Patients on hemodialysis frequently encounter multiple complications during the course of therapy. Anemia occurs from impaired erythropoiesis stemming from chronic kidney disease and loss of blood and iron during the hemodialysis process. Dietary restrictions are often necessary in patients on hemodialysis to maintain adequate nutritional status and prevent the accumulation of nutrients that are not effectively removed with hemodialysis. These factors can significantly affect a patient’s iron status and result in iron-restricted erythropoiesis and eventually absolute iron deficiency. This article describes the role that nephrology nurses have in effectively managing nutrition, iron status, and anemia in patients on hemodialysis and highlights important clinical characteristics that should be considered in select racial or ethnic populations. The results of an initiative within one dialysis network to track dietary intake and administer appropriate anemia treatment, including intravenous iron, through an educational program are examined.

Goal
To increase awareness about initiatives being taken that address iron-deficiency anemia

Objectives
1. Describe various factors in selected populations that contribute to iron-deficiency anemia.
2. Summarize the findings of a dietary and pharmacological study of patients on hemodialysis.
3. Outline the importance of nephrology nurses and staff on iron management in patients on hemodialysis.

patients may have low iron status for several reasons, including loss of blood and iron during the hemodialysis procedure, reduced dietary iron intake, and poor iron absorption. Because diet has the potential to substantially have an impact on anemia outcomes, nephrology nurses should be aware of how ethnicity and cultural food preferences affect nutritional status, dietary compliance, and iron intake ( Seaverson et al, 2007).

Nephrology nurses require an advanced understanding of how these factors influence anemia treatment with erythropoiesis-stimulating agents.
Dietary Intake and Impact on Outcomes

Research has confirmed that the majority of patients on hemodialysis do not receive adequate nutrition as recommended by national guidelines, which can have a profound impact on outcomes (Bossola et al., 2005). Therefore, it is critical for nephrology nurses to regularly monitor a patient’s diet to prevent complications and improve response to therapy. Malnutrition, characterized by inadequate protein and energy intake, has been found to contribute to poor quality of life and increased morbidity and mortality in patients on hemodialysis (Kalanter-Zadeh, Block, McAllister, Humphreys & Kopple, 2004; Locatelli, DelVecchio & Manzoni, 1998). Investigators reported a mortality risk in patients on hemodialysis with a self-reported poor appetite that was 4 to 5 times higher than those with a normal appetite (Kalanter-Zadeh et al., 2004). Another significant finding is the association between reduced appetite and lower Hb levels as well as an increased requirement for ESA administration (Kalanter-Zadeh et al., 2004). Thus, nutritional and appetite status may yield significant insight into the management of anemia and the degree of ESA responsiveness in patients on hemodialysis.

Nutrition and Impact on Iron Status

Nephrology nurses need to emphasize the importance of proper nutrition and dietary compliance for their patients on hemodialysis. Many of these patients consume low levels of vitamin C, fiber, and some carotenoids, possibly due to dietary restrictions that limit fruit and vegetable choices. Inadequate intake of vitamin C may be a concern because vitamin C has been reported to increase the release of iron from stores and increase iron utilization (NKF, 2006). Patients on hemodialysis also consume a lower level of many nutrients. It is important to note that iron intake is negatively influenced by low nutrient density foods, which are high in calories but low in vitamins and minerals. It is recommended that patients with CKD who do not require hemodialysis consume a low-protein diet (0.6 g/kg/day) to slow the progression of kidney disease (Medline Plus Medical Encyclopedia, 2007). However, insufficient protein intake can lead to protein malnutrition and possibly contribute to low serum protein/albumin levels. Conversely, those receiving maintenance hemodialysis require higher amounts of protein in the diet due to the loss of protein and amino acid during the hemodialysis process (Goldstein-Fuchs, 2006). A decreased protein intake results in a reduced iron intake and contributes to depleted iron stores (Medline Plus Medical Encyclopedia, 2007). Patients on maintenance hemodialysis are counseled to control their sodium, potassium, and phosphorus consumption as well as fluid intake. Phosphorus is not effectively removed by hemodialysis therapy, so patients must limit its intake (Medline Plus Medical Encyclopedia, 2007). Daily intake of potassium is controlled to help prevent hyperkalemia, which is a common problem for patients on dialysis. The limitations of certain foods due to high potassium or phosphorus content can have an impact on dietary iron intake. Finally, patients on hemodialysis may consume lower levels of iron due to dietary restrictions that limit fat and cholesterol (Kalanter-Zadeh, Kopple, Deepak, Block & Block, 2002; National Institutes of Health Clinical Center [NIHCC], 2007).

