IJFANS
International Journal of Food And Nutritional Sciences

Volume 4, Issue 1, Jan-Mar 2015, www.ijfans.com e-ISSN: 2320-7876

INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES

IMPACT FACTOR ~ 1.021

Official Journal of IIFANS

INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES

e-ISSN **2320 –7876** *www.ijfans.com*
Vol.4, Iss.1, Jan-Mar 2015

Research Paper ***Open Access***

SIMPLE NUTRITIONAL INTERVENTION IMPROVED HYPERPHOSPHATEMIA IN HEMODIALYSIS EGYPTIAN PATIENTS

Nadia Youssef Sadek Morcos[1], Ezzat Abdel-Rahman El Etreby[2], Maha Moustafa Kamal[1*] and Zeinab Al SaadEid[3]

[1]Biochemistry Department, Faculty of Science, Ain Shams University, Egypt, [2]Department of Internal medicine and Nephrology, Faculty of Medicine, Al-Azhar University, Egypt, [3]Department of Biochemistry, Faculty of Science, Ain Shams University Egypt

[*]Corresponding author: mmkmahmed@yahoo.com

Received on: 12th January, 2015 **Accepted on: 19th March, 2015**

ABSTRACT

Twenty three patients on maintenance-hemodialysis were selected from El Doaah and El Rayan hospitals, in Cairo. Thirteen patients were first advised to adhere to a simple diet for 4 months, suggested by the National Nutrition Institute, Cairo, Egypt. On the 5th month, 10 patients were included, and all patients received the diet + 2 cups of green tea/day, for 4 months. 2 patients with hyperparathyroidism were excluded. Blood samples were taken at baseline and monthly from all patients. Serum phosphorous, calcium, and Ca x P were measured together with, urea and creatinine. *Results:* The phosphorous levels were significantly reduced (from 6.58 to 4.4 mg/dL), while the calcium levels were elevated (from 7.9 to 9.2 mg/dL), resulting in a decrease in Ca x P (from 51.9 to 40.9 mg^2/dL^2) at all intervals, showing maximum effect after adding green tea to the diets. These effects were observed in total, male, and female patients.

Key words: Hyperphosphatemia, End Stage Renal Disease, Dietary control, Green tea.

INTRODUCTION

End-stage renal disease (ESRD) is one of the main health problems in Egypt. The prevalence of ESRD in Egypt increased from 225/million in 1996 to 483/million in 2004. Its main cause is hypertension followed by diabetes and still unknown causes represent about 15% (Zahran, 2011).

Chronic Kidney Disease (CKD) is associated with an increased risk of cardiovascular disease (CVD) and mortality. The increased mortality is related to traditional CV risk factors, such as diabetes and hypertension, in addition to disorders of bone and mineral metabolism (renal osteodystrophy) and vascular calcification. The imbalance in phosphate and calcium homeostasis in patients with ESRD has long been the subject of much research. Given the complex pathologies and treatment regimen associated with CKD, close collaboration among the different members of the renal team and the patient is important in order to develop*individualized*treatment plans that fit patients' lives and improve adherence over time (Kendrick, 2008).

Hyperphosphatemia is a common problem in individuals with advanced CKD. Correction and prevention of hyperphosphatemia via dietary intervention is a main component of the management of dialysis patients. However, imposing dietary phosphorus restriction is often associated with a reduction in dietary protein intake. The latter can lead to malnutrition andprotein-energy wasting. It is thus important to examine sources of dietary protein that are associated with the least phosphorus burden, since higher dietary phosphorus intake or foods with higher phosphorus-to-protein ratio are associated with increased death risk in dialysis patients. Hyperphosphatemia is remediated via diet, phosphorus binders, and dialysis. Dietary counseling should encourage the consumption of foods with the least amount of inorganic or absorbable phosphorus, low phosphorus-to-protein ratios, and adequate protein content, and discourage excessive calcium intake in high-risk patients (Reddy *et.al.*, 2014).

Patient education on phosphorus and calcium management can improve concordance and adherence and empower patients to collaborate actively for optimal control of mineral metabolism.The main goal of the present study is to find a suitable dietary intervention to improve hyperphosphatemia and hypocalcemia in maintenance-hemodialysis Egyptian patients.These interventions should be simple, easily applied, related to Egyptian diets, and the patients could adhere to them.

MATERIALS AND METHODS

1. PATIENTS

The work was done after taking acceptance of all patientsand controls to share in the study as well as acceptance of ethicscommittee of the University. The work has been carriedout in accordance with the code of Ethics of the World MedicalAssociation (Declaration of Helsinki) for experimentsinvolving humans.

