Symposium-Dialysis

Dr. Charley Gutch, AmSECT's dialysis symposium authority, has selected the following manuscript for inclusion in this issue of *The Journal.*

Dietary Management of Hemodialysis Patients

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Dietary management is an important part of the treatment of kidney failure. Hemodialysis is an intermittent form of therapy. Proper dietary management prevents potentially harmful changes in body composition between hemodialysis treatments. The diet is the patient's continuous therapy. Each patient's dietary requirements vary with his residual kidney function, the degree of biochemical inbalance and the presence of other complications. Complications most directly related to diet include protein-calorie malnutrition, hypertension and overhydration, hypotension and dehydration, and hyperkalemia.

The nursing and technical staff of the dialysis unit has the closest and most continuous contact with patients. This staff should monitor laboratory data and insure that other members of the health care team, particularly the physician and dietitian, are aware of changes. Nutritional complications may not be noticed until they become severe. Periodic review of predialysis BUN, creatinine, sodium, potassium and dry body weight help the health care team detect early changes in the patient's nutritional status.

The "Recommended Dietary Allowances" were set up by the National Research Council as a guide in planning a nutritionally adequate diet.[1] It is not difficult to plan a diet according to the RDA requirements. However, in a stressful situation such as renal disease and chronic hemodialysis, careful planning is needed to prevent deficiency or excess of any one nutrient.

The principles of any therapeutic diet are based on modification of the nutritional components of the normal diet. The goal for patients on hemodialysis is to provide optimal recommended nutritive composition without causing undue change in the blood composition between hemodialysis treatments. If the patient does not follow a proper dietary program, he will not do well on chronic hemodialysis.

The condition of the patient, the presence of complications, and the frequency of dialysis affect the dietary allowances for each individual. Because of increased efficiency of the hemodialysis equipment, the diet for patients on maintenance hemodialysis has become less restricted. Patients should be advised as to their maximum nutrient allowances to be sure their nutritional requirements are filled. There are six main areas of concern in the dietary management of hemodialysis patients—these are; protein-calorie, sodium, fluid requirements, potassium, vitamins, and minerals.

PROTEIN-CALORIE REQUIREMENTS

Protein is an essential nutrient needed by the body for tissue building and repair. Protein comes in many foods. There are about seven grams of protein in an egg, or one ounce of meat. There are about two grams of protein in one slice of bread or ½ cup of mashed potatoes.

Proteins are made up of amino acids. These amino acids are what the body uses to build and repair body tissue. For adult humans, eight amino acids are "essential". They are essential because they cannot be synthesized in the body. They must be provided in the diet. It is vitally important that the patient receives these eight essential amino acids from his food intake every day in the amounts necessary for proper tissue repair and body building.

A "complete protein" contains all eight essential amino acids in the amounts for the body to use efficiently. These complete proteins, or proteins of high biological value, are usually found in food sources derived from animals and include eggs, milk, meat and cheese.

Other foods, such as bread and cereals, also provide protein, but are usually "incomplete proteins", or proteins of low biological value. They contain protein with amino acids, but one or more of the essential amino acids are missing, or are not present in sufficient amounts for the needs of the body.

Patients on hemodialysis need protein of high biological value. It has been proven that there is a loss of amino acids in the dialysate fluid. Loss of essential amino acids can amount to more than 50 percent of the minimum daily requirements for the normal man.[2] Therefore, it is vitally important that the patient eat enough high biological value protein to meet his RDA plus that needed to replace that lost in the dialysate. Various authors have made different suggestions as to the amount and quality of protein necessary to maintain a patient on hemodialysis. Ginn studied the quality and quantity of protein required to maintain a stable nitrogen balance in patients on twice weekly hemodialysis. A diet containing 0.75 grams of high quality protein per kilogram of ideal body weight was sufficient to maintain positive nitrogen balance.[3] However, Comty and Doyal suggested a mixed dietary protein intake of one gram per kilogram, with 15-20 grams being of high biological value, as sufficient to meet the essential amino acid requirements of patients on hemodialysis.[4] In accordance with the National Research Council's recommendations, a mixed protein intake of one gram per kilogram should contain approximately 70 percent high quality protein.[1]

The protein of high biological value should be consumed throughout the day for efficient utilization of the essential amino acids. In other words, the high quality protein foods should be distributed throughout three meals each day.