The type of dietary iron consumed (i.e., heme iron and nonheme iron) can influence iron absorption (NIHCC, 2007). Heme iron is found in animal foods that originally contained Hb, whereas nonheme iron is found in plant foods. Heme iron is well-absorbed by the body and contributes to iron stores. Sources of heme iron, such as red meats, fish, and poultry, are generally allowed in patients on hemodialysis but should be limited due to fat and cholesterol content. Meanwhile, many fruits, vegetables, cereals, and legumes are important sources of nonheme iron. Cooking foods in iron cookware, such as cast iron skillets, may enhance the iron content of foods due to the iron that leaches from the cookware during the cooking process (Kröger-Öhlsen, Trúgvason, Skibsted, & Michaelsen, 2002).

Although the body does not absorb nonheme iron as well as heme iron, absorption can be improved by eating sources of nonheme iron with foods that supply vitamin C or heme iron. Caffeine can affect iron absorption and should be avoided during meals that supply nonheme iron. Beans are high in potassium and should be limited in patients on hemodialysis, but are nevertheless a good source of nonheme iron. Nephrology nurses should counsel patients on obtaining good sources of both heme and nonheme iron without consuming excessive amounts of fat, cholesterol, potassium, or phosphorus.

These nutritional considerations and their impact on iron status are especially important in the hemodialysis population as their daily iron intake is often less than recommended, iron losses are high, and iron requirements are increased.

Dietary Compliance in Select Demographic Groups

Demographic factors, particularly ethnicity, can predict nutritional status in patients on hemodialysis and should be considered when assessing diet. Cultural food preferences may affect dietary compliance and the intake of important nutrients, including iron. Nonadherence to dietary restrictions that limit phosphorus and potassium intake has been found to correlate closely with culturally important foods. This was reported in an analysis of dietary noncompliance among different ethnic and racial populations of patients on hemodialysis. Sources of noncompli-
Nephrology nurses need to be aware of the clinical and dietary issues of this population to deliver more effective hemodialysis care, including anemia management.

**Dietary Tracking in Hispanic Populations**

Hispanic individuals undergoing hemodialysis are more likely to suffer from CKD due to underlying type 2 diabetes, compared with similarly matched Black or White individuals (Rocco et al., 2000). Hispanic individuals on hemodialysis are also more likely to have comorbid hypertension (Rocco et al., 2000). These factors should be considered when developing nutritional plans for these individuals.

Dietary tracking is important in Hispanic populations due to the frequency of diet-related issues and the method of tracking dietary intake may affect the accuracy of the information gathered. Educational levels are lower among some U.S. Hispanic populations, and language also may pose a barrier to the accurate assessment of dietary intake (Block et al., 2006). Although self-reported forms are often used to track diet, food intake information may be more accurate when gathered by an interview with the nurse or another staff member, such as a dietitian, in hemodialysis centers with a large proportion of Hispanic individuals (Block et al., 2006).

**Iron Status in Hispanic Populations**

There is a higher prevalence of iron-deficiency anemia in Mexican American females than in non-Hispanic white females (Frith-Terhune, Cogswell, Kettel Khan, Will, & Ramakrishnan, 2000), and individuals of Latin American descent may exhibit a greater tendency toward iron deficiency in the presence of pernicious anemia (Carmel, 1990). Nephrology nurses should therefore recognize the potential for additional iron deficiency problems in Hispanic patients on hemodialysis, particularly those of Latin American descent with a history of pernicious anemia.

