Dialysis Case Study

A group project involving researching dialysis, preparing a power point presentation used when teaching the class a full hour and a half lesson on dialysis complete with a handout, writing and analyzing a menu appropriate for a dialysis patient, and writing a research paper on dialysis.

My portion of the project consisted of researching the history, explanation and medications of dialysis, writing that section of the paper, preparing the power point slides and presenting on that section.

In addition the professor had organized for us to meet with a dialysis dietitian at a local dialysis clinic but last minute she had to cancel. I used my resources to find another dialysis dietitian we could meet with and we were still able to go and observe the process of dialysis and ask questions about what is important to a dietitian when working with in kidney failure.

The components of this project are in subsequent dialysis case study links under assignments.
INTRODUCTION

The initial concept of dialysis was drawn up by Thomas Grahm in 1854. In addition to the general concept of an artificial kidney, he developed a parchment membrane that preceded dialysis membranes used today (1). In 1912, at John Hopkins University School of Medicine, Abel et al. began application of the dialysis idea by practicing viva-dialysis on animals, which involved passing blood through collodion tubes and using hirudin to prevent clotting (2). Twelve years later, at the University of Giessen in Germany, the first human hemodialysis (HD) was performed; however, it did not successfully prolong the patient’s life (1). Subsequently, additional advances were made in the process of dialysis, but it was not until World War II that major strides were made.

The invention of the artificial kidney, or dialysis, is credited to Dr. Willem J. Kolff. In the Netherlands, between 1943 and 1945, he conducted 16 unsuccessful trials on patients suffering from acute renal failure in hopes of resting the kidneys until they healed enough to function. Though many patients improved temporarily, ultimately they all died in a relatively short period. In the seventeenth trial, done on a 67-year-old Nazi collaborator, the procedure was successful and she lived for an additional seven years (3). Advances continued following the war, and in 1950, Dr. Kolff immigrated to the United States where he worked for the Cleveland Clinic. He later worked for the University of Utah where the artificial kidney was refined, though never patented, because Dr. Kolff saw it as a contribution to humanity. In the 1960s, the creation of the Quinton and Scribner AV shunt allowed continuous circulation of blood when the patient was not attached to the dialysis machine (3). All of these findings contribute to dialysis treatments for patients with End-Stage Renal Disease (ESRD). Overall, patients on dialysis
achieve optimum quality of life by choosing the best dialysis for their lifestyle, proper medication administration, and compliance with medical nutrition therapy.

DIAGNOSIS

Survival is impossible without at least one properly functioning kidney. Everyone with kidney failure, however, is not immediately treated with dialysis. Rather, patients use their own kidneys until GFR falls below 15 ml/min, making dialysis necessary. This fall in GFR is diagnosed as stage five of kidney failure, also known as ESRD. At this point, the patient must either use dialysis or obtain a transplant to remain alive. The medical team takes into account the GFR levels, symptoms, nutritional status (albumin levels), and lifestyle when helping patients make the best possible decision. A person with severe symptoms caused by acute kidney failure may also go on dialysis to alleviate side effects, even though GFR may exceed 15 ml/min. Often, these patients discontinue dialysis when their kidneys heal and function properly, whereas people with ESRD cannot terminate dialysis without a transplant if they wish to stay alive (4).

EXPLANATION OF DIALYSIS

The purpose of dialysis is to balance fluids and electrolytes, and excrete toxic wastes when the kidneys are failing, thereby prolonging the patient’s life. Dialysis takes over some of the basic kidney functions, but the synthetic substitute cannot fully compensate for loss of a human kidney (5).

Dialysis involves filtering the patient’s blood through a machine with a semi-permeable membrane containing a liquid called dialysate. Toxins are filtered out via diffusion, non-toxic material is reabsorbed, and blood is returned to the patient. There are two types of dialysis, both of which utilize the dialysate differently. HD involves an external machine through which the blood is pumped over the course of a few hours, cleaned, and then pumped back into the patient
in a closed circuit. Peritoneal dialysis (PD) involves inserting a permanent catheter through the abdomen, into the peritoneal cavity, where dialysate is placed routinely. Toxins and water are filtered out of the blood and into the filtrate where they can drain out through the catheter as new dialysate is added. Dialysis can also be done either in a clinic or at home. Deciding whether dialysis is the ideal treatment is a team decision between the patient, doctor, and family (5).

