Journal of Medical Sciences

ISSN 1682-4474

science alert

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Research Paper

JMS (ISSN 1682-4474) is an International, peer-reviewed scientific journal that publishes original article in experimental & clinical medicine and related disciplines such as molecular biology, biochemistry, genetics, biophysics, bio-and medical technology. JMS is issued eight times per year on paper and in electronic format.

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J. Med. Sci., 7 (2): 294-298
15th February, 2007

Nutritional Assessment of Hemodialysis Patients

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The objective of this study was to evaluate the nutrition status of chronic renal failure (CRF) patients. The study was carried out in 61 CRF patients (29 males and 32 females) who had been undergoing Maintenance Hemodialysis (MH). The mean intake of energy was 19.4±6.8 kcal/kg/day. Notably 95.1% of patients had energy intake below the recommendations for hemodialysis patients (HP) (30-35 kcal/kg/day). The mean intake of dietary protein was 0.8±0.4 g/kg/day which was substantially less than the recommended intake for hemodialysis patients (HP) (1.2-1.4 g/kg/day). About 82% of patients had the protein intake below 1.2 g/kg/day. The intake of calcium, phosphorus, iron, vitamin C, vitamin B_6, folate and vitamin B_{12} was also inadequate. Most of patients had intake of these nutrients below the recommendations. The mean serum albumin level was 3.37±6.5 g dL^{-1} which was substantially less than normal range. Moreover, 60% of patients had a serum albumin level of less than 3.5 g dL^{-1}. The mean hemoglobin concentration was 11.4 g dL^{-1} with 48% of patients had hemoglobin concentrations below normal levels; meanwhile 46% of patients had hematocrit value below 30%. In conclusion, malnutrition is common in HP and high percent of HP in Saudi Arabia are at high risk mortality and morbidity. It seem important to take some responsible and effective steps to correct the malnutrition of HP. Increasing the intake of energy, protein and other nutrients, especially, calcium, iron, folate, vitamin B_{12}, vitamin B_6 and vitamin C is recommended for HP.

Key words: Nutrition status, protein-energy malnutrition, chronic renal failure hemodialysis, albumin

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INTRODUCTION

Malnutrition is a common among patients with End-stage Renal Disease (ESRD) and is associated with elevated mortality and morbidity (Galland and Traeger, 2004; Fujino *et al*., 2005; Shinaberger *et al*., 2006). Malnutrition is present in about 40% of Chronic Renal Failure (CRF) patients on Maintenance Hemodialysis Patients (MHP) (Bergström and Lindholm, 1993; Cuppari *et al*., 1994). One of the most important risk factors for morbidity and mortality on MHP is Protein-Energy Malnutrition (PEM) and Protein Malnutrition (PM) may be associated with elevated mortality risk in individuals with CRF patients on maintenance hemodialysis. The prevalence of PEM in CRF patients is reported to vary between 30 and 76% (Young *et al*., 1991; Cianciaruso *et al*., 1995; Shinaberger *et al*., 2006; Kopple *et al*., 2006). The importance of nutrition in dialysis patients was recognized shortly after maintenance hemodialysis started to be used in the treatment of ESRD (Blagg, 1991). There are no enough data about nutrition status of maintenance hemodialysis patients in Saudi Arabia, therefore the aim of this study was to evaluate the nutrition status of MDP.