**Nutrition and Iron Management Considerations in the Hispanic Population**

Nephrology nurses responsible for anemia management may need to consider important factors that can affect iron status in select populations. It has been suggested that Hispanic populations often present with a challenging clinical profile resulting from the etiology of their kidney disease, various dietary compliance issues, and iron status. Demographic studies project that the Hispanic population will grow to comprise almost 25% of the American population by the year 2050. The Hispanic population may be more vulnerable to diet-related health problems including obesity and type 2 diabetes (Block, Wakimoto, Jense, Mandel & Green, 2006). Nephrology nurses need to be aware of the clinical and dietary

Nephrology nurses play an integral role in monitoring dietary intake and nutritional status in patients on hemodialysis and require an understanding of assessment tools used to effectively track diet. The subjective global assessment (SGA) tool measures overall clinical status by tracking five components of medical history, including weight change, dietary intake, gastrointestinal symptoms, functional capacity, and CKD and its relationship to nutritional requirements. The SGA tracks findings from a physical examination at each assessment that includes signs of fat and muscle wasting and nutrition-associated changes in fluid balance as an indication of nutritional status (Steiber et al., 2004). Nephrology nurses may use this tool to track overall nutritional status in patients, but the SGA may be less reliable in tracking relative malnutrition in an individual over time.

A food frequency questionnaire (FFQ), such as the one developed by Gladys Block, (Kalantar-Zadeh et al., 2002) has been used effectively on an epidemiologic basis to compare dietary intake between hemodialysis and non-hemodialysis populations. It may be used to compare relatively higher or lower intakes of certain foods among patients on hemodialysis. Respondents answer multiple-choice questions on food intake based on 107 different prespecified food types. There are, however, limitations to the FFQ to accurately track an individual’s regular dietary intake. It does not provide the opportunity to track precise amounts of each food consumed on a daily basis and does not have the ability to track specific foods within more general categories.

Technological advances have presented opportunities for new methods to track dietary intake and nutritional status. Self-report food diaries help patients reliably track food intake and may improve dietary compliance (Burke et al., 2005). Although paper diaries have been used as inexpensive
and readily available tools to track diet, they are limited by a patient’s literacy and handwriting. Diaries that require calculations of nutrient intake can be time-consuming. The use of personal digital assistants (PDAs) or other electronic devices that contain dietary software may improve accuracy and compliance with dietary guidelines. Although literacy may limit the utility of PDAs in some patients, the use of PDAs may improve dietary compliance by providing more accurate tracking of food and nutrient intake. PDAs may facilitate real-time tracking nutrient intake, including sodium, potassium, and phosphorus, and may prevent individuals from consuming excessive amounts of these nutrients. PDAs may help nephrology nurses more accurately track nutritional status on a real-time basis. Nephrology nurses should keep these important tools in mind when developing plans to regularly track food intake, improve dietary adherence, and develop patient self-management goals.

**Dietary Surveys in Clinical Practice: The Experience of a Dialysis Network**

Nephrology nurses associated with a network of nine clinics based in Rio Grande Valley, Texas, conducted dietary surveys in approximately 600 patients on hemodialysis. The majority of them were Hispanic and were being treated for anemia with ESA and IV iron therapy. These dietary surveys were conducted in response to 6 months of observed outcomes. The patients’ average serum ferritin levels were approximately 700 ng/mL, the average Hb levels were 11.9 g/dL, and adequate albumin levels and transferrin saturation (TSAT) levels indicated adequate protein intake.

As part of a larger continuous quality improvement initiative to standardize anemia management in hemodialysis centers, a new anemia management protocol was introduced in January 2006. The protocol specified that maintenance IV iron regimens should be reduced, but not held, in patients with serum ferritin levels of 500 to 800 ng/mL (see Table 1). Despite reductions in IV iron therapy, patients continued to have moderately higher serum ferritin levels and maintained adequate Hb levels.