SIGNS & SYMPTOMS

Multiple signs and symptoms, aside from a patient’s labs, indicate that a person has ESRD. Many of these are caused by problems from the kidney’s inability to excrete waste products, maintain fluid and electrolyte balance, and produce hormones. The most common symptoms are loss of appetite, nausea, and vomiting. Furthermore, anemia is a major symptom caused by the low production of erythropoietin, resulting in decreased red blood cell production. This can cause fatigue, either constantly or upon physical exertion, difficulty concentrating, memory loss, and sleep disorders. Uremia is another issue that arises due to high amounts of nitrogenous wastes in the body. This can lead to malaise, weakness, nausea, vomiting, muscle cramps, metallic taste in the mouth, or neurologic impairment (tingling in extremities, itching, etc). Fluid retention leads to high blood pressure, swelling, and shortness of breath. Dialysis is often the only way to solve these issues. Finally, high levels of serum phosphorous lead to pruritus, which is unbearable itching all over the body (5, 6).

Most of these symptoms can be resolved by going on dialysis because it removes harmful substances and helps maintain fluid balance. However, patients on dialysis experience other symptoms that may not be as severe but are still harmful and uncomfortable if uncontrolled. These consist of depression, alternating constipation and diarrhea, increased blood pressure, nausea and vomiting, shortness of breath due to increased blood pressure, increased
thirst from limiting fluid intake, and easier bruising because of the high levels of heparin administered during dialysis. While doing dialysis, patients also have symptoms that can arise, such as being cold from chilled blood returning into the body and cramping caused when excess fluid is drawn from patients. Patients become very tired and drained once dialysis is over and often go home and sleep for a few hours to recover. Although these symptoms occur, dialysis allows people to lead a reasonably normal life while in kidney failure by improving the ESRD symptoms (7).

HEMODIALYSIS

HD is one of two main types of dialysis, and is the most common treatment for ESRD (5). In HD, blood is filtered through an artificial kidney, also known as a dialyzer. The dialyzer contains compartments for both blood and dialysate, which are separated by a semipermeable membrane. Dialysate is used to remove toxins and fluid from blood via osmosis, diffusion and ultrafiltration. With an electrolyte content similar to plasma, the dialysate can be adjusted according to the patient’s needs to promote increased or decreased serum concentrations of potassium, calcium, sodium, glucose and bicarbonate (5). For example, potassium levels are usually high in renal failure, thus the dialysate concentration of potassium can be lowered to facilitate diffusion of potassium out of the blood and into the dialysate (8). Ultrafiltration is similar to osmosis and diffusion, except pressure is applied to force extra fluid through the membrane. Removal of accumulated fluid in dialysis patients is necessary to minimize adverse side effects, such as shortness of breath, cardiac complications, and edema. Due to fluid loss, the concentration of substances in the blood to which the membrane is impermeable increases (8). The amount of fluid that is removed via ultrafiltration varies from patient to patient.
In order for waste in the blood to be filtered in ESRD patients, an access site must be created. Access sites include fistulas, grafts, or catheters. A fistula is created by surgically joining a vein and artery in the arm. This is also known as an arteriovenous fistula, or an AV fistula. This is the preferred site for HD because it lasts longer and is associated with fewer complications, such as infections and clotting. A fistula is made before a patient’s GFR reaches below 15 ml/min so that it has ample time to mature and strengthen to provide adequate blood flow. Grafts are preferred second to fistulas. They also require a minor surgery in which an artificial tube is used to connect a vein and nearby artery. Two needles are inserted into the graft, which are connected to two tubes that will carry blood to and from the dialyzer. Lastly, toxic blood can be accessed through a catheter inserted in the subclavian or jugular veins. Catheters are most commonly used when temporary access is needed. For instance, a catheter is used when a newly created fistula needs proper time to heal and strengthen (9).