Twenty-three patients on maintenance-hemodialysis were selected from El- Doaah and El Rayan hospitals, Cairo, Egypt. All patients were under treatment according to the dialysis units. Thirteen patients were first advised to adhere to a simple diet, for 4 months, suggested by the National Nutrition Institute, Cairo, Egypt [2006]. On the 5th month, 10 patients were included, and all patients received the diet + 2 cups of green tea/day, for 4 months.

2. DIETS

Diets used in the study are summarized in table 1 (National Nutrition Institute, Cairo, Egypt, 2006).

Table 1- Diets used in the study [National Nutrition Institute, Cairo, Egypt ,2006].

Diet	Amount g	Water g	Kcal	Protein g	Fat g	CHO g	Ca mg	P mg	Na mg	K mg	Fiber g
Breakfast											
1 Pita bread	100	35.3	254	8.8	1	52.5	42	134	338	236	1.3
1 boiled egg	50	37.6	74.5	6.3	5.4	0.3	31	109	77.5	65	---
1 slice cheddar cheese	25	8.95	101.5	6.5	8.25	0.37	181	131	181	22.5	---
Lunch											
Fish	100	58.5	233	20	15	4.4	72	---	364	116	---
Fried rice with onion	100	53.7	203	3.1	4.6	37.2	15	62	283	42	0.6
Green salad	185	169.1	69	1.79	3.62	8.02	31.9	52.2	71.2	345.8	1.27
Fruits	100	90.3	34	0.8	0.4	6.7	26	24	2	185	1.2
Dinner											
1 Pita bread	100	35.3	254	8.8	1	52.5	42	134	338	236	1.3
Falafel	50	16.3	177.5	5.5	10.5	16.3	12	59	262	129	0.75
Beans (Ful medames)	50	36.8	49	2.8	0.35	8.6	18.5	91.5	12	109	1
Juice (guava)	200	169	120	0.6	---	29	16	26	14	150	0.2
Snack											
Halva	50	1.15	222	3.9	6	38	9.5	---	38.5	--	0.45
Total		**670.3**	**1966.1**	**68.8**	**55.76**	**254.07**	**496.9**	**822.7**	**1981.2**	**1676.3**	**8.07**

3. COLLECTION OF BLOOD SAMPLES

Blood samples were taken at baseline and monthly from all patients throughout the months of diet and green tea supplementation.

4. BIOCHEMICAL ANALYSES

The following analyses were carried out using commercial kits (Biodiagnostics, Giza, Egypt): Determination of serum total calcium, serum total phosphorus, serum creatinine and blood Urea

5. STATISTICAL ANALYSES

Statistical analysis was performed using the Statistical Package of Social Science (SPSS) version 17. Data were presented as mean ± standard error of the mean (SEM).The study design and complex aim call for different ways of statistical analysis that allow to compare not only effects of fasting, but also to compare effects with respect to the baseline of each subject individually.

ANALYSIS OF VARIANCE (ANOVA) FOR INTERGROUP DIFFERENCES

The corresponding parameters in the groups (healthy, diabetics, and controls) were compared by means of a one-way analysis of variance (ANOVA) test, followed by least significant difference (LSD) multiple range-test to find intergroup significance. The level of statistical significance was set at $P < 0.05$.

WILCOXON RANKED-PAIRS TEST

Results were then compared with their own baseline values (paired tests). Because non-normal distribution was found for most of the analytes, results were assessed by Wilcoxon ranked-pairs test. The level of statistical significance was set at $P < 0.05$.

THE CRITICAL DIFFERENCES

The preceding analysis relates to the comparison of measured data with expected values based on observations on other people. When a measurement has been repeated, it is more relevant to consider it in relation to its previous value.The relevant question is whether the two values differ significantly. This will depend on two factors:

The change in the parameter level being measured (biological variation “BV”), and

THE ANALYTICAL VARIATION (AV)

Biological variation (BV); the normal fluctuation around the homeostatic set point, has been used to evaluate the significance of changes in serial results. Therefore, it can provide clinicians with an indication of future patient status: A change between two consecutive observations higher than the established variation around the homeostatic set point could signal the beginning of a complication or improvement (Biosca *et.al.*, 1997 and Hui *et.al* 2009).

Both BV and AV can be determined from the results of repeated measurements of the same samples, and a function known as the critical difference (CD) calculated from the equation:

$$CD = 2.8\ X\sqrt{SDa^2 + SDb^2}$$

Where “*SDa”*and “*SDb”* are the analytical and biological standard deviations, respectively.