One goal of tracking the dietary patterns of these patients was to assess their dietary iron intake. It was proposed that an increased dietary intake of iron contributed to the moderately higher serum ferritin levels and optimal Hb levels, even when IV iron doses were reduced. The dietary survey used by the hemodialysis centers allowed patients to track general categories of food intake, including organ

<table>
<thead>
<tr>
<th>TSAT</th>
<th>Serum Ferritin</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater than 20%</td>
<td>Less than 500 ng/mL</td>
<td>Administer IV iron 62.5 mg IVP over 5-7 minutes weekly</td>
</tr>
<tr>
<td>Greater than 20%</td>
<td>Greater than 500 but less than 800 ng/mL</td>
<td>Administer IV iron 62.5 mg IVP over 5-7 minutes every other week</td>
</tr>
<tr>
<td>Greater than 20%</td>
<td>Greater than 800 ng/mL</td>
<td>Hold IV iron for 1 month, and reorder serum ferritin and TSAT next month</td>
</tr>
<tr>
<td>Greater than 50%</td>
<td>Any level</td>
<td>Notify anemia manager for patient-specific assessment</td>
</tr>
</tbody>
</table>

IVP = intravenous push.


**Figure 1**

**Dietary Survey of Rio Grande Valley Dialysis Network**

<table>
<thead>
<tr>
<th>Beef</th>
<th>Organ Meats</th>
<th>Chicken, Pork, Fish, Luncheon Meats</th>
<th>Rice</th>
<th>Beans</th>
<th>Peppers and/or citrus fruit</th>
<th>Spinach</th>
<th>Tortilla or Tamale</th>
<th>Grains</th>
<th>Eggs</th>
<th>Dairy</th>
<th>Iron Skillets</th>
<th>Clay Pots</th>
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<tbody>
<tr>
<td>How many servings† of the following food groups did you eat for breakfast?</td>
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<td>How many servings† of the following food groups did you eat for lunch?</td>
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<tr>
<td>How many servings† of the following food groups did you eat for dinner?</td>
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<tr>
<td>How many servings† of the following food groups did you eat as a snack?</td>
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</tbody>
</table>

* The dietary survey was available in Spanish and English.
† Estimate one serving as the size of the patient’s fist.
meats; chicken, pork, fish, and luncheon meats; rice; beans; peppers and/or citrus fruit; spinach; tortillas or tamales; grains; eggs; and dairy products (see Figure 1). Patients were prompted to indicate when meals were prepared in clay pots or iron cookware, which can enhance the iron content in foods (Kröger-Ohlsen, Trúgvason, Skibsted, & Michaelsen, 2002). Patients were asked if they smoked, as that can influence anemia management outcomes (Colfer, 2003).

The survey was conducted as a two-fold process, in which the nurses administered the survey and the hemodialysis technicians interviewed the patients. The technicians’ role was important because they had established a good rapport with the patients and their caregivers.

Analysis of the survey results showed that patients had an iron-rich diet. This is important because iron facilitates healthy RBC development; however, an increased dietary iron intake does not ensure adequate iron absorption, which may be altered in patients with CKD. Several factors have been attributed to the sufficient dietary iron intake of this patient population:

- The dietary habits of this patient population, which is approximately 90% of Mexican origin, are influenced by the types of foods they consume, especially meats, beans, rice, tortillas, and breakfast tacos. These and other ethnic foods are readily available at local convenience stores, thereby allowing patients easy access to the foods they customarily eat. It is important to note that many processed foods contain large quantities of sodium, thereby increasing the patient’s dietary sodium intake. Nurses should advise patients on hemodialysis to limit their salt intake, which will help limit thirst and, in turn, help patients restrict fluid intake. Fluid intake is an important determinant of weight gain between dialysis sessions, especially in patients with minimal residual urine output (Tomson, 2001).
- The patient population is located in the Rio Grande Valley, which is a major producer of citrus fruits that can be a source of iron. These fruits are consumed by these patients because they are available year-round and are less expensive than other fruits.
- In this rural setting, the families are more likely to cook and eat at home, even if the food was purchased in a convenience store, as opposed to eating in fast-food restaurants.
- Due to the close proximity of the Rio Grande Valley to the Mexico border, patients and their families buy many of their pots and pans from Mexico. Therefore, a large majority of them regularly cook in cast iron skillets and clay pots, which can increase their iron intake (Kröger-Ohlsen et al., 2002).

