases serum potassium and BUN levels) and protein malnutrition as evidenced by low serum albumin levels. Low serum albumin is a strong predictor of mortality in patients starting dialysis.

For pre-ESRD, the recommended daily protein intake is 0.6 to 1.0 g/kg of ideal or adjusted body weight, a range that extends from slightly below the normal RDA for protein (0.8 g/kg) to slightly above. Protein allowance may begin at 1.0 g/kg and be adjusted downward as the disease progresses. Limiting protein to 0.6 g/kg can be difficult to implement because most Americans generally consume almost twice this level.

There is some evidence to suggest that some animal proteins, such as red meat, are more damaging to the kidneys than are vegetable proteins such as soy. Because restricting protein is so difficult, a compromise may be to substitute vegetable protein for some animal protein.

TABLE 20.1

NUTRIENT RECOMMENDATIONS FOR CHRONIC RENAL DISEASE

Nutrient	Pre-End Stage Renal Disease	Hemodialysis	Peritoneal Dialysis
Protein	0.6–1.0 cal/kg; >50% HBV sources	1.1–1.4 g/kg; >50% HBV sources	1.2–1.5 g/kg; >50% HBV sources
Calories	35 cal/kg ideal or adjusted weight (<60 years old) 30–35 cal/kg ideal or adjusted weight (>60 years old)	35 cal/kg ideal or adjusted weight (<60 years old) 30–35 cal/kg ideal or adjusted weight (>60 years old)	35 cal/kg ideal or adjusted weight (<60 years old) 30–35 cal/kg ideal or adjusted weight (>60 years old) Subtract calories absorbed from dialysate
Sodium	Individualized or 1–3 g/day	Individualized or 2–3 g/day	Individualized or 2–4 g/day
Potassium	Individualized per lab values	Individualized per lab values or 40 mg/kg ideal or adjusted weight	Individualized per lab values
Phosphorus	Individualized or 8–12 mg/kg ideal or adjusted weight	Individualized or <17 mg/kg ideal or adjusted weight	Individualized or <17 mg/kg ideal or adjusted weight
Calcium	Individualized per calcium, phosphorus, PTH lab values	Individualized per lab values; approximately 1000 mg/day	Individualized per lab values; approximately 1000 mg/day
Fluid	Individualized	500–750 mL + urine output/day	Individualized
Vitamin and mineral supplement	Individualized	Individualized	Individualized

Renal Practice Group of the American Dietetic Association. (2002). *National renal diet: Professional guide* (2nd ed.). Chicago: American Dietetic Association.

BOX 20.1

SAMPLE RENAL MENUS: PRE-ESRD DIET VERSUS ESRD DIET

Sample Pre-ESRD Diet: 42 g Protein, at least 2300 Calories	Sample ESRD Diet: 90 g Protein Diet, 2600 cal, 2g K, 3g Na, 1200 mg P
Breakfast	
½ cup orange juice	1 medium canned plum
1 English muffin	1 English muffin
At least 1 tbsp margarine	1 tbsp margarine
	2 eggs fried in margarine
Jelly	Jelly
Coffee	1 cup coffee
Sugar	Sugar
Nondairy creamer	Nondairy creamer
Lunch	
Sandwich made with	
1 oz turkey	2 oz turkey
2 slices white bread	2 slices white bread
At least 2 tbsp mayonnaise	2 tbsp mayonnaise
lettuce	lettuce
1 slice tomato	1 slice tomato
1 small apple	1 small apple
Ginger ale	1 cup milk
Snack	
2 fruit rollups	4 sugar cookies
Dinner	
2 oz roast beef	4 oz toast beef
low sodium gravy	low sodium gravy
½ cup unsalted noodles with 2 tbsp margarine	½ cup unsalted noodles with 2 tbsp margarine
½ cup carrots with margarine	½ cup carrots
Lettuce, onions, cucumbers, green pepper salad with olive oil and vinegar dressing	Lettuce, onions, cucumbers, gr pepper salad with olive oil and vinegar dressing
⅛ blueberry pie	⅛ blueberry pie
Ginger ale	1 cup ginger ale
Snacks	
Carbonated beverages*	
Marshmallows, gum drops, hard candy	Marshmallows, gum drops, hard candy

*As allowed, depending on fluid needs.

Career Connection

Even though highly motivated clients can successfully lower their protein intake, maintaining a consistently low protein intake is extremely difficult. Consider that a client who weighs 70 kg (154 pounds) whose level of renal function allows only 0.6 g protein/kg would be allowed to eat only 42 g of protein/day. Look how quickly protein adds up even before meats are considered.

If the client stuck to the minimum serving recommendations in the food guide pyramid, he would eat

6 servings from the grain group × 3 g protein/average serving	= 18 g pro
3 servings of vegetables × 2 g protein/average serving	= 6 g pro
½ cup milk (limited because of the phosphorus)	= 4 g pro
Total before meat:	28 g pro

42 g total −28 g used so far = 14 g left for meat, fish, and poultry. At 7 g protein/ounce, the client is "allowed" only 2 oz of meat/day plus the amounts of foods listed above. Fruit is virtually protein-free but may not be eaten freely because of its potassium content. The only other source of protein-free calories available: pure sugars and pure fats.

Strategies that may help promote dietary adherence are to

- Encourage clients to weigh and measure foods for accuracy.
- Provide positive messages about what to eat rather than emphasizing food restrictions.
- Encourage social support from family and friends.
- Foster the client's perception as successfully adhering to the plan. People who are more confident in their ability to adhere to the eating plan make better choices.
- Provide feedback on self-monitoring and biochemistry data. Correlation of records with laboratory data enables the client to see cause-and-effect, reinforces the importance of nutrition therapy, and opens the door for problem solving.
- Encourage the client to try low protein breads, cereals, cookies, gelatin, and pastas. Acceptability varies greatly among low protein products, so if a client does not like one brand, it does not mean he won't like another.

Calories

Quick Bite

Renal formulas designed for pre-end stage renal disease that provide calories with limited amounts of protein, fluid, and electrolytes are

Renalcal Diet
Suplena

Adequate calories are needed to prevent weight loss and spare body protein from catabolism. Taking in too few calories can have the same effect as eating too much protein: BUN levels rise because body proteins are broken down for energy.

Calorie recommendations are 35 cal/kg for adults under 60 years of age and 30 to 35 cal/kg for those who are older. In contrast to healthy eating messages for the general population, clients who must limit their intake of protein are advised to increase their intake of pure sugars and pure fats to meet their calorie requirements while keeping protein low. Pure sugars and pure fats are protein-free even though they are not considered "nutritious" foods by normal standards (Box 20.2). In this population in whom diabetes and hyperlipidemia are common, an increased intake of pure sugars and pure fats is seemingly contraindicated. The best protein-free calorie option is to choose fats rich in monounsaturated fats such as canola oil, olive oil, and trans fat–free margarines.