MATERIALS AND METHODS

The study was carried out in 61 CRF patients (29 males and 32 females) who had been undergoing maintenance hemodialysis for at least six months and were considered to be clinically stable. CRF patients were randomly chosen from the 3 hospitals in Riyadh city and data were collected in early 2006. Blood samples were drawn from the patients under fasting conditions immediately before the dialysis session for determination of biochemical assay. Albumin was determined with a standard autoanalyzer. The intakes of energy, protein and other nutrients like vitamins and minerals were determined by 3-day food record. Food process software was used, to calculate daily nutrient intakes. The intakes of iron, vitamin C, vitamin B_6, folate and vitamin B_{12} were compared with Dietary Reference Intake (DRI) (Dietary Reference, 1998 and 2001) while, The intakes of energy, protein, calcium and phosphorus were compared with American Dietetic Association (ADA) (ADA, 2000). The recommended energy intake is 35 kcal kg^{-1} body weigh for those younger than 60 years and 30-35 kcal kg^{-1} body weigh per day for those who are 60 years or older (ADA, 2000). The recommended minimum of hemoglobin and hematocrit in HP is 11 g dL^{-1} and 30%, respectively, while the cutoff low albumin was set at <3.5 g dL^{-1} (Pichard, 2004). The statistical analysis included means; standard deviations, were analyzed by SSPS version 10.

RESULTS

Characteristics of the subjects are presented in Table 1. Mean BMI was 25.13 and 25.06 kg m^{-2} for men and women, respectively. The analysis of the food diaries showed that the mean energy and protein intakes were below the recommendations for patients on hemodialysis Table 2. The energy and protein intake should be higher than 30 kcal/kg/day (30-35 kcal/kg/day) and 1.2 g/kg/day (1.2-1.4 g/kg/day), respectively. American Dietetic Association (2000) calculated for ideal body weight (Chertow and Lazarus, 1997; Kopple, 1994; Lorenzo *et al*.,

Table 1: Characteristics of the study populations (mean±SD)

Parameter	Men	Women
Number	29	32
Age (year)	51±13.2	52.6±16.9
Height (cm)	163.4±9.7	152.4±4.9
Weight (kg)	67.1±15.3	58.2±12.5
IBW (kg)	64±7.8	55.8±3.5
BMI (kg m^{-2})	25.13±6.6	25.06±5.6

IBW: Ideal Body Weight; BMI; Body Mass Index

Table 2: Intakes of energy, protein, calcium and phosphorus (n = 61)

Nutrients	Recommendations[1]	Intake mean	Percent deficient (lower than recommendation)
Energy (kcal/kg/day)	30-35	19.4±6.8	95.1
Protein (g/kg/day)	1.2-1.4	0.8±0.4	82
Calcium (mg/day)	1000-1800	500.8±266	91.1
Phosphorus (mg/day)	1200	592.8±260	83.6

[1] (American Dietetic Association, 2000); Values are mean±standard deviation

Table 3: Iron, vitamin C, B_{12}, B_6 and folate intakes and their recommendations

	Daily intake		DRI		Percent below DRI	
Nutrients	Male	Female	Male	Female	Male	Female
Iron (mg)	10.30±4.6	6.40±3.5	8	8	27.6	71.9
Vitamin C (mg)	72.20±38.5	54.10±37	90	70	62.1	78.1
Folate (μg)	178.00±96.9	123.00±74	400	400	96.6	96.9
Vitamin B_{12} (μg)	2.70±1.6	1.50±0.9	2.4	2.4	44.8	87.5
Vitamin B_6 (mg)	0.82±0.5	0.68±0.5	1.7	1.5	96.6	87.5

DRI: Dietary Reference Intake (n = 61; 29 males and 32 females)