An important observation from this initiative is that while IV iron regimens were reduced as serum ferritin levels approached 800 ng/mL, iron continued to be effective in maintaining these patients’ Hb levels. Although this was not a rigorous scientific study, it was proposed that iron helped to enhance and maintain Hb levels in patients with moderately higher serum ferritin levels. The benefits of iron in patients with high serum ferritin levels also are supported in the recent study, Dialysis Patients’ Response to IV Iron With Elevated Ferritin (DRIVE) (Coyne, et al., 2007).

**Effectiveness of Iron at Higher Serum Ferritin**

The DRIVE study was an open-label, randomized trial designed to characterize the effects of IV iron therapy in 134 anemic patients on hemodialysis who had higher serum ferritin levels (500 to 1200 ng/mL) and TSAT levels of equal to or less than 25% and were receiving adequate ESA therapy (Coyne et al., 2007). Patients were randomized to receive IV iron (1 g of sodium ferric gluconate administered over 8 hemodialysis sessions) or no IV iron. Although the ESA dose was increased by 25% at the beginning of the first week of treatment in both patient
groups, adjustments in ESA dose were prohibited over the next 6 weeks of the trial. Findings from the trial showed that patients who received IV iron demonstrated a greater increase in Hb and a more rapid Hb response, as compared to the no iron group (see Figure 2). Moreover, a greater percentage of patients receiving IV iron demonstrated an Hb response, defined as equal to or greater than 2 g/dL increase in Hb at any point during the study, than those who did not receive IV iron. DRIVE demonstrated that sodium ferric gluconate is effective in anemic patients on hemodialysis who are receiving adequate ESA therapy and have serum ferritin levels of 500 to 1200 ng/mL and TSAT levels equal to or less than 25%.

Guidelines to Managing Anemia in Hemodialysis

Nephrology nurses are responsible for routine anemia management with ESA and IV iron therapy and therefore require an advanced understanding of the National Kidney Foundation’s Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines and recommendations. The effective management of anemia in the hemodialysis population is critical to avoid poor outcomes, including increased morbidity and early mortality (Gouva, Nikolopoulos, Ioannidis & Siamopoulos, 2004). Standardized anemia management protocols are often needed to achieve consistent outcomes, and the KDOQI guidelines and recommendations can be a useful resource in developing an effective protocol.

The KDOQI guidelines and recommendations for anemia management in CKD populations, both on and off hemodialysis, recognize the importance of ESA therapy in maintaining adequate levels of Hb in patients with anemia. The guidelines suggest that ESA dosing should be tailored for each patient based on target Hb levels and the observed patient response in terms of changes in Hb levels [NKF, 2006].

Administration of IV iron therapy and monitoring of iron status is routinely required to help manage anemia in the vast majority of patients on hemodialysis. The guidelines and recommendations emphasize that IV iron therapy is effective not only in patients who demonstrate evidence of iron deficiency but also is necessary to avoid storage iron depletion, prevent iron-restricted erythropoiesis, and achieve and maintain adequate Hb levels [NKF, 2006].

The guidelines and recommendations suggest that clinicians responsible for anemia management should perform iron status tests on a monthly basis during the initial stages of ESA therapy. These studies should be performed at least every 3 months once a stable ESA regimen has been instituted. It is also suggested that anemia managers interpret iron status tests, Hb levels, and ESA dose as a whole to guide IV iron therapy [NKF, 2006].

The guidelines and recommendations have determined that iron status targets in patients on hemodialysis should include a serum ferritin level of greater than 200 ng/mL, TSAT greater than 20%, and reticulocyte Hb content of greater than 29 pg/cell. The guidelines and recommendations also stipulate that insufficient evidence exists to recommend routine IV iron therapy in patients with serum ferritin levels of greater than 500 ng/mL, but recommend that therapy in the presence of these levels should be guided by ESA responsiveness, Hb levels, TSAT levels, and the patient’s clinical status [NKF, 2006]. It is also noted that a trial regimen of IV iron may be warranted to determine clinical response in patients with low TSAT levels and serum ferritin levels of greater than 500 ng/mL [NKF, 2006].