BOX 20.2

SOURCES OF PROTEIN-FREE CALORIES AND SEASONINGS

Protein-Free Calories

Beverages*
- Alcoholic
- Carbonated (colas may be restricted due to their relatively high phosphorus content)
- Cranberry juice cocktail
- Fruit drinks and punches
- Kool-Aid
- Lemonade, limeade
- Tang

Candies
- Buttermints
- Candy corn, fondant
- Chewy fruit snacks
- Cotton candy
- Fruit chews, fruit rollups
- Gum
- Gumdrops
- Jelly beans
- Life Savers
- Lollipops
- Marshmallows
- Mints

Desserts
- Fruit ice*
- Juice bar
- Popsicle*
- Sorbet

Fats
- Butter and margarine (unsalted)
- Coconut
- Mayonnaise, oils
- Powdered coffee whitener
- Shortening
- Tartar sauce

Sweeteners
- Corn syrup
- Honey
- Jams
- Jellies
- Maple syrup
- Marmalade
- Sugar: confectioners, white, brown

Protein-Free Seasonings

Flavoring extracts
Herbs
Spices
Vinegar

*As allowed by fluid restriction.

Phosphorus

Quick Bite

High-phosphorus foods include

- Beer
- Bran
- Bran cereal
- Cheese
- Chocolate
- Cola
- Dairy products
- Dried peas and beans
- Meat
- Nuts
- Peanut butter

Like protein restriction, low-phosphorus diets have been shown to delay the progression of renal disease. A high phosphorus intake contributes to hyperphosphatemia, which stimulates parathyroid hormone PTH secretion, which in turn promotes loss of bone mass and increases the risk that damaging deposits of calcium and phosphorus will form in the kidneys and other soft tissues. Restricting phosphorus is appropriate for all stages of renal disease. On the plus side, low-protein diets are usually low in phosphorus and may effectively control hyperphosphatemia in pre-ESRD.

Controlling Blood Glucose Levels

Studies clearly show that controlling blood glucose levels can prevent renal damage and reverse early kidney hyperfiltration. Consistent meal timing and consistent carbohydrate intake, as well as increased physical activity and weight loss, help to control blood glucose levels. See Chapter 19 for nutrition therapy for diabetes.

Controlling Hypertension

Controlling high blood pressure reduces the risk of renal disease. In people diagnosed with renal disease, controlling blood pressure reduces the rate of kidney function decline, reduces the likelihood that dialysis or transplant will be required, and decreases mortality. Weight loss, limiting alcohol consumption, and healthy eating can significantly lower blood pressure. Studies confirm that a diet rich in fruits and vegetables and low in fat, saturated fat, and sodium can lower blood pressure. See the DASH diet in Chapter 18.

Food Guidance for Pre-ESRD

In terms of food, nutrition recommendations for pre-ESRD can be summarized as follows:

- Limit meat intake to <5 to 6 oz/day for most men and <4 oz/day for most women. Protein intakes less than this may actually worsen symptoms and cause weight loss with increased risk of malnutrition. However, as renal function deteriorates, more drastic cuts in protein intake may be necessary, including limiting regular breads and cereals.
- Limit dairy products including milk, yogurt, ice cream, and frozen yogurt, to ½ cup/day. Nondairy creamers are a low-phosphorus alternative, but they can be high in saturated fat.

- Limit cheese to 1 oz hard cheese/day or ⅓ cup cottage cheese/day.
- Limit high-phosphorus foods to 1 serving or less/day. High-phosphorus foods include beer, chocolate, cola, nuts, peanut butter, dried peas and beans, bran, bran cereals, and some whole grains.
- Lowering sodium intake can help to maintain normal blood pressure or lower high blood pressure.
- A consistent intake of carbohydrate with regularly timed meals is important for people with diabetes.
- Because loss of renal function changes vitamin and mineral requirements, caution clients against using any vitamin, mineral, or nutritional supplement without prior approval from their physician.

End Stage Renal Disease: a severe stage of chronic renal failure that requires life-sustaining treatment with either dialysis or a kidney transplant. BUN may be as high as 150 to 250 mg/dL.

End Stage Renal Disease

Glomerular Filtration Rate (GFR): the rate at which the kidneys form filtrate as determined by the amount of creatinine excreted per 24 hours. Normal GRF is about 120 to 130 ml/min.

End-stage renal disease occurs when glomerular filtration rate falls to <25 ml/min; serum creatinine levels steadily increase, overt symptoms are apparent, and dialysis or transplantation are required. Malnutrition is common in people with ESRD and is associated with increased morbidity and mortality. A high-protein, low-phosphorus, low-potassium, low-sodium, fluid-restricted diet is used to help maintain acceptable blood chemistries, blood pressure, and fluid status between dialysis treatments. Saturated fat and cholesterol may also be restricted because of hyperlipidemia. Other nutrients of concern include calcium, vitamin D, vitamins, and trace minerals. A sample menu appears in Box 20.1.

Protein

Once dialysis is initiated, the need for protein increases to greater than normal levels to compensate for the loss of serum proteins and amino acids in the dialysate. However, most people receiving dialysis consume less than the recommended 1.2 g/kg/d. Achieving this level of intake within the confines of other restrictions is difficult.

Quick Bite

Sources of high biologic protein are

Eggs	Meat
Milk products	Fish
Soy	Poultry

It is recommended that at least 50% of protein intake be from high biologic sources. The rationale for using high biologic proteins, which provide adequate amounts of all the essential amino acids, is that they promote reuse of circulating nonessential amino acids for protein synthesis and by doing so minimize urea production.

Calories

Daily consumption of 35 cal/kg of ideal or adjusted weight is recommended for adults under 60 years of age. Clients over 60 years old may need 30 to 35 cal/kg. The protein-sparing effect of sufficient calories enables dietary protein to be used

Dialysate: the dialysis solution used to extract wastes and fluid from the blood.

Career Connection

Calorie requirements are typically based on an amount per kilogram of weight. But which weight? Ideal? Actual? Usual? Adjusted? Currently nutrient guidelines are based on ideal body weight, but ideal may not be appropriate for all clients. For clients who are significantly underweight, using ideal can lead to overfeeding and the risk of refeeding syndrome. For clients who are obese, using ideal weight ignores the increase in muscle mass. A common practice is to calculate an adjusted body weight for clients who are obese, based on the premise that an obese person has a greater percentage of body fat, which is much less metabolically active than muscle tissue and requires fewer calories.