The reference change value (RCV) is an important parameter of biological variation used to assess the significance of differences between consecutive results obtained in *a single individual.*It is defined as the critical differences that must be exceeded between two sequential results for a significant (or true) change to occur (Smellie, 2008). RCVs were calculated according to (Ricos *et.al.*, 2009 and Westgard, 2012) (for healthy subjects), and (www.westgard.com) (for diabetics).

In the present study, RCV is given as % change from the median value of each group. These RCVs differed between healthy and diabetics.

RESULTS

Patients' characteristics are listed in table 2. Figure 1 shows the changes in urea levels compared to baseline for both diets in all patients, while figure 2 shows the changes in urea (mg/dL) levels throughout the experimental period in both genders.

Table 2.Patients characteristics

		Mean ± SD (min – max)	n	%
Age		50.3 ± 11.1 (24 – 64)		
Weight		76.4±13.6 (52 -110)		
Gender	Males/ Females		13 / 10	56.5/ 43.5
Other chronic diseases	None		6	26.1
	Hypertension		9	39.1
	Hypertension + Diabetes		1	4.3
	HCV		1	4.3
	Hypertension + HCV		4	17.4
	2ry Hyper-parathyroidism		2	8.7

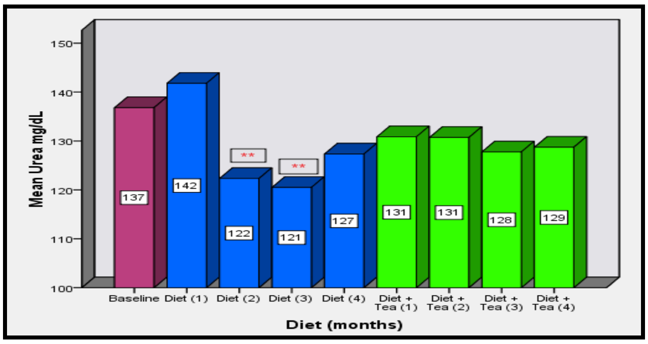

Figure 1- Changes in Urea levels compared to baseline for both diets in all patients (paired t-test) **: p<0.01 vs. baseline.

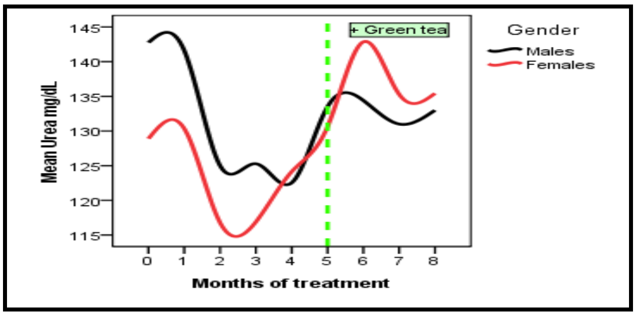

Figure 2. Changes in Urea (mg/dL) levels throughout the experimental period in both genders

Urea levels decreased in all patients, reaching significance only after the 2nd and 3rd months of diets without tea. This change applies also to males. However, females showed an increase in their urea levels after receiving green tea (non-significant).

Urea levels decreased in all patients, reaching significance only after the 2nd and 3rd months of diets without tea. This change applies also to males. However, females showed an increase in their urea levels after receiving green tea (non-significant).

Figure 3 represents the changes in Creatinine levels compared to baseline for both diets in all patients, while figure 4 representsthe changes in Creatinine (mg/dL) levels throughout the experimental period in both genders.Creatinine levelsdid not significantly decrease in all patients.However, male patients showed a slight decrease in their creatinine levels only after the 2nd month of the diet + tea while female patients showed the decrease only after the 2nd and 3rd months of diets without tea.

Figure 5 shows the changes in Calcium levels compared to baseline for both diets in all patients, while figure 6 shows the changes in Calcium (mg/dL) levels throughout the experimental period in both genders.