The statement in the guidelines and recommendations that “there is insufficient evidence to recommend routine administration of IV iron if serum ferritin level is greater than 500 ng/mL” may be misconstrued by some clinicians as a serum ferritin cutoff value for IV iron therapy [NKF, 2006, S58]. Therefore, it is important to point out that the current statement does not advocate a specific upper level of serum ferritin at which to hold IV iron therapy. The misinterpretation of the recommendation has the potential to deny IV iron to some patients who could benefit from it.

The DRIVE trial was published after the development of the 2006 KDOQI guidelines and recommendations. It has helped clinicians understand how to treat patients on hemodialysis who remain anemic despite substantial ESA doses and have a serum ferritin between 500 and 1200 ng/mL and a TSAT equal to or less than 25%. Study results demonstrated that 1 gram of sodium ferric gluconate administered during 8 consecutive hemodialysis sessions is effective in improving anemia in this patient type (Coyne et al., 2007).

Balancing ESA and IV Iron Therapy

ESAs require the availability of additional iron to maintain effective erythropoiesis (Cavill, 1999). Patients who receive ESA therapy without IV iron can develop iron-restricted erythropoiesis (Tang, Huang, Chen & Yang, 1999). The development of iron-restricted erythropoiesis occurs when ESA therapy increases the demand for iron but the reticuloendothelial cells are unable to release enough iron to transferrin (the transporter of iron) to meet the increased demand (Eschbach, 2005).

IV iron has been shown to reduce the need for ESA therapy, even in the presence of iron indices that suggest adequate iron status, such as serum ferritin and TSAT (Fishbane, Frei & Maesaka, 1995). For example, the administration of IV iron therapy to maintain TSAT levels between 30% and 50% has been shown to reduce the need for ESA therapy by 40% compared with a control group who received IV iron therapy guided by a target TSAT of 20% to 30% (Besarab et al., 2000). More recently, patients who participated in DRIVE were then enrolled in DRIVE-II, a follow-up observational study in which patients returned to routine management of ESA and IV iron therapy (sodium ferric gluconate) at the discretion of the anemia manager (Kapoian et al., 2006). The objective of the second analysis was to assess how IV iron affect-
ed weekly ESA doses. DRIVE-II results showed that the mean ESA dose decreased by approximately 21% in the IV iron group but remained unchanged in the control group, with the final ESA dose being significantly higher in the control group (Kapoian et al., 2006). Reductions in the need for ESA therapy can result in substantial cost savings (Besarab et al., 2000).

Iron status can be affected by dietary preferences and nutritional status in patients on hemodialysis. Nephrology nurses need to effectively balance ESA and IV iron therapy and develop an individualized treatment plan based on underlying factors that may affect iron stores.

Serum Ferritin and Iron Status

As demonstrated by recent studies, serum ferritin may be a poor marker of iron status in patients on hemodialysis. Serum ferritin is often elevated due to inflammatory processes that are common in the CKD and hemodialysis populations. These high serum ferritin levels may mask the presence of inadequate iron stores or iron-restricted erythropoiesis (Kopelman, Smith, Peoples, Biesecker & Rizkala, 2007). When iron-restricted erythropoiesis is suspected, IV iron can be used safely and effectively to improve iron status and the efficacy of ESA therapy.

One retrospective analysis from a single hemodialysis center studied the effects of IV iron administration in 94 patients with serum ferritin greater than 800 ng/mL and TSAT less than 25% on at least one occasion (Kopelman et al., 2007). Investigators noted that patients receiving equal to or greater than 250 mg of IV iron (sodium ferric gluconate) experienced significant increases in Hb levels and reductions in ESA requirements. Meanwhile, serum ferritin levels did not increase significantly during IV iron therapy. These findings suggest that patients with iron-restricted erythropoiesis, characterized by low Hb, low TSAT, and moderately higher serum ferritin (greater than 800 ng/mL) may benefit from the administration of IV iron to improve iron status.

The results from the DRIVE trial indicated that sodium ferric gluconate increased, but did not produce excessively high, serum ferritin levels, thereby overcoming iron-restricted erythropoiesis in the sample population (Coyne et al., 2007).