Adjusted weight = [(actual weight–ideal weight) × FFM factor] + ideal weight

FFM (fat free mass) factor = 0.22–0.33 for women
0.19–0.38 for men

Example: For a 200 (91 kg) pound woman whose ideal weight is 100 pounds (45 kg):
[(200 pounds – 100 pounds) × .28 (middle of the FFM factor range for women)] + 100 pounds
100 pounds × .28 = 28 pounds + 100 pounds = 128 pounds adjusted weight
128 is then divided by 2.2 to get adjusted weight in kilograms, which is approximately 58 kg

Compare using different weights:

Actual wt	Ideal wt	Adjusted wt
91 kg	45 kg	58 kg
× 35 cal/kg	× 35 cal/kg	× 35 cal/kg
3185 total cal	1575 total cal	2030 total cal

The bottom line is that there is currently no validated method for calculating calorie and protein needs in obese people. Nutrient recommendations should be viewed as starting points that are refined over time, based on the individual's lab values and other factors. The same holds true for people who are significantly underweight.

to replenish the protein lost through the dialysate and maintain normal body proteins.

Because hyperlipidemia is common, a low–saturated fat, low-cholesterol diet is prudent. Lean meats, nonfat milk (allowed only in limited amounts because of the phosphorus content), and egg whites are the best choices of animal protein. Canola oil, olive oil, and trans fat-free soft margarines are recommended sources of fat.

Clients receiving peritoneal dialysis need to decrease their calorie intake to compensate for the glucose calories absorbed from the dialysate (approximately 340 to 680 cal/day). Likewise, sedentary clients and post-transplantation clients who are taking immunosuppressive steroids may require fewer calories to avoid excess weight gain.

Phosphorus

A low phosphorus intake continues to be important: Vitamin D deficiency, which occurs as the kidneys fail to convert the vitamin to its active form, alters the metabolism of calcium, phosphorus, and magnesium, resulting in hyperphosphatemia, bone demineralization, bone pain, and possible calcification of the soft tissues (e.g., eyes, skin, heart, lungs, blood vessels, and kidneys).

A low phosphorus intake is relatively easy to achieve when protein intake is restricted as in the case of pre-ESRD. However, when dialysis begins and protein allowance increases, phosphorus intake correspondingly increases. Phosphate binders in addition to dietary restriction are necessary to control serum phosphorus levels for the majority of patients. Phosphate binders must be taken with all meals and snacks. Table 20.2 lists the calcium, phosphorus, and protein contents of selected foods.

Potassium

Quick Bite

Low-potassium vegetables include

- Beans, wax and green
- Bean sprouts
- Cabbage
- Cucumber
- Endive
- Escarole
- Green pepper
- Lettuce
- Water chestnuts
- Watercress

Potassium allowance is based on the individual's lab values. A general recommendation for people undergoing hemodialysis is to allow 40 gm/kg of ideal or adjusted weight, but again, lab values dictate dietary allowance. Clients receiving continuous ambulatory peritoneal dialysis, as well as those taking potassium-wasting diuretics or those experiencing vomiting or diarrhea, are at risk of hypokalemia. GI bleeding, acidosis, catabolism, and hyperglycemia increase the risk of hyperkalemia. Individual needs vary widely.

Sodium and Fluid

The client's blood pressure, weight, serum electrolyte levels, and urine output determine the amount of sodium and fluid allowed. Most renal diets contain a moderate amount of sodium (2 to 4 g/day), but some clients with advanced renal failure are unable to conserve sodium and a sodium deficit may occur if sodium intake is restricted. If the client does not have edema, hypertension, or signs of heart failure, increasing the sodium intake as tolerated may slightly improve GFR. Actual sodium allowance is determined on an individual basis.

Fluid allowance is determined by urine output. Generally, daily fluid allowance exceeds urine output by 500 mL to 750 mL to account for the amount of insensible losses through skin, lungs, and perspiration. Sodium and fluid allowances are set at levels that control weight gain between treatments to 1 to 2 pounds, although much larger gains are common.

TABLE 20.2

CALCIUM, PHOSPHORUS, AND PROTEIN CONTENT OF SELECTED FOODS

Item	Amount	Calcium (mg)	Phosphorus (mg)	Protein (g)
Bread, Cereal, Rice, and Pasta Group				
White bread	1 slice	27	24	2
Whole wheat bread	1 slice	20	64	3
Long-grain rice	½ cup	10	81	3
Corn tortilla	1 med	44	79	1
Vegetable Group				
Artichoke, boiled	1 med	135	258	3
Cassava, raw	3.5 oz	91	70	3
Kale, frozen, boiled	½ cup	90	18	2
Okra, boiled	½ cup	77	37	2
Spinach, boiled	½ cup	122	50	3
Turnip greens, boiled	½ cup	99	21	1
Fruit Group				
Orange juice, calcium-fortified	¾ cup	200	25	0
Avocado, raw	1 med	13	45	2
Cypres, dried	10	43	67	2
Mango, raw	1 med	21	23	1
Strawberries, raw	½ cup	10	14	0
Milk, Yogurt, and Cheese Group				
Skim	1 cup	302	247	8
1%	1 cup	300	235	8
2%	1 cup	297	232	8
Whole	1 cup	291	228	8
Goat milk	1 cup	326	270	9
Chocolate milk (with 1% milk)	1 cup	287	256	8
Plain low-fat yogurt with nonfat dry milk	1 cup	415	326	12
Plain whole-milk yogurt	1 cup	274	215	8
Low-fat fruit-flavored yogurt	1 cup	314	247	8
Cheddar	1 oz	214	145	7
Cottage cheese, 1% fat	½ cup	78	170	12
Mozzarella, part skim	1 oz	147	105	7
Ricotta, part skim	½ cup	337	226	8
Swiss	1 oz	272	171	8
Ice cream, vanilla soft serve	½ cup	138	106	4

TABLE 20.2
(continued)

CALCIUM, PHOSPHORUS, AND PROTEIN CONTENT OF SELECTED FOODS

Item	Amount	Calcium (mg)	Phosphorus (mg)	Protein (g)
Meat, Poultry, Fish, Dry Beans, Eggs, and Nuts Group				
Ground beef, broiled	3½ oz	12	191	27
Ham, cured, roasted	3½ oz	6	224	19
Veal, ground, broiled	3½ oz	17	217	24
Beef liver, braised	3½ oz	7	404	24
Chicken breast, roasted	½	13	196	27
Salmon, chinook	3 oz	24	316	22
Tuna, white, canned	3 oz	12	185	20
Refried beans, canned	½ cup	45	109	7
Great northern beans, canned	½ cup	70	178	7
Egg, poached	1	25	89	6
Almonds, blanched	1 oz	73	150	6
Peanut butter	2 tbsp	13	101	7
Sunflower seeds, dry roasted	1 oz	20	327	6
Fats, Oils, and Sweets				
Sour cream	2 tbsp	28	20	1
Cola	12 oz	11	44	0
Milk chocolate bar	1.55 oz	84	95	3
Orange sherbet	½ cup	52	38	1