1995; Schmicker, 1995; Toigo *et al*., 2000). The mean intake of energy was 19.4±6.8 kcal/kg/day. Notably 95.1% of patients had energy below the recommended intake for HP (30-35 kcal/kg/day). The mean intake of dietary protein was 0.8±0.4 g/kg/day which was substantially less than recommended intake for HP (1.2 g/kg/day.). About 82% of patients had the protein intake below 1.2 g/kg/day (Table 2). The intake of calcium and phosphorus was also inadequate. The levels of dietary calcium and phosphorus were 500.8±266 and 592.8±260 mg day^{-1}, respectively, which were far below the recommended amount for patients on hemodialysis. Moreover, 91.1 and 83.6% of patients had calcium and phosphorus intakes below the recommendations, respectively (Table 2). The intakes of other nutrients including iron, vitamin C, vitamin B_6, folate and vitamin B_{12} were also inadequate (Table 3). Most of patients had intake of dietary iron, vitamin C, vitamin B_6, folate and vitamin B_{12} below DRI. Notably, more than 95% of males and females had intake of folate below DRI (Table 3). The mean serum albumin level was 3.37±6.5 g dL^{-1} which was substantially less than normal range (Table 4). Moreover, 60% of patients had a serum albumin level of less than 3.5 g dL^{-1} (Fig. 1). The mean hemoglobin concentration was 11.4 g dL^{-1} (Table 4) Moreover, 48% of patients had hemoglobin concentrations below normal levels, meanwhile 46% of patients had hematocrit value below 30% (Fig. 1).

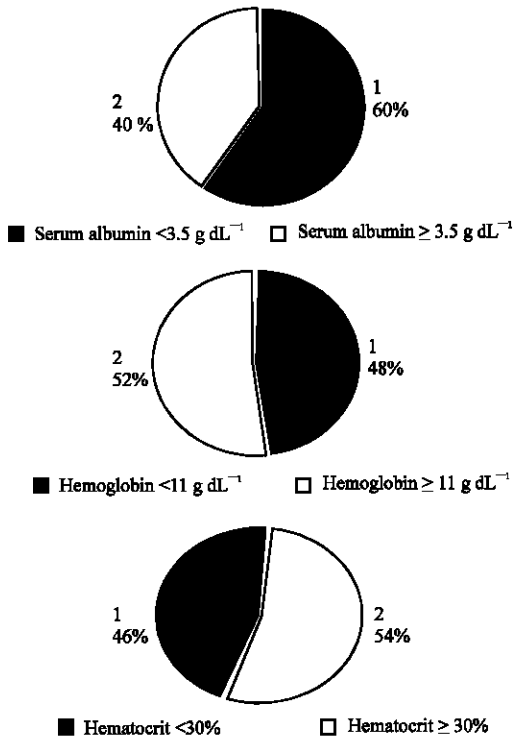

Fig. 1: Percentage of patients with hemoglobin <11 g dL^{-1}, hematocrit < 30% and serum albumin levels below 3.5 g dL^{-1}. The cutoff low albumin was set at <3.5 g dL^{-1}, while the recommended minimum Hb and hematocrit in HP is 11 g dL^{-1} and 30%, respectively

Table 4: Hematocrit, Hb and albumin concentrations of HP (n = 61)

Parameters	Hb (g dL^{-1})	Hematocrit (%)	Albumin (g dL^{-1})
Range	7.2-18.4	20.3- 53	2.1- 4.3
Mean (±SD)	11.4±6.8	33.7± 6.8	3.37±6.5
Normal value	≥11	≥30	3.5-5.5