Investigators previously hypothesized that high serum ferritin levels may be due to the malnutrition-inflammation-cachexia syndrome (MICS) that is common in the hemodialysis population. They performed a retrospective analysis on case data from more than 58,000 patients on hemodialysis over a period of 2 years (Kalantar-Zadeh, Regidor, McAllister, Michael & Warnock, 2005). The analysis resulted in the findings that serum ferritin levels of 200 to 1200 ng/mL were associated with the lowest risk of cardiovascular and all-cause mortality. The investigators concluded that the relationship between moderately high serum ferritin and mortality risk was due to the effects of MICS on serum ferritin levels and the mortality risks that are inherent with inflammation, malnutrition, and cachexia.

Serum Ferritin in Select Populations

Serum ferritin levels may be considered an important metabolic change in select populations. A cross-sectional analysis of Mexican-American men enrolled in the Third National Health and Nutrition Examination Survey (NHANES III) reported that serum ferritin levels correlated positively with waist-to-hip ratio, as well as other markers of fat distribution and obesity. Although it is difficult to make definitive conclusions regarding serum ferritin and health risk from these findings, abdominal fat and obesity increase the risk of developing atherosclerosis and Type 2 diabetes (Gillum, 2001). Serum ferritin may be elevated in Mexican-American individuals and similar Hispanic populations with excess abdominal fat or obesity, which may represent an additional confounding factor in the accurate assessment of serum ferritin as a measure of iron status.

Serum ferritin levels should be interpreted with caution and may not reflect available iron stores in some patients on hemodialysis. Nephrology nurses responsible for routine anemia management should take multiple factors into account, including ethnicity, nutritional status, ESA dosing, and clinical status, when evaluating serum ferritin to guide therapy.

Conclusions

Iron management in the hemodialysis population is complex and requires a multifactorial assessment of iron markers, nutritional status, and cultural food preferences to develop an individualized anemia treatment plan for each patient. CKD impairs effective erythropoiesis, and the hemodialysis process causes ongoing losses of blood and iron, all of which can contribute to anemia. Hemodialysis often has an impact on individual dietary habits and results in low intake of iron-rich foods.

Nephrology nurses and other staff members play a critical role in managing anemia and iron status in hemodialysis patients. Therefore, they require an advanced understanding of IV iron and ESA therapy and the monitoring of iron stores. In particular, nurses responsible for anemia management should realize that elevated serum ferritin levels may not accurately reflect iron stores, especially in the presence of low TSAT levels. IV iron may still be required to overcome iron-restricted erythropoiesis and allow for effective erythropoiesis in patients who present with high serum ferritin levels and low TSAT.

Nephrology nurses are responsible for daily management issues, including the assessment of nutritional status to determine that dietary needs are being met. The regular monitoring and correction of dietary issues can prevent poor outcomes, including early mortality associated with malnutrition in the hemodialysis population. Nurses need to be sensitive to individual patient issues, including race and ethnicity, which can affect dietary preferences and have an important influence on nutritional and iron status.
Important Considerations in Iron Management and Nutritional Status in Select Hemodialysis Populations

Rosie Olivares, RN

Posttest – 1.5 Contact Hours

Posttest Questions

(See posttest instructions on the answer form, on page 434.)

1. What iron marker can be an unreliable measure of iron status in patients on hemodialysis?
   a. Hemoglobin
   b. C-reactive protein
   c. Albumin
   d. Serum ferritin

2. How do cultural food preferences affect patients on hemodialysis?
   a. Result in higher doses of erythropoiesis-stimulating agent (ESA) and intravenous (IV) iron therapy
   b. Influence dietary compliance and intake of important nutrients, such as iron
   c. Lead to disease progression
   d. Have no effect on patients

3. How can the absorption of nonheme iron be improved?
   a. Eat sources of nonheme iron with foods that supply vitamin C or heme iron
   b. Consume excessive amounts of fat, cholesterol, potassium, and phosphorus
   c. Avoid fruits and vegetables
   d. Avoid cooking in a cast iron skillet

4. Patients on hemodialysis are at an increased risk for developing iron-deficiency anemia and therefore often require what type of treatment?
   a. Diet high in fat and cholesterol
   b. IV iron
   c. Peritoneal dialysis
   d. Vitamin B supplement

5. Which of the following statements best describes heme iron?
   a. Heme iron is found in plant foods.
   b. Heme iron is only found in fruits.
   c. Heme iron is poorly absorbed in the body.
   d. Heme iron is found in animal foods.