Career Connection

For many clients on dialysis, limiting fluid intake is the biggest challenge. Teaching clients *why* the fluid restriction is important is only half the battle; teaching them *how* to control their intake and thirst is vital. Strategies to relieve thirst include

- Use ice or popsicles within the fluid allowance—very cold things are better at relieving thirst.
- Suck on hard candy or mints.
- Chew gum.
- Frequent mouth rinsing with refrigerated water.
- Suck on a lemon wedge.
- Bread with applesauce or jelly may relieve dry mouth.
- Control blood glucose levels, as appropriate.
- Try frozen grapes.
- Use small glasses instead of large ones.
- Apply petroleum jelly to the lips.

Quick Bite

Sources of fluid in addition to beverages consumed include

- Gelatin
- Gravy
- Ice (melts to 9/10 initial volume)
- Ice cream (melts to ½ initial volume)
- Ice milk (melts to ½ initial volume)
- Liquid medication
- Popsicles
- Sauces
- Sherbet
- Soup

Calcium

Hypocalcemia in ESRD is related to altered vitamin D metabolism, impaired intestinal absorption of calcium, and hyperphosphatemia. Foods high in calcium, namely dairy products, are also high in phosphorus and so are not allowed freely. It is not likely that calcium requirement can be met through food alone when dairy products are restricted. Calcium carbonate taken between meals acts like a calcium supplement; taken with meals, it functions as a phosphorus binder so the amount of calcium absorbed is diminished. Calcium supplements are adjusted according to the individual's calcium, phosphorus, and PTH lab values.

Vitamin D

Supplements of the active form of vitamin D promote calcium absorption to help maintain blood calcium levels and prevent bone disease. Doses are individualized to maintain desirable serum calcium levels (see Drug Alert).

DRUG ALERT

Drugs Used During Chronic Renal Disease

Epoetin alfa (Procrit, Epogen) is recombinant human erythropoietin, which stimulates bone marrow production of red blood cells. It is used to treat anemia of chronic renal failure in which there is an erythropoietin deficiency.

Possible side effects include worsening hypertension, edema, fatigue, nausea, vomiting, and diarrhea.

Because deficiencies of iron, vitamin B_{12}, and folic acid can cause a poor response, it is important to identify and prevent nutritional deficiencies.

Calcitriol (Calcijex, Rocaltrol) is the active form of vitamin D (1-25-dihydroxycholecalciferol). It is used to manage hypocalcemia in patients receiving chronic renal dialysis. Vitamin D raises serum calcium levels and decreases parathyroid hormone levels. An adequate intake of calcium and fluids is important. The risk of hypermagnesemia is increased when calcitriol is used with magnesium-containing antacids.

Vitamins

Alterations in vitamin metabolism, intake, or requirements occur secondary to renal disease and dialysis. Deficiencies of water-soluble vitamins occur frequently in clients with renal failure and may be caused by inadequate intake related to anorexia or dietary restrictions; altered metabolism related to uremia or medications; or increased losses related to dialysis. For instance, amounts greater than the RDA of folic acid and vitamin B_6 are recommended to promote red blood cell production. Conversely, less than normal amounts of vitamin C are recommended for people with ESRD because vitamin C increases the risk of oxalate stones and many people with renal failure have high blood oxalate levels.

Fat-soluble vitamins tend not to be removed by dialysis; however, except for vitamin D mentioned previously, supplements of fat-soluble vitamins usually are not necessary. In fact, vitamin A supplementation is contraindicated in clients with ESRD because of reported toxicity.

Specially formulated vitamin supplements are available with the appropriate levels of essential vitamins for people with renal disease. Regular multivitamin preparations may provide too much of some vitamins (e.g., Vit A) and too little of others (e.g., folic acid).

Trace Minerals

Renal failure can cause toxic accumulations of aluminum and magnesium; products containing either of these minerals, such as antacids or supplements, should be avoided. Clients who are undergoing dialysis may develop a deficiency of zinc, which could contribute to anorexia and taste alterations. Supplements are recommended if a zinc deficiency is identified. Zinc supplements and iron supplements should not be taken at the same time, nor should zinc supplements be taken within 1 hour before meals or within 2 hours after eating.

Iron supplements plus human erythropoietin are used to treat anemia of ESRD. Iron supplements may cause gastrointestinal upset and constipation, and they should not be taken with calcium or zinc supplements. Potential side effects of recombinant human erythropoietin appear in the accompanying Drug Alert.

Meal Planning

Quick Bite

Low-potassium fruits include

- Applesauce
- Blueberries
- Cranberries
- Cranberry juice cocktail
- Grape juice
- Lemon
- Papaya nectar
- Peach nectar
- Pears, canned
- Pear nectar

Unlike the relatively simple food guidance offered for pre-ESRD, the "diet" for ESRD is complex and seemingly unrealistic. How can a high protein intake be achieved if phosphorus is restricted? How can adequate calories be consumed if fat and saturated fat are problems? And with so many restrictions, what is left to eat anyway?

Designing a "diet" to provide enough of what the individual needs, but not so much as to worsen symptoms of uremia and fluid retention, is a complex task. An even greater challenge is converting grams, milligrams, and calories into servings of particular foods and acceptable menus. Yet the biggest hurdle is getting the client to make permanent changes in eating habits and food choices. Nutritional success stories seem to be scarce.

The National Renal Diet, developed by the Renal Dietitians Dietetic Practice Group of the American Dietetic Association, simplifies meal planning through the use of food lists (referred to as "choices," rather than "exchanges," to eliminate confusion with diabetic exchanges). For pre-dialysis renal disease, choices include protein, fruit, calorie and flavorings. For people on dialysis, the choices are identified as protein; fruit and vegetable; dairy and phosphorus; bread, cereal and grain; fluid; and calorie and flavoring. Foods are grouped into lists based on their protein, sodium, potassium, and/or phosphorus content; calories are also addressed, and fluids may be considered. For instance, the Fruit Choice list is divided into three groups based on the potassium content, and the Bread, Cereal, and Grain Choices is split into two lists, one of which has higher levels of sodium, potassium, and/or phosphorus. Portion sizes are specified so that relative consistency in nutrient intake can be achieved. Items within a list may be substituted for each other; substitutions from one list to another are not appropriate.