Another critical point in the protein need for dialysis patients is the total calorie requirement. The renal patient needs sufficient calories to maintain or to achieve his ideal body weight. If the patient does not consume enough food to provide sufficient calories, the body will break down its own tissue to provide energy. In this process water is formed. Tissue is lost, but weight may remain the same. The proportion of total body water is thus increased. Fluid overload, increase in blood pressure, and heart failure can result even though weight stays the same. If the patient is losing weight, he probably will experience muscle wasting, edema and irritability. The "dry" body weight of the patient who is clinically free of edema is used as a criterion of adequate protein and calorie intake.

According to Ginn, patients that are malnourished have a higher nitrogen

requirement, and usually need more than one gram of high biological value protein per kilogram body weight, and a higher caloric intake than does the well nourished dialysis patient.[3]

Low protein intake by a chronic hemodialysis patient becomes inadequate during periods of stress, such as infection or bleeding, and particularly after the removal of a rejected transplanted kidney. Sometimes such a patient is unable to maintain sufficient caloric intake unless he is given special dietary supplements such as Controlyte,® Cal Power®, or Hi Cal®. There are many ways to provide adequate caloric intake until the patient is able to tolerate food. The health care team can help the malnourished patient by encouraging him to eat. The patient who is malnourished is often very depressed. He represents a difficult clinical problem since he is often unwilling to eat, yet adequate nutrition is essential for replacemnt of lost muscle mass.

A chronic patient may gradually reduce his protein and caloric intake over a period of months and become protein depleted. These changes are usually slow to occur and are not easily detected. As muscle mass is broken down, the intercellular space is expanded with endogenous water. There may not be a marked weight change or edema. The changes may be reflected in the predialysis BUN and serum albumin.

The predialysis BUN can be used as an index of protein intake. If the patient is not in a catabolic state, an increase in the predialysis BUN may indicate that the patient is: 1) *in negative nitrogen balance* because he did not eat sufficient quantities of calories and is utilizing his body protein for an energy source, or because he took an excess amount of low quality protein which cannot be utilized, or because he may not have taken sufficient amount of any protein; or 2) *in positive nitrogen balance* but had an excess protein intake for the amount of dialysis time per week. Urea is an easily dialyzed molecule and readily reflects the dialysis time.

The serum creatinine does not reflect protein malnutrition as directly as the BUN. The predialysis creatinine relates to the patient's residual renal function, the amount of tissue breakdown according to body size, the present of other tissue destruction, and the number of hours of dialysis. An increase in predialysis serum creatinine may be due to an increase in activity, or to insufficient calories if tissue destruction is occurring.

Serum albumin can also be used as an indicator of quality and quantity of protein intake. A serum albumin below 3.5 milligrams per 100 milliliters indicates protein depletion. A serum albumin of 2.5 milligrams per milliliter indicates protein malnutrition.[5] Any patient with a serum albumin below 2.5 milligrams per milliliter needs to have the quality and quantity of his protein increased.

Changes in predialysis BUN, dry body weight and serum albumin concentrations are clinical indicators which the health care team can use to evaluate protein-calorie malnutrition in patients. Recording this data on a flow sheet for several weeks or months will help to indicate an association of the factors, and whether the trend is toward adequate protein and calorie nutrition, or if the patient's intake is deficient in these areas.

SODIUM AND FLUID REQUIREMENTS

Papper states that the patient's blood pressure, urinary sodium and fluid excretion, insensible plus gastrointestinal losses, presence of extracellular over-

hydration, and weight changes are factors used to determine the recommended sodium and fluid intake.[6] The dietary sodium and fluid needs must be determined for each individual patient.

It is usually necessary to keep the patient on a moderate sodium restriction: approximately 2-3 grams (87.0-130.4 millequivalents) per day. The degree of sodium restriction used varies among different dialysis centers. If the patient has a very small urinary output or is anephric, limitation of sodium intake helps to reduce thirst and therefore helps to decrease fluid consumption.