6. Which of the following statements is incorrect regarding IV iron therapy?
   a. IV iron is effective in improving anemia in patients with serum ferritin between 500 and 1200 ng/mL and transferrin saturation equal to or less than 25% and receiving adequate ESA doses.
   b. IV iron has been shown to decrease ESA requirements.
   c. IV iron should be automatically held at a serum ferritin level of 500 ng/mL.
   d. The Kidney Disease Outcomes Quality Initiative published in 2006 does not specify an upper limit of serum ferritin.

7. Malnutrition has been found to contribute to what condition?
   a. Increased mortality
   b. Improved quality of life
   c. Increased iron intake
   d. Reduced morbidity

8. How does a decreased protein intake affect the body?
   a. Improves anemia
   b. Reduces iron intake
   c. Increases serum ferritin levels
   d. Increases transferrin saturation levels

9. What factor can increase serum ferritin levels?
   a. Low hemoglobin level
   b. ESA administration
   c. Dietary restrictions
   d. Malnutrition-inflammation-cachexia syndrome

10. One study demonstrated that serum ferritin levels within what range were associated with the lowest risk of cardiovascular and all-cause mortality?
    a. 100 to 500 ng/mL
    b. 200 to 1200 ng/mL
    c. 200 to 500 ng/mL
    d. 800 to 1200 ng/mL
Important Considerations in Iron Management and Nutritional Status in Select Hemodialysis Populations

Rosie Olivares, RN

Complete the Following:

Name: ____________________________________________________________
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Payment:
ANNA Member: ____ Yes   ____ No    Member #___________________________
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ANNJ0715

GOAL To increase awareness about initiatives being taken that address iron-deficiency anemia

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Suggested topics for future articles?
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Note: If you wish to keep the journal intact, you may photocopy the answer sheet or access this posttest at www.annanurse.org/journal

Posttest Answer Grid (Please circle your answer choice):
1. a b c d  3. a b c d  5. a b c d  7. a b c d  9. a b c d
2. a b c d  4. a b c d  6. a b c d  8. a b c d  10. a b c d

Evaluation

1. The objectives were related to the goal. Strongly disagree Strongly agree
2. Objectives were met
   a. Describe various factors in selected populations 1 2 3 4 5
   that contribute to iron-deficiency anemia.
   b. Summarize the findings of a dietary and pharmaco-
      logical study of patients on hemodialysis with
      iron-deficiency anemia.
   c. Outline the importance of nephrology nurses
      and staff on iron management in patients on
      hemodialysis.
3. The content was current and relevant.
4. This was an effective method to learn this content. 1 2 3 4 5
5. Time required to complete reading assignment: ___________ minutes.

Posttest Instructions
• Select the best answer and circle the appropriate letter on the answer grid below.
• Complete the evaluation.
• Send only the answer form to the ANNA National Office, East Holly Avenue Box 56; Pitman, NJ 08071-0056; or fax this form to (856) 589-7463.
• Enclose a check or money order payable to ANNA. Fees listed in payment section.
• If you receive a passing score of 70% or better, a certificate for the contact hours will be awarded by ANNA.
• Please allow 2-3 weeks for processing. You may submit multiple answer forms in one mailing, however, because of various processing procedures for each answer form, you may not receive all of your certificates returned in one mailing.

Special Note
Your posttest can be processed in 1 week for an additional rush charge of $5.00.

Yes, I would like this posttest rush processed. I have included an additional fee of $5.00 for rush processing.

1.5 Contact Hours Expires: August 20, 2009
ANNA Member: $15
Non-Member: $25

Online submissions through a partnership with HDCN.com are accepted on this posttest at $20 for ANNA members and $30 for nonmembers. CNE certificates will be available immediately upon successful completion of the posttest.