In-center HD is done three times a week for three to four hours per session. Home HD is a form of dialysis that can better suit patients’ daily schedules. There are three types of HD that can be performed at home; traditional, short daily, and nocturnal. Traditional is the same as if the patient were at a dialysis center, except they are at home. Short daily HD is typically done five to seven times per week using machines specifically designed for short, daily home treatments. Treatments on short daily HD last about two hours. Due to the short duration of the treatment, less fluid is removed each time. Therefore, the patient will have less severe symptoms than someone on in-center or traditional home HD. Finally, nocturnal HD occurs at a much slower rate than the previously stated methods. It is done six nights a week or every other night for six to eight hours while the patient is asleep (10).
Complications

Many complications are associated with HD, but can be prevented by maintaining a clean access site. When the access site is not properly cared for, infection causes symptoms such as reddening around the site, swelling, fever, or chills. If these symptoms occur, patients should contact their doctor immediately. Clotting or poor blood flow can also occur at access sites. Other complications include bleeding from the access site or decreased circulation in the access arm (9).

PERITONEAL DIALYSIS

PD is another option for patients with kidney failure. In PD, the peritoneal membrane of the abdominal cavity acts as a filter, similar to how the dialyzer functions in HD. A surgical procedure is done to place a catheter through the abdomen and into the peritoneal cavity (5). The catheter provides the means for dialysate to enter and leave the cavity. Dialysate used for PD contains a higher dextrose concentration than HD, which facilitates osmosis of fluid across the peritoneal membrane. The waste-containing dialysate is then drained from the peritoneal cavity and a fresh bath of dialysate replaces it.

Types of PD include continuous ambulatory PD (CAPD) and continuous cyclic PD (CCPD). In CAPD, no machine is required to administer and drain the dialysate. Instead, the dialysate bag is hung above the patient, similar to an IV drip, and gravity causes dialysate to flow into the peritoneal cavity, taking 10 to 15 minutes. Dialysate dwells in the peritoneal cavity for four to eight hours. It is drained, which takes about 20 minutes, and is replaced by fresh dialysate (11). This is usually done four to five times a day. With CCPD, the exchange of fluid is done by a machine, the cycler, which delivers and drains dialysate a specific number of times while the patient sleeps. While on CCPD, large fluctuations in blood chemistry are avoided,
residual renal function is lengthened, and the patient has the ability to lead a more normal lifestyle (5).

Complications

Complications associated with PD include peritonitis, hypotension, and weight gain. Hypotension associated with PD is due to the increased amount of sodium lost. Weight gain is due to the high concentration of dextrose in the dialysate; high dextrose concentrations are necessary in PD dialysate to remove excess fluid. Simultaneously however, patients absorb 400 to 800 excess calories per day from the glucose in the dialysate, which may cause problematic weight gain (5).

LABS

Some of the blood labs of a dialysis patient differ from those with a healthy kidney. Because the labs are different, there have been healthy dialysis lab levels established for blood urea nitrogen (BUN), creatinine, calcium, phosphorus, and PTH. These adjusted values help monitor the current condition according to values normal for dialysis. It is important to know what these healthy levels are for proper evaluation of dialysis individuals’ health status (5).

BUN tests determine how much urea nitrogen (a waste product of protein degradation) is building up in the blood. Normally, urea nitrogen is removed from the blood by a functioning kidney. Urea levels in the blood are 7-23 mg/dl in healthy individuals. However, with kidney problems, urea nitrogen is not filtered out of the blood, resulting in a higher BUN reading. On dialysis, the values do decrease but they never reach normal values. Therefore, the normal value for patients on dialysis is 50-100 mg/dl. If values increase above this level, the patient is most likely underdialyzed and other blood values such as eKT/V and nPNA should be checked to help
alter the amount of dialyzing. If the BUN values are too low, the patient might be eating a low-protein diet secondary to decreased appetite (5,12).

Creatinine is another test usually done simultaneously with BUN to monitor dialysis effectiveness. Creatinine serum levels measure the amount of creatine phosphate breakdown in the muscles, indicating levels of lean body mass. This is usually filtered out through the kidney, so altered levels indicate kidney filtration problems or extremely altered muscle mass levels. In normal individuals, levels should be from 0.6 – 1.5 mg/dl, but in dialysis patients, the normal level is anything less than 15 mg/dl. If levels are low, dialysis is either efficiently clearing blood or there is decreased body muscle. When the creatinine levels are high, inadequate dialysis filtration may be occurring. Another issue that could be the cause of high creatinine is severe weight loss, resulting in muscle catabolism, increasing creatinine levels in the blood. Monitoring these levels is crucial in maintaining adequate nutrition to prevent weight loss and lean body mass wasting, as well as making sure the dialysis treatment is adequate (5,13).