The brain's thirst center is sensitive to the osmolality of blood water. Uremia is accompanied by an increased concentration of blood solutes at all times. Therefore, the thirst mechanism is activated and the patient feels physically thirsty. Since sodium and chloride are the major contributors to serum osmolality, if the patient can maintain a lower serum sodium, it helps to keep the thirst center "turned off".

The patient should not gain over 1½ pounds (0.5-0.7 kilograms) of fluid weight between dialyses. An intake of 500 milliliters plus an amount equivalent to the urinary output is sufficient. The patient gets 300-500 milliliters of fluid from the solid food he eats, but this can, for the ease of calculation, be discounted as being matched by insensible losses.

At the beginning of hemodalysis therapy, the uremic patient is usually over-hydrated, hypertensive and possibly in congestive heart failure. As the patient loses sodium and water during dialysis, the blood pressure should come under better control.

The goal of sodium and fluid control, and dialysis therapy, is to achieve the patient's "dry weight," and to determine if the hypertension is renin dependent and not responsive to ultrafiltration. Indices used to judge hypertension and/or overhydration include: supine and standing blood pressures, pre and post dialysis, in association with weight change, and the presence of edema or evidence of heart failure.

If hypertension is amenable to sodium and water control, both the supine and standing predialysis blood pressures should decrease as the patient approaches his dry weight. Blood pressure should be normal or slightly hypotensive at the termination of dialysis. If the elevated blood pressure is renin dependent, the predialysis supine and standing diastolic pressure may remain elevated, even though the patient has reached his dry weight.

The health care team can help the patient control his hypertension and avoid excessive weight gain by encouraging him to monitor his sodium and water intake. The patient should weigh himself every day, and measure his urinary output once a week on a non-dialysis day. These observations should be recorded and discussed with members of the health care team. Hopefully, the patient will develop an understanding for the need for his sodium and water restriction.

Hypotension frequently occurs during hemodialysis. The fall in blood pressure can be controlled by regulating the rate of ultrafiltration or by slow fluid replacement. Inadequate dietary control can produce dehydration with reduction in the plasma volume, if sodium and water output exceeds intake. Inadequate protein intake, or uncompensated protein losses, may result in hypoalbuminemia and loss of fluid to the interstitial space. The goal of diet therapy for the hypoalbuminemic patient is to increase the serum albumin by increasing intake of high biological value

proteins, and limitaton of fluid.

The patient who becomes dehydrated during dialysis may require saline in order to replace extracellular fluid losses. His dietary intake should be adjusted to replace the measurable losses without producing overhydration. The patient who is hypertensive but does not have edema may only tolerate small decrements of weight removal over several dialyses.

The predialysis serum sodium cannot be used as an indication of the individual's sodium intake. If the patient is consuming a lot of sodium, he is usually thirsty and also consumes too much fluid. The excess fluid increases his blood volume, thereby diluting the sodium measured in the serum. Actually, he has an excess of both sodium and water. Body weight and blood pressure are more accurate reflections of the sodium intake. Sodium and fluid restriction may be the most difficult aspects of his management for the patient to follow. Usually he is required to limit his intake of salt. Salt is America's number one seasoning ingredient, and it is difficult for most patients to learn to do without it. Sodium restriction requires the patient to give up many of his favorite foods—such as bacon, ham, cold cuts and weiners. He is also told to abstain from foods that have been preserved in brine such as olives, pickles and saurkraut. He may have to give up many of his favorite snack foods such as potato chips, salted nuts and crackers. A lot of encouragement is needed to help the patient to stick with his sodium restricted diet. He must be reminded continually of the consequences of deviation from his regime. The patient that cannot follow his dietary restrictions usually does poorly on dialysis. He comes in overdehydrated, and finds it difficult to maintain the other restrictions necessary for dialysis patients.