An individualized meal pattern specifies the number of choices permitted from each list; actual allowances are based on laboratory data and clinical symptoms and correspond as closely as possible to the client's food preferences and habits. The composition, complexity, and number of choice lists used in the treatment of renal failure vary considerably among institutions. Despite the use of "choice" lists, trying to adhere to a renal diet is extremely challenging. The diet is complex; modifications are numerous, extensive, and lifelong; and changes are frequent.

Quick Bite

Renal formulas designed for clients undergoing dialysis that provide calories and protein in a limited volume and low electrolytes are

Magnacal Renal
Nephro
Novasource Renal
NutriRenal

Additional meal planning considerations are as follows:

- Clients with uremia may experience a deterioration of appetite as the day progresses. Encourage a good breakfast.
- Highly seasoned or strongly flavored foods may be preferred because of changes in the sense of taste attributed to uremia.
- Clients should initially weigh or measure portion sizes and, thereafter, periodically spot-check portion sizes for accuracy because either too little or too much

protein in the diet can cause BUN levels to increase and uremic symptoms to return.
- Protein allowance should be spread over the whole day instead of saving it all for one meal.
- Renal formulas may be necessary to achieve adequate protein and calorie intake within the context of other dietary restrictions.
- Foods high in potassium include fruit (especially bananas, citrus fruits and juices, melons, raisins), potatoes, tomatoes, dried peas and beans, whole grains, milk, and fresh meat. The potassium content of vegetables and potatoes can be reduced by cutting them into small pieces, soaking them overnight, and boiling them in fresh water.

Kidney Transplantation

Kidney transplantation is a treatment option for people with ESRD. As with any surgery, the immediate postoperative diet is high in protein and calories to promote healing; nutrient needs gradually decrease after the initial postoperative period (Table 20.3).

TABLE 20.3 **POST-TRANSPLANT NUTRIENT RECOMMENDATIONS FOR ADULTS**

Nutrient	Acute Post-Transplant Recommendations	Maintenance Post-Transplant Recommendations
Protein	1.3–2.0 g/kg wt or adjusted for obesity	0.8–1.0 g/kg
Calories	30–35 cal/kg wt or adjusted weight	25–30 cal/kg or adequate to maintain desirable weight
Fat	30–50% non protein calories	<7% saturated fat, <200 mg cholesterol/day
Sodium	4 g/day or unrestricted if HTN/edema are absent	2–4 g/day based on blood pressure and presence of edema
Fluid	High volume given to stimulate urine output; 500 mL + urine output	Generally not restricted
Vitamin and mineral supplements	Not indicated if oral intake is adequate and balanced	Not mandatory; multivitamin is acceptable. 1000–1500 mg calcium with vitamin D may be appropriate.

Dietitians in Nutrition Support Dietetic Practice Group. (Hasse, J. & Blue, L. [Ed.]) (2002). *Comprehensive guide to transplant nutrition.* Chicago: American Dietetic Association.

Patients usually begin with liquids within 24 hours after surgery and quickly progress to solid foods. Patients with persistent hyperglycemia may benefit from a carbohydrate-controlled diet. Pretransplant dietary restrictions may be necessary until the new kidney functions normally. Nutritional supplements may be necessary but tube feedings are rarely needed. General guidelines are as follows:

- During the immediate post-transplant period, protein needs may be as high as 1.3 to 2.0 g/kg due to surgical stress, high-dose corticosteroid therapy, muscle catabolism, and preexisting malnutrition. If the grafted kidney fails to work immediately, dialysis rather than dietary protein restriction is used to control uremia.
- Provide calories to maintain reasonable weight and spare protein. Corticosteroids may contribute to obesity, but other drugs may promote weight loss related to anorexia, nausea, vomiting, and diarrhea.

DRUG ALERT

Drugs Used After Renal Transplantation

Corticosteroids (e.g., prednisone) cause protein catabolism, negative nitrogen balance, glucose intolerance, sodium and fluid retention, potassium excretion, and impaired calcium absorption. Gastrointestinal upset may occur. Possible diet modifications include increasing protein and potassium and limiting sodium. Small, frequent meals may help to minimize gastrointestinal distress. A diabetic diet may be indicated for hyperglycemia.

Cyclosporine (Neoral, Sandimmune) commonly causes GI distress, nausea, vomiting, and diarrhea. Other potential side effects include hypertension, hyperlipidemia, and hyperkalemia. Sodium and potassium intakes may be restricted; because cyclosporine is nephrotoxic, a renal diet may be used. Dietary fat decreases drug absorption.

Immunosuppressants (muromonab-CD3, Orthoclone, antithymocyte globulin) are less toxic than cyclosporine but may cause nausea, vomiting, diarrhea, and anorexia. Fever and stomatitis may occur.

Azathioprine (Imuran) may cause esophageal sores, vomiting, diarrhea, and macrocytic anemia. A liquid or soft diet may be needed.

- Limit fat to less than 30% of total calories, saturated fat to <7% of calories, and cholesterol to <200 mg/day because blood lipid levels are often elevated. Elevated low density lipoprotein cholesterol has been associated with chronic rejection in renal transplant recipients.
- Limit sodium to 4 g/day. No restriction is necessary in the absence of hypertension and edema.
- Adjust potassium intake according to diuretic therapy.
- Supplements of phosphorus and magnesium may be necessary.

Quick Bite

A 4-g sodium diet is very liberal with few restrictions. The client may simply be told to not use salt in cooking or at the table and to avoid obviously salty foods such as

Cold cuts
Convenience foods such as frozen dinners and dried soup mixes
Fast foods
Pickled vegetables
Salted snack foods
Salty condiments such as soy sauce, dill pickles, mustard, ketchup
Smoked, salted, and kosher meats
Regular canned soup, vegetables, meat, and sauces

NURSING PROCESS

Allen Parker is 34 years old and has had type 1 diabetes for 27 years. He has a history of mild hypertension and mild anemia and complains of sudden weight gain and "swelling." His BUN and creatinine have been steadily increasing over the last several years. During his last appointment, the doctor told Allen to watch his protein intake and avoid salt. His diabetes is fairly well controlled with diet and multiple insulin injections. The doctor has diagnosed renal insufficiency and asked you to talk to Allen about his diet.