Adequate calcium, phosphorus and parathyroid hormone (PTH) levels are crucial for maintaining bone health. Normal levels of serum calcium stay the same during dialysis at 8.5 – 10.5 mg/dl. Phosphorous levels are usually a little higher (3 – 6 mg/dl) than normal (2.5 - 4.8 mg/dl) when on dialysis. Finally, PTH normal values are 10-65 pg/ml, while normal values for a dialysis patient are 200 – 300 pg/ml. All of these substances are crucial in maintaining health while on dialysis (5).

NORMAL PHYSIOLOGY OF CALCIUM & PHOSPHORUS

Maintaining healthy bones is a major concern for dialysis patients. Proper levels of both calcium and phosphorous (with a ratio of about 1:1) in the blood are necessary for normal bone mineralization. The ionic forms of calcium and phosphorous combine in blood to form calcium
phosphate, which makes up the bone structure. Vitamin D is necessary for proper absorption of calcium from the gut into the blood. When phosphorous is increased above normal serum values, too much calcium binds to it in the gut, creating a calcium insufficiency. If there are low levels of calcium, vitamin D, or too much phosphorus in the blood (all resulting in lowered serum calcium levels), parathyroid hormone (PTH) and 1, 25 dihydroxy vitamin D3 (calcitriol) are up-regulated. PTH stimulates osteoclast resorption in bones to release calcium into the blood and maintain needed levels (10 mg/dl) for normal function. This reaction needs to be kept to a minimum for optimal bone health. Calcitriol is activated in the kidneys and acts on the upper part of the small bowel to increase dietary calcium absorption. It also directly helps with bone remodeling and maintenance. Finally, calcitriol ensures bone health is maintained by suppressing PTH production, keeping bone resorption to a minimum. The kidneys help maintain proper levels of calcium and phosphorous in the blood by producing the calcitriol and excreting or retaining both calcium and phosphorous, depending on serum levels (5).

Pathophysiology of calcium and phosphorous

In dialysis and ESRD patients, normal homeostatic mechanisms related to maintaining appropriate levels of calcium and phosphorous do not function properly. Lack of kidney function causes decreased or absent secretion of excess minerals resulting in buildup of these substances. On dialysis, many constituents can be filtered out that would be filtered through normal kidney function. However, phosphorous’ molecular weight is too large to cross the barrier, resulting in increased levels in the blood. When phosphorus is high in the blood, it binds to calcium, making vascular and visceral calcium-phosphate calcifications. This results in lower calcium serum levels. Lower levels of serum calcium result in increased PTH, increasing bone resorption for the maintenance of calcium levels. Calcitriol is also normally increased when
calcium is low; however, because the kidneys cannot function normally, calcitriol cannot be activated. This results in decreased absorption of calcium in the gut, less bone remodeling/maintenance, and no suppression of PTH, resulting in continuous bone resorption. The only way to solve this problem is by taking medication (5,14,15).

Abnormal levels of PTH, calcium, and phosphorus have been studied to find which ones cause side effects in dialysis patients. The purpose of one study was to determine an association between these substances and risk of death, cardiovascular mortality, and nonfatal cardiovascular events or death in individuals with chronic kidney disease. The findings confirmed that high levels of PTH and low levels of calcium do not correlate with the risk of cardiovascular events of death. However, higher serum levels of phosphorous resulted in higher mortality for dialysis patients. Thus, controlling phosphorus levels when in ESRD and on dialysis is critical (16).

MEDICATIONS

Kidney malfunction leads to improper balance of calcium, phosphorus, PTH, and vitamin D, which lead to renal osteodystrophy. Five bone disorders result from renal failure: osteomalacia, osteitis fibrosa cystica, metastatic calcification, aplastic bone disorder and low turnover bone disease. These result when decreased GFR leads to excess phosphorus, lowering serum calcium levels as discussed previously. This, in turn, increases PTH, promoting bone breakdown (17). Therefore, the goal of medications is to decrease phosphorus and PTH in the serum, thus increasing calcium, which is often done by binding phosphorus (5).

Phosphate Binders

Methods for binding phosphate include aluminum binders, calcium binders, and magnesium binders. Basaljel and Amphojel, both of which are aluminum binders, bind phosphate in the gut and prevent absorption, thus decreasing serum phosphate levels and
increasing serum calcium. Binding occurs at optimum levels, making aluminum phosphate
binders especially effective (18). However, the use of aluminum phosphate binders is not
recommended due to risk of aluminum toxicity, which could lead to osteomalacia,
encephalopathy, and refractory anemia (17). Because of this, the use of calcium-based
phosphorus binders is more common.