Hb: Hemoglobin, SD: Standard Deviation

DISCUSSION

Nutritional assessment of MHP is very important, because malnutritional status contributes to high morbidity and mortality (Kalantar-Zadeh *et al*., 2001). The analysis of dietary intake is an important way to determine the daily nutrient intake such as energy, protein and other nutrients. In this study, the mean energy intake of patients, 19.4 kcal/kg/day, was far below the recommended requirements for patients on hemodialysis (30-35 kcal/kg/day recommended for HP) (Table 2) (ADA, 2000; Slomowitz *et al*., 1989), as systematically observed in many studies (Shoenfeld *et al*., 1983; Toigo *et al*., 2000; Bergström and Lindholm, 1993). The recommended energy intake is 35 kcal kg^{-1} body weigh for those younger than 60 years and 30-35 kcal kg^{-1} body weigh per day for those who are 60 years or older (ADA, 2000), Similarly, the mean intake of dietary protein was 0.8±0.4 g/kg/day (Table 2) which was substantially less than the recommended intake for HP (1.2-1.4 g/kg/day). About 95.1 and 82% of patients had the energy intake and protein intake below the recommended requirements, respectively. The prevalence of PEM in CRF patients is reported to vary between 30 and 76% (Marckmann, 1988; Bilbrey and Cohen, 1989; Young *et al*., 1991; Cianciaruso *et al*., 1995). Ge *et al*. (1998) fond that 90% of HP ingested less than 35 kcal/kg/day. Anorexia of HP may be implicated in this low energy and protein intake and may be related to the malnutrition of these patients (Ikizler *et al*., 1995). In addition, the intake of calcium, phosphorus and other nutrients including iron, vitamin C, vitamin B_6, folate and vitamin B_{12} were also inadequate. Most of patients had intake of dietary calcium, phosphorus iron, vitamin C, vitamin B_6, folate and vitamin B_{12} below recommended requirements (Table 2 and 3). Similarly, Ge *et al*. (1998) found that the intake of calcium, vitamin C, vitamin B_6, was inadequate. Anorexia of HP may be implicated in the low intake of energy, protein and other nutrients observed in this study (Ikizler *et al*., 1995).

The mean hemoglobin concentration was 11.4 g dL^{-1} and 48% of patients had hemoglobin concentration below 11 g dL^{-1} (Table 4). In USA Kimmel *et al.* (2003) found that the mean hemoglobin concentration was 11.8 g dL^{-1} (Kimme *et al.*, 2003). Recently Vaiciuniene *et al.* (2005), observed that the mean hemoglobin concentration was 10.4 g dL^{-1}. More recently, Wu *et al.* (2006) reported that 87.6 of HP had anemia. Anemia in HP is more commonly due to losses erythropoietin and iron deficiency. The prevalence of anemia in patients in this study could be attributed to sub-optimal iron intake found in most of study samples. Moreover, the prevalence of anemia in patients could be attributed to sub-optimal intake of other nutrients including folate and vitamin B_{12} that may be implicated in the anemia (Table 3). In addition, the hemodialysis procedure may cause malnutrition either by inducing losses of nutrients or by promoting inflammatory responses through blood-membrane interactions (Kopple *et al.*, 1973; Gutierrez *et al.*, 1990). Sub-optimal intakes of nutrients may be attributed to anorexia of patients. Supplemental vitamin B_6, vitamin B_{12}, vitamin C, folate and iron should be given to attain the DRI for the individual patient. Serum albumin is probably still the most commonly used nutritional marker in HP. Low albumin level is a strong predictor of mortality and morbidity among HP. Nutritional status assessed by serum albumin concentration was poor (3.37±6.5 g dL^{-1}) (Table 4), which was lower than that found in other study. In England, Huidobro *et al.* (2001) observed that the mean serum albumin was 3.9 g dL^{-1}. In USA, Kimmel *et al.* (2003) showed that the mean serum albumin was 3.7 g dL^{-1}. Recently Morsch *et al.* (2005) found that the mean serum albumin was 3.6 g dL^{-1}. Notably, 60% of patients in this study had a serum albumin level of less than 3.5 g dL^{-1} (Fig. 1). Low serum albumin levels observed in this study could be attributed to the low intake of energy and protein. Energy deficiency might be an important factor to poor utilization of dietary protein. In decrease in intakes of energy, protein and other nutrients in this study may be due to anorexia associated with uremia. It has been demonstrated that uremia alters appetite (Ikizler *et al.*, 1995; Johansen, 1998).

In summary, malnutrition is common in HP and high percent of HP in Saudi Arabia are at high risk mortality and morbidity. It seems important to take some responsible and effective steps to correct the malnutrition of HP. Increasing the intake of energy and protein is recommended. In addition, vitamins and mineral supplementation especially, calcium, iron, folate, vitamin B_{12}, vitamin B_6 and vitamin C may be an effective approach to improve nutritional status of HP.

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