Assessment

Obtain Clinical Data:

Current height, weight, BMI, recent weight history
Medical history including cardiovascular disease, hypertension, diabetes, and history of renal disease
Abnormal laboratory values, especially BUN, creatinine, lipid levels, glucose, albumin, electrolytes, phosphorus, calcium, hemoglobin, and hematocrit
Urine specific gravity
Blood pressure
Medications that affect nutrition such as diuretics, insulin, and lipid-lowering medications

Interview Client to Assess:

Understanding of the relationship between diet and renal function, specifically the role of protein, calories, sodium, potassium, phosphorus, calcium, and fluid

Motivation to change eating style; how successful he was at avoiding salt
Usual 24-hour intake, portion sizes, frequency and pattern of eating.
Assess usual quantity and quality of protein consumed and whether most of the protein is of high biologic value (usually animal sources) or of low biologic value (gelatin and plant sources). Assess the use of salt and intake of high-sodium foods: cold cuts, bacon, frankfurters, smoked meats, sausage, canned meats, chipped or corned beef, buttermilk, cheese, crackers, canned soups and vegetables, convenience products, pickles, and condiments. Determine if a salt substitute is used and, if so, its chemical composition. Assess intake of calories, potassium, calcium, and fluid.
Cultural, religious, and ethnic influence on eating habits
Psychosocial and economic issues such as living situation, cooking facilities, financial status, employment, and education
Use of vitamins, minerals, and nutritional supplements: what, how much, and why taken
Use of alcohol and nicotine
Physical complaints such as fatigue, taste changes, anorexia, nausea, vomiting, diarrhea, muscular twitches, and muscle cramps

Nursing Diagnosis

1. Fluid Volume Excess, related to impaired renal function

Planning and Implementation

Client Goals

The client will

Maintain normal urinary output.
Achieve and maintain normal blood pressure.
Achieve normal or near-normal electrolyte levels.
Maintain adequate glucose control.
Consume adequate calories to minimize tissue catabolism.
Attain and maintain adequate nutritional status.
Describe the rationale and principles of nutrition therapy for renal insufficiency and implement appropriate dietary changes.
Practice self-management strategies especially self-monitoring protein intake.

Nursing Interventions

Nutrition Therapy

The doctor has prescribed a 50-g protein, 2-g sodium diet in addition to the patient's normal 2400-cal diabetic diet.

Client Teaching

Instruct the client

On the role of nutrition therapy in the treatment of renal insufficiency
On eating plan essentials, including
- Limiting protein, emphasizing high-quality proteins, spreading protein allowance over the whole day
- Consuming adequate calories
- Limiting high-sodium foods, not adding salt during cooking or at the table

On behavioral matters including
- How to weigh and measure foods to ensure accurate portion sizes
- To self-monitor protein intake
- To weigh himself at approximately the same time every day with the same scale while wearing the same amount of clothing. Unexpected weight gain or loss should be reported to the physician.
- That renal diet cookbooks are available to increase variety

On attitudinal adjustment. Learn to view the diet as an integral component of treatment and a means of life support. Strict adherence to the diet can improve the quality of life and decrease the workload on the kidneys.

Evaluation

The client

Maintains normal urinary output
Achieves and maintains normal blood pressure
Achieves normal or near-normal electrolyte levels
Consumes adequate calories to minimize tissue catabolism
Attains and maintains adequate nutritional status
Describes the rationale and principles in nutrition therapy of renal insufficiency and implements the appropriate dietary changes
Practices self-management strategies, especially self-monitoring protein intake

Acute Renal Failure

Acute renal failure (ARF) is the sudden but often reversible loss of renal function characterized by rising blood levels of urea and other nitrogenous wastes and oliguria or anuria. During the initial anuric phase, aggressive treatment with dialysis is required. Even though urine output begins to increase in the next phase (oliguric phase), dialysis is typically used. As the diuretic phase begins, dehydration is a risk as urine output rises as high as 1½ to 2 times normal. Optimally, the convalescent phase follows as normal renal function is restored.

Complications of ARF include infection, which is the leading cause of death in these clients. Hyperkalemia may result in cardiac arrest, metabolic acidosis, hypercatabolism, circulatory overload (dyspnea, orthopnea, pulmonary congestion, pulmonary edema), hypertension, hypertensive crisis, convulsions, and neurologic abnormalities. ARF may progress to CRF; at least 5% of clients with acute tubular necrosis require long-term hemodialysis. ARF is fatal in 50% of cases.

The primary focus of treatment is to correct the underlying disorder so as to prevent permanent renal damage. Dialysis is used to keep BUN levels lower than 100 mg/dL and creatinine levels lower than 8 mg/dL. Diuretics and other measures to restore fluid and electrolyte balance are used. Symptomatic anemia is treated with transfusions of packed red blood cells. Nutrition therapy may help to lessen the workload of the kidneys and restore optimal nutritional status.

The optimal diet for clients with ARF is more elusive than the optimal diet for CRF. Although the exact nutritional requirements are not known, it is evident that needs vary among individuals and according to the phase of ARF and that diet restrictions are liberalized once dialysis is instituted.

Protein

Protein recommendations are based on the degree of renal function, the level of underlying stress, and whether dialysis therapy is used. Clients under mild stress and not receiving dialysis therapy may be limited to 0.6 g protein per kilogram body weight. As GFR returns to normal or dialysis begins, the protein allowance is increased to promote nitrogen balance and tissue healing. Depending on the type of dialysis used and levels of underlying stress, protein intake may increase to as high as 1.5 to 2.0 g/kg.

Calories

Calorie requirements depend on the rate of catabolism and metabolism and range from 30 to 45 cal/kg. Carbohydrate modules, pure fats, refined sugars, and low-protein starches are used liberally.

Fluid

For both the oliguric and diuretic phases of ARF, fluid intake should equal total fluid output per 24 hours plus an additional 500 mL, depending on the client's hydration status. Up to 3 L of fluid may be needed daily to prevent dehydration during the diuretic phase.

Potassium

Life-threatening hyperkalemia that occurs during the oliguric phase of ARF is related to potassium retention and tissue catabolism, which causes potassium to leave the cells and enter the serum. Diets that are low in potassium (2 g/day or less) and exchange resins such as Kayexalate may be used during the oliguric phase to reduce serum potassium levels. Once diuresis begins, large amounts of potas-

sium are excreted and potassium supplements may be necessary to avoid hypokalemia.

Sodium

Sodium intake is adjusted according to urine output, serum sodium level, symptoms of sodium imbalance, and concurrent use of dialysis. Typically, 2 to 3 g/day is recommended, although sodium may be restricted to < 2 g/day during the anuric phase. As with potassium, sodium requirements increase during the diuretic phase to replace increased losses.

Method of Feeding

Clients who are unable to eat because of critical illness or impaired gastrointestinal function secondary to ARF may need enteral or parenteral nutrition. Special enteral and parenteral renal formulas are available. Fluid restrictions may complicate either type of feeding.