Calcium carbonate (TUMS) in some forms, when used as a phosphate binder, is
comparable to aluminum binders. Ultimately, however, it is less effective because it is pH
dependent, requiring a low pH for solubility and a high pH for binding (17,18). Calcium acetate
is the most effective calcium phosphorus binder in kidney failure patients, more so than calcium
carbonate because it is more soluble, enabling acetate to bind twice as much as calcium
carbonate (19, 18). However, calcium binders negatively impact bone health, causing low-
turnover bone disease (due to low PTH) and calcification of soft tissue (from excess calcium).
Using calcium as a phosphate binder causes increased calcium absorption independent of
vitamin D, which leads to calcification of soft tissues (19). Additional binders, especially various
salts, have been considered for diminishing such problems.

Magnesium salts in the form of magnesium hydroxide and magnesium carbonate have
been studied, though neither is very effective. Negative side effects prevent it from being a
preferred method, as it causes hypermagnesemia and severe diarrhea (18). Lanthanum salts may
be effective phosphorus binders; however, long-term safety and efficacy have yet to be
determined. Iron salts have also been considered and studied, but none of the studies have been
large scale; therefore, iron salts are not generally used. Sevelamer hydrochloride is a new-age
phosphorus binder, as it has no heavy metals that could be potentially toxic. It works best at a
higher pH by binding phosphate and releasing chloride and does not cause excess calcium
absorption. It has yet to become main stream because it is expensive (about $2,500 a year in low doses), requires large quantities to cause benefits, and generally leads to gastrointestinal problems (19).

Parathyroid Hormone Levels and Vitamin D

The imbalance of calcium, phosphorus, and vitamin D levels also cause an influx in parathyroid hormone (PTH). Decreased serum calcium and vitamin D, and increased phosphorus lead to an increase in PTH, which breaks down bone to increase serum calcium. This, in turn, causes secondary hyperparathyroidism (SPTH) to increase renal phosphorus excretion. However, with renal failure this mechanism cannot function properly and leads to bone weakening and metabolic disorders (20).

Chronic renal failure patients often are vitamin D deficient and may develop a resistance to the action of vitamin D. This causes decreased absorption of calcium, which leads to secondary hyperparathyroidism. In some cases supplementing vitamin D will increase calcium, which will decrease PTH. When medications and dialysis fail to properly balance these mechanisms, the patient needs to receive a kidney transplant for survival (19).

TRANSPLANT

Currently, there are over 85,000 individuals waiting for a kidney transplant. Over 28,000 transplants were performed from January to December of 2010, with over 22,000 of those coming from cadavers and 6,000 from living donors (21). Kidney transplants last an average of five years (7). The main factors that contribute to how long a kidney transplant lasts are the health of the patient and the histocompatibility of the donor kidney to the patient. A lack of histocompatibility will result in rejection, the main concern associated with kidney transplants. To prevent rejection, immunosuppressives are administered, which alter the medical
nutrition therapy of the patient. For instance, corticosteroids cause protein metabolism, sodium retention, hyperlipidemia, glucose intolerance, and inhibition of the metabolism of calcium, phosphorous and vitamin D (5). Thus, MNT depends on the type of immunosuppressives a patient is taking.

The first month after a kidney transplant, patients should receive a high protein diet of 1.3-1.5g/kg/day. Protein needs increase to 1.6-2.0 g/kg, however, if the patient suffers from infection, fever, or stress due to surgery. To prevent negative nitrogen balance, 30-35 kcal/kg should be administered. Sodium should be restricted to 80-100 mEq/mL and hydration monitored as well. Typically, patients are told to drink two liters of fluid a day; however this fluctuates individually based on urine output (5).

MEDICAL NUTRITION THERAPY FOR DIALYSIS

Although dialysis performs the same regulating functions as the kidneys in a healthy individual, dialysis patients must follow specific dietary recommendations for optimal health and prevention of complications. The goals of medical nutrition therapy in dialysis patients include the following: (a) prevent deficiency and maintain good nutrition status through adequate intake of protein, energy, vitamins, and minerals, (b) control edema and electrolyte imbalance through regulating sodium, potassium, and fluid intake, (c) prevent or slow down development of renal osteodystrophy through controlling calcium, phosphorus, and vitamin D, and (d) provide patients with a palatable and enjoyable diet that is tailored to individual lifestyles (5).