POTASSIUM

Potassium is also an element that may have to be restricted for the patient on chronic hemodialysis. Potassium serves many functions in the body. It affects the contractility of the skeletal and cardiac muscles. It also serves an important function in nerve impulse conduction. The uremic patient with a moderate urine output can usually secrete sufficient potassium. He does not need a potassium restricted diet. However, if the urinary output decreases to under 400 milliliters per day, potassium restriction usually becomes necessary.

The amount of potassium that is allowed depends directly on the amount of potassium that is excreted in the feces, and whether there are other causes of potassium release into the serum such as bleeding, muscle breakdown or infection. The predialysis serum potassium should not exceed 5.5-6.0 milliequivalents per liter. Serum potassium is directly related to the dietary intake. It can be controlled by dietary management and adjustment of the concentration in the dialysis fluid. The usual dietary restriction for hemodialysis patients is 1.5-2.5 grams (38.5-64.1 milliequivalent) potassium per day.

Hyperkalemia often occurs after the patient has been stabilized and adherence to the diet over a long period of time has become difficult. Potassium is present in many foods, and if the patient's protein intake, or fruit and vegetable intake has increased, his potassium will rise. Hyperkalemia usually does not occur alone. It is most often associated with an increase in predialysis BUN, and often indicates an increased protein intake. Tissue breakdown may also be a reason for increase in serum potassium. It may also occur with bleeding, or with infections. Many times, an increase in potassium comes from unrecognized sources such as chewing tobacco, or use of a salt substitute. Hyperkalemia can usually be effectively treated by dietary restrictions. The patient with a high predialysis serum potassium needs dietary

counseling to make him aware of foods that are high in potassium, and which foods he needs to restrict in his intake.

VITAMIN REQUIREMENTS

The effects of hemodialysis on vitamin metabolism are not well known. The degree to which water soluble vitamins are dialyzed is not certain. Siddiqi and others have suggested that there are folic acid deficiencies in dialysis patients and folic acid has been measured in the dialysate.[7] Vitamin C is dialyzable, as is B_{12}. It is therefore important for the dialysis patient to receive a vitamin supplement. It is common practice in most dialysis units to give folic acid and multivitamin supplements. The multivitamins should contain: A, D, thiamine, riboflavin, niacine and ascorbic acid.

MINERAL REQUIREMENTS

Very little is known about mineral utilization in the hemodialysis patient. The minerals of concern in the dietary management of the chronic dialysis patient include phosphorus, calcium and iron.

Uremic patients usually have a high serum phosphorus. Because of the many dietary restrictions that are already placed upon dialysis patients, it is difficult to require them to also restrict phosphorus. Also, phosphorus is usually high in the high biological value protein foods.

Phosphorus is most effectively controlled by using a phosphorus binding agent such as aluminum hydroxide. The efficient use of phosphorus binding agents can lower the serum phosphorus concentration to normal levels. Unfortunately, efficacy of this therapy is limited by the inability of the majority of patients to regularly take phosphorus binding agents such as aluminum hydroxide gel in liquid or tablet form.[8] Ogden and others have reported successful control of serum phosphorus in chronic hemodialysis patients with amphojel incorporated in cookies.[9, 10] It must be remembered that the phosphorus binding agent must be in the stomach when the food is present to effectively bind the phosphorus.

Serum calcium is difficult to control through dietary management. If the serum phosphorus is of normal limit, it is less difficult to maintain the serum calcium level.

Iron deficiency occurs with loss of blood. If the dialysis patient has repeated blood losses or is anemic, the patient may require an iron supplement. Oral iron may cause gastrointestinal distress, and some dialysis centers prefer short courses of parenteral iron when indicated.

CONCLUSION

The goal of dietary management for patients on hemodialysis is to maintain the patient in biochemical balance between dialyses, and to help avoid the development of complications. A systematic approach to recording data which indicate nutritional status should be used. Nutritional problems may be slow to occur and may not become apparent unless they are compared with other factors over a period of time. A record of the patient's dietary habits will provide a useful history of his progress as he continues on long term dialysis. His pattern of dietary management, or mismanagement, can be anticipated and plans made. If dietary control continues to be a problem, the dietitian can evaluate whether this reflects poor knowledge, or an unwillingness to adhere to the overall hemodialysis program.

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