Nephrotic Syndrome

Nephrotic Syndrome: a collection of symptoms that occurs when increased capillary permeability in the glomeruli allow serum proteins to leak into the urine.

Nephrotic syndrome may be caused by diabetes, hypertension, infection, immunological and hereditary conditions, and certain chemicals. Symptoms include hypoalbuminemia, massive edema, hyperlipidemia, and blood hypercoagulation. Loss of proteins in the urine, such as albumin, immunoglobulins, transferrin, and vitamin D-binding protein, may lead to protein malnutrition, anemia, vitamin D deficiency, and increased risk of infection. Accelerated atherosclerosis is a distinguishing feature that increases not only the risk of cardiovascular disease, but also the risk of progressive renal damage. In some cases, treating the underlying disorder corrects nephrotic syndrome. In others, especially diabetes, nephrotic syndrome may be a sign of progressive renal deterioration.

The goals of nutrition therapy are to minimize edema, replace nutrients lost in the urine, and reduce the risk of progressive renal damage. Nutrients of primary concern are protein and sodium. Additional modifications in fat, cholesterol, and calorie intake may be indicated.

Protein

Protein intake should be sufficient to meet protein needs but not excessive so as to accelerate renal deterioration and increase urinary protein losses. An intake of 0.7 to 1.0 g/kg/day, a level close to the RDA, is recommended. Consuming a soy-based vegetarian diet appears to decrease urinary protein losses and lower serum lipid levels.

Sodium and Fluid

A low-sodium diet, in conjunction with drug therapy, is needed to control edema and hypertension. Generally, a 2-g sodium diet is recommended, but a more severe restriction

may be necessary depending on the client's response to diuretics. A fluid restriction is generally not necessary. Daily weights are used to assess fluid status.

Fat and Cholesterol

The Total Lifestyle Change (TLC) Diet discussed in Chapter 18 for the primary and secondary prevention of coronary heart disease is recommended to control elevated lipid levels seen in nephrotic syndrome. Drug therapy may be combined with the low saturated fat (<7% of calories), low cholesterol (<200 mg/day) diet for maximum effectiveness. Studies have shown that in high-risk clients with IgA nephropathy, early and prolonged treatment with fish oil supplements slows disease progression.

Calories

A calorie intake of 35 cal/kg is recommended to spare protein. However, gradual weight loss in overweight clients improves serum lipid levels and blood pressure.

Kidney Stones

Struvite: magnesium ammonium phosphate crystals formed by the action of bacterial enzymes.

Kidney stones are one of the most common and painful urologic disorders. Precipitation of insoluble crystals in the urine leads to formation of stones that vary in size from sand-like "gravel" to large, branching stones. Although they form most often in the kidney, they can occur anywhere in the urinary system.

Approximately 80% of stones contain calcium, and most of these are composed of calcium oxalate; fewer calcium stones are composed of calcium phosphate. Approximately 10% of stones are composed of uric acid and 10% are struvite. Cystine (an amino acid) stones are rare and occur only in people with cystinuria, an autosomal recessive disorder.

The likelihood of kidney stones increases when urine volume is low, which favors the precipitation of stones. For instance, people who lose large amounts of fluid through ileostomies have low urine output and an increased risk of kidney stones. Certain occupational circumstances that limit fluid intake (e.g., in delivery people and salespeople) may also increase risk, as does living in the southeastern United States (the "stone belt"). It has been suggested that the increased risk is related to low urine volume secondary to increased perspiration caused by high environmental temperatures or to increased absorption of calcium secondary to vitamin D activation from greater sunlight exposure.

Excessive intakes of protein, sodium, calcium, and oxalate may increase the risk of stone formation in susceptible people.

Protein. High intakes of protein increase urinary excretion of calcium, oxalate, and uric acid and reduce urinary pH. These factors increase the risk for forming uric acid and/or calcium oxalate stones.

Sodium. Because the body rids itself of excess sodium through the urine, the greater the sodium intake, the greater the level of urinary sodium. High urinary sodium increases urinary excretion of calcium and uric acid.

Oxalates. Endogenous oxalate production provides more urinary oxalate than dietary intake does. Although certain foods are rich sources of oxalate and are well absorbed, such as spinach, rhubarb, beets, nuts, chocolate, tea, wheat bran, and strawberries, the bioavailability of oxalate in other foods, such as Swiss chard and collards, is low. Unfortunately, studies on bioavailability are lacking, so conservative advice is that people with calcium oxalate stones should avoid all foods high in oxalate (Box 20.3.)

BOX 20.3

FOODS HIGH IN OXALATE

Foods Known to Increase Urinary Oxalate

Spinach
Rhubarb
Beets
Nuts
Chocolate
Tea
Wheat bran
Strawberries

Other High-Oxalate Foods That May or May Not Increase Urinary Oxalate

Beer
Instant coffee
Grits
Wheat germ
Whole wheat flour
Fruitcake
Berries: blackberries, gooseberries, black raspberries
Concord grapes
Red currants
Damson plums
Tangerine
Baked beans with tomato sauce
Peanut butter
Tofu
Sweet potatoes
Beans (wax or legumes)
Celery
Dark leafy greens
Eggplant
Leeks
Summer squash
Cocoa
Carob
Vitamin C intake in excess of RDA

Calcium. Hypercalcuria, an inherited condition, is the cause of stones in more than half of all clients. Although it would seem that limiting calcium intake would be beneficial, people who follow a low-calcium diet excrete more calcium in their urine than they consume, indicating that calcium is being lost from bone. Therefore, most adults with hypercalcuria are urged to consume 800 mg calcium/day, preferably from food. That translates to two 1-cup servings of milk or yogurt with the remaining calcium coming from less significant, nondairy sources. Dietary calcium may favorably bind with dietary oxalate in the intestines, forming an insoluble compound that the body cannot absorb. The decrease in urinary oxalate that occurs with increased dietary calcium is proportionally more significant than the accompanying rise in urinary calcium levels. However, consuming the RDA for calcium from supplements or antacids appears to increase the risk of calcium stones. In cases where hypercalcuria is not caused by excessive GI absorption of calcium, 1000 mg of calcium/day is recommended.

Nutrition Therapy

The most effective nutritional intervention for the treatment and prevention of all renal calculi is to increase fluids and thereby dilute the urine. It is also the intervention that clients are most apt to comply with. A high urine output not only helps the client to pass an existing stone, but also decreases the likelihood that another stone will precipitate out of the urine. A daily fluid intake of 3 L is recommended with at least 50% from water. Coffee (regular and decaffeinated), tea, and wine may lower the risk of kidney stone formation while grapefruit juice may increase the risk. Fluid intake should increase when perspiration increases such as with hot weather and exercise. At least 8 to 12 ounces of fluid, preferably water, should be consumed before bedtime because urine normally becomes more concentrated at night.