Energy

Dialysis patients’ energy intake should be sufficient to prevent catabolism of lean body mass and promote tissue synthesis and repair. The energy requirement for HD patients is 35 kcal/kg while the energy requirement for PD patients is 30-35 kcal/kg. These requirements are
based on the patient’s ideal body weight (IBW), not their weight with fluid buildup between dialysis treatments (5). Requirements for PD patients are lower because the glucose in the dialysate adds about 500 extra calories per day (22).

Protein

In both HD and PD, protein requirements are increased and depend on the state of the patient. In general, however, patients on hemodialysis have an average protein requirement of 1.2 g/kg IBW. On the other hand, PD patients require between 1.2 and 1.5 g/kg IBW (5). On average, this equates to eight to 10 ounces of protein per day (5,22). The recommendation for protein in PD patients is higher due to increased risk of infection and continuous loss of protein to peritoneal dialysate (22). Furthermore, patients on dialysis with low albumin levels demonstrate higher mortality rates, emphasizing the importance of protein. Protein recommendations, however, are not determined based on albumin levels because of the confounding influence of comorbid diseases, inflammation, and nutrition on protein levels (5). Approximately 50% of protein should be from high quality sources such as eggs, lean beef, pork, tuna, and salmon (5,22).

Phosphorus

While consuming adequate protein is requisite, a barrier to sufficient intake is phosphorus balance. Animal tissue is metabolically active, meaning it contains ATP, and thus, phosphorus. In adults with normal renal function, approximately 1400 mg of phosphorus are consumed on a daily basis. From this 1400 mg, 65% (910 mg) is absorbed in the duodenum and jejunum. The remaining phosphorus is excreted in the urine (65%) and stool (35%). In the dialysis patient, urine formation is significantly decreased or non-existent. Thus, the method for excreting 65% of
the unabsorbed phosphorus is altered, resulting in more absorption than excretion (23). Dialysis removes 50% of the patient’s daily phosphate intake (5).

To keep serum levels within a reasonable range, the patient must restrict his or her intake of phosphorus-containing foods. Patients on both HD and PD must limit phosphorus intake to between .8 and 1.2 g/day (or no more than 17 mg/kg/day) (5). In addition to metabolically active tissue, phosphorus is prominent in cola, chocolate, nuts, peanut butter, and dairy products (22). While dietary restrictions are pertinent to maintaining patient phosphorus levels, dietary restriction is not enough to keep phosphate under control. In summary, successful phosphorus control is achieved by combining a low-phosphate diet, phosphate binders, and compliance with the dialysis schedule (5).

Calcium

In a patient with normal renal function, the kidney reabsorbs about 98% of the calcium that passes through the kidney. Thus, patients with impaired renal function can develop hypocalcemia (23). Because many foods that are high in calcium are also high in phosphorus, treatment can be difficult. Patients suffering from hypocalcemia are supplemented with calcium carbonate, calcium acetate, lactate, malate, or gluconate between meals to increase absorption. In addition, 300 mg to 500 mg of calcium should be provided through the diet. Even with supplementation, decreased blood calcium persists in some patients. In situations such as this, active vitamin D is supplemented in the forms of calcitriol and Calcijex to increase gut absorption of calcium (5).

Fluid and Sodium Control

Due to decreased or absent renal function, dialysis patients must restrict sodium and fluid. Requirements for patients on HD are calculated to allow four or five pounds of fluid
weight gain between dialysis treatments, equaling one to two pounds each day. Fluid intake in HD patients should equal between 750 and 1000 milliliters plus daily urine output (5,24). Anything that is liquid at room temperature is fluid; this includes water, juice, coffee, tea, ice cream, gelatin, ice, popsicles, sauces, gravies, and soups (25). Dialysis patients often feel thirsty, but this feeling can be remedied by sucking on hard candy or tart items, chewing on gum or ice, and distributing fluid intake throughout the day (5). PD patients must also limit their fluid intake, but not to the same extent as HD patients because their dialysis is more frequent. Additionally, the peritoneal membrane allows more water than solutes to move across the membrane, resulting in increased fluid loss (23). These patients should obtain a minimum of 2000 milliliters per day in addition to urinary excretion. (5)

Sodium, and in effect, fluid intake is the most important determinant of weight gain between dialysis treatments because sodium increases thirst and water retention (23). Patients on HD must limit sodium to between two and three grams per day, meaning they must avoid convenience foods and not add salt when cooking. Because PD is more frequent, sodium allowances are between two and four grams of sodium daily (5). Most patients maintain sodium balance when on PD (23). Reducing excess water weight in PD patients is critical because increased fluid requires stronger dialysate, resulting in increased calories (24). Overall, sodium and fluid balance help preserve a healthy fluid load for heart health and ease of dialysis treatments (5,24).

Potassium

Healthy kidneys excrete 90-95% of the potassium load. In dialysis patients, the gut adapts to loss of renal function and increases gastrointestinal excretion of potassium from 5-10% to 25%. Excretion of potassium is proportionate to the patient’s stool volume. Because constipation
occurs in 40% of HD patients, these patients can be predisposed to hyperkalemia. If a patient is suffering from hyperkalemia, it is likely a combination of excessive potassium intake, decreased removal, or a combination of both (23). HD patients should limit potassium consumption to between two and three grams per day to maintain proper potassium levels (5). As a general rule, patients should consume two to three servings of low-potassium fruits and two to three servings of low-potassium vegetables in a day. Dialysis patients should always avoid foods containing potassium chloride salt replacements (26). On the other hand, significant amounts of potassium are removed through PD on a more frequent basis, sometimes resulting in hypokalemia (22). PD patients should obtain between three and four grams of potassium per day to account for increased losses through dialysate (5).

Iron

Many dialysis patients are supplemented with synthetic erythropoietin (EPO) to stimulate red blood cell synthesis. Increased iron requirements accompany this rise in hematocrit, and is met through intravenous (IV) administration. In cases of extreme intolerance of or allergies to IV iron, oral iron may be used. In such cases, 325 mg of FeSO₄ is administered in three doses. FeSO₄ has an affinity for phosphate binders, and thus should be taken between meals and without phosphate binders. Doses of vitamin C above 500 mg/day are contraindicated because this increases absorption above oral iron absorption and can cause kidney stone formation (5).

Vitamins

During dialysis, water-soluble vitamins are lost, folate being most affected. Furthermore, water-soluble vitamins are generally higher in foods containing potassium and phosphorus, combining increased loss with decreased ingestion. Consequently, supplementation of vitamin C
(60 mg), folic acid (1 mg), thiamin (1.5 mg), riboflavin (1.7 mg), niacin (20 mg), vitamin B6 (10 mg), vitamin B12 (6 mcg), pantothenic acid (10 mg), and biotin (0.3 mg) is recommended for HD and PD dialysis patients alike. Supplementation with vitamin K is contraindicated because dialysis patients often take anticoagulants. Moreover, due to increased levels of retinol-binding protein, supplementation with vitamin A is not recommended (5).

Physical Activity

Dialysis patients are marked by decreased exercise capacity, as demonstrated by a peak maximal oxygen uptake that is only 50%-60% of the predicted values for normal adults in the same age category. In a survey of 2,264 patients from the Dialysis Morbidity and Mortality study, exercise limitations in dialysis patients were correlated with malnutrition, cardiovascular disease, and poor mental health. Additionally, sedentary behavior was associated with increased risk of mortality in dialysis patients; only 5% of non-sedentary patients died during the study period in comparison with the death of 11% of sedentary patients. This equates to a 62% increased risk of death in the sedentary population. Exercise regimens should be tailored to individual patients and their capabilities with approval of the physician (27).

CONCLUSION

ESRD patients are able to achieve the highest quality of life when dialysis, medications, and diet are used together to meet each patient’s unique needs. Unfortunately, such drastic changes make compliance difficult for many patients. Because of this, use of support groups and tailored, achievable goals is critical to successful management (7). This is best done when a medical team consisting of a dietitian, doctor, social worker, and nurse work together to educate and assist the patient and family. This treatment pattern enables optimal quality of life, thus helping the patient adjust to the changes that take place when on dialysis.
REFERENCES


23. Nanovic L. Electrolytes and fluid management in hemodialysis and peritoneal dialysis.