Additional recommendations for clients with calcium stones are as follows:

- Avoid high intakes of protein and sodium.
- People at risk for oxalate stones should avoid megadoses of vitamin C because the body can synthesize oxalate from vitamin C.
- Maintain adequate calcium intake. Restricting calcium intake has not been shown to decrease stone formation and may worsen osteoporosis.
- Avoid high-oxalate foods (see Box 20.3).

Quick Bite

High-purine foods include

Red meats, especially organ meats
Anchovies
Sardines
Scallops

Recommendations for clients with uric acid stones are as follows:

- Low-purine diets are sometimes used in conjunction with medication but their benefits are unproven.
- Consume protein in moderation because high protein intakes acidify the urine. However, drugs are much more effective and consistent at lowering urinary pH.
- Limit alcohol.

How Do You Respond?

Does cranberry juice prevent urinary tract infections? Although conclusive evidence is lacking, it appears that cranberry juice is effective against urinary tract infections because it contains an ingredient that may prevent bacteria from adhering to the lining of the urinary tract, thereby promoting their excretion. However, not all bacteria are sensitive to the juice, and protection lasts only as long as the juice is consumed regularly. Clients who are prone to urinary tract infections and like cranberry juice should be encouraged to consume it regularly just in case. The only other dietary recommendation for urinary tract infections is to increase fluid intake to flush bacteria.

Are omega-3 fish oil supplements beneficial for people on hemodialysis? In addition to their cardioprotective effects, supplements of omega-3 fats have been shown to improve uremic pruritus, decrease vascular access graft thrombosis, and decrease the dose of erythropoietin needed to maintain hemoglobin level within the goal range for people on hemodialysis. The American Heart Association recommends people with or at risk of heart disease consume 1 g of EPA and DHA per day, but people on dialysis may need as much as 2 g daily. Future research may show that omega-3 from fish are equally effective as those from supplements. In the meantime, advise clients who want to use an omega-3 supplement, instead of increasing fish consumption, to first talk to their physician to determine the best dose for the individual. Caution them against using brands made from halibut and/or shark liver oils because they may contain toxic levels of vitamin A. Fish oil supplements should be stored in the refrigerator to avoid rancidity.

▲ Focus on Critical Thinking

Respond to the following statements:

1. For someone with ESRD, it is necessary to eat enough protein even if this means exceeding the phosphorus allowance.
2. For clients with pre-ESRD, it is better to eat too little protein than too much.
3. People with calcium kidney stones should limit calcium intake.

Key Concepts

- Loss of renal function profoundly affects metabolism, nutritional status, and nutritional requirements. The nutrients most affected are protein, calcium, phosphorus, vitamin D, fluid, sodium, and potassium.
- Diet modifications for renal disease are complex, unpalatable, and frequently adjusted according to the client's laboratory values and symptoms.

- Protein restriction remains the cornerstone of dietary treatment for pre-ESRD because limiting protein has the potential to lessen renal workload and slow disease progression.
- There is a narrow margin of error regarding protein intake: too little protein results in body protein catabolism, which has the same effect as eating too much protein, namely, an increase in BUN levels.
- A high-calorie diet is indicated whenever protein intake is restricted to ensure that the protein consumed will be used for specific protein functions, not for energy requirements.
- Usually clients with pre-ESRD need to limit phosphorus and, if blood pressure is a problem, sodium. Potassium is usually not restricted.
- Fluid allowance is based on urine output plus an additional 500 mL to 750 mL to account for insensible losses.
- Calcium metabolism is impaired because of faulty vitamin D metabolism, impaired intestinal absorption, and hyperphosphatemia as a result of loss of renal function. A high calcium intake from food is not achievable when phosphorus is restricted.
- When dialysis is instituted, dietary restrictions are liberalized; a high protein intake is recommended to compensate for protein lost through the dialysate.
- ARF represents an even greater nutritional challenge than CRF. Protein, sodium, potassium, phosphorus, and fluid are adjusted according to lab data, use of dialysis, renal function, and drug therapy.
- Clients who experience renal transplantation may need to alter their diets to lessen the side effects of immunosuppressant therapy. Steroids cause hyperglycemia, sodium retention, weight gain, potassium depletion, loss of calcium from the bones, and gastrointestinal upsets.
- A fluid intake of 3 L/day or more is the most effective nutritional intervention for the prevention of renal calculi.

ANSWER KEY

1. **TRUE** Early in the course of chronic renal disease, limiting protein may help to preserve kidney function but there are no guarantees and the optimal level of protein intake is not known.
2. **TRUE** Foods high in protein tend to be high in phosphorus. Other high-phosphorus foods include cola, chocolate, beer, bran, and bran cereal.
3. **FALSE** Although milk is an excellent source of high biologic value protein, it is high in phosphorus and so it can only be consumed in limited amounts (½ cup/day).
4. **FALSE** Some people with advanced renal failure are unable to conserve sodium, and a sodium deficit may occur if sodium intake is restricted.
5. **TRUE** People with chronic renal disease tend to have accelerated atherosclerosis and may benefit from eating more monounsaturated fat while restricting their intakes of saturated fat and cholesterol.
6. **TRUE** Dialysis causes protein requirements to increase about 50% above normal because proteins and amino acids are lost in the dialysis.

7. **TRUE** People receiving peritoneal dialysis may absorb 100 to 200 g of glucose from the dialysate, which is 340 to 680 calories.
8. **FALSE** Weight gain between dialysis treatments reflects fluid retention. Excessive weight gain between dialysis treatments means the intake of sodium and fluid are too high, not that calorie intake is too high.
9. **FALSE** Most people with hypercalcuria should consume 800 mg calcium/day. Restricting calcium intake does not decrease the risk of calcium stones because high calcium levels are maintained at the expense of bone. Dietary calcium may bind with oxalate in the GI tract to promote its excretion.
10. **TRUE** The most effective nutritional intervention to treat or prevent all types of renal stones is to increase fluid intake to dilute the urine. It also is the intervention clients are most likely to comply with.

WEBSITES

American Association of Kidney Patients at **www.aakp.org**
American Kidney Fund at **www.kidneyfund.org**
Kidney Information Clearinghouse at **www.renalnet.org**
National Institute of Diabetes and Digestive and Kidney Diseases at **www.niddk.nih.gov**
National Kidney Foundation at **www.kidney.org**
Nephron Information Center at **www.nephron.com**
www.ikidney.com

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