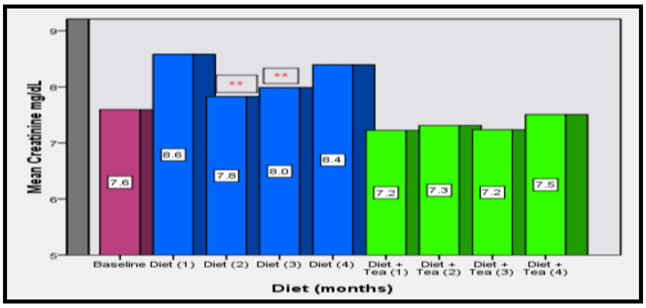

Figure 3- Changes in Creatinine levels compared to baseline for both diets in all patients (paired t-test): p<0.01 vs. baseline.**

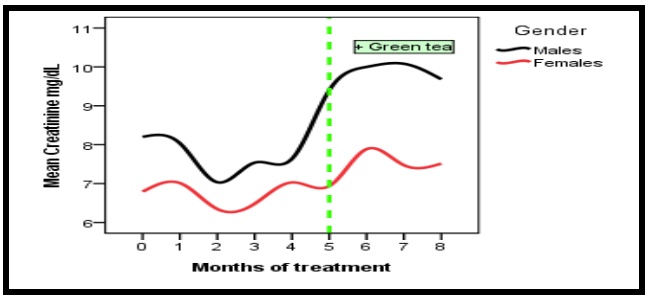

Figure 4- Changes in Creatinine (mg/dL) levels throughout the experimental period in both genders.

Creatinine levels did not significantly decrease in all patients. However, male patients showed a slight decrease in their creatinine levels only after the 2nd month of the diet + tea while female patients showed the decrease only after the 2nd and 3rd months of diets without tea

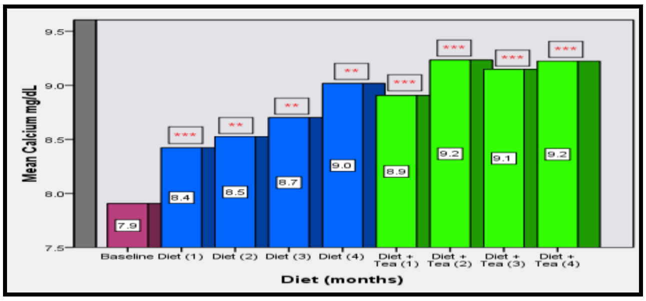

Figure 5- Changes in Calcium levels compared to baseline for both diets in all patients (paired t-test): p<0.01 vs. baseline***: p<0.001 vs. baseline**

Table 3- Within-individual changes in BUN (no change, improved or worse) after dietary intervention calculated from the RCV% value according to diet (Westgard, 2012 and Gardham *et.al.*, 2010)

RCV†	Change		Intervention after 4 months		Total
			Diet	Diet + Tea	
RCV BUN 11.7%	No change	n	7	7	14
		%	58.3%	38.9%	46.7%
	Improved	n	5	6	11
		%	41.7%	33.3%	36.7%
	Worse	n	0	5	5
		%	0%	27.8%	16.7%

RCV† (% of median); n =number of subjects

Table 4- Within-individual changes in Creatinine (no change, improved or worse) after dietary intervention calculated from the RCV% value according to diet (Westgard, 2012 and Gardham *et.al.*, 2010)

RCV†	Change		Intervention after 4 months		Total
			Diet	Diet + Tea	
RCV creatinine 6.4%	No change	n	3	2	5
		%	25.0%	11.1%	16.7 %
	Improved	n	7	9	16
		%	58.3%	50.0%	53.3 %
	Worse	n	2	7	9
		%	16.7%	38.9%	30.0 %

RCV† (% of median); n* =number of subjects

Table 5- Within-individual changes in Ca (no change, improved) after dietary intervention calculated from the RCV% value according to diet (Westgard, 2012 and Gardham *et.al.*, 2010)

RCV†	Change		Intervention after 4 months		Total
			Diet	Diet + Tea	
RCV Ca 8.2%	No change	n	3	3	6
		%	25.0%	16.7%	20.0 %
	Improved	n	9	15	24
		%	75.0%	83.3%	80.0 %

RCV† (% of median); n* =number of subjects

Table 6- Within-individual changes in P (no change or improved) after dietary intervention calculated from the RCV% value according to diet (Westgard, 2012 and Gardham *et.al.*, 2010)

RCV†	Change		Intervention after 4 months		Total
			Diet	Diet + Tea	
RCV P 41%	No change	n	8	12	20
		%	66.7%	66.7%	66.7 %
	Improved	n	4	6	10
		%	33.3%	33.3%	33.3 %

RCV† (% of median); n* =number of subjects

Urea (RCV=11.7%), creatinine (RCV=6.4%), and phosphorous (RCV=41%) levels improved (decreased) in 41.7%, 58.3% and 33.3% respectively in patients who did not take tea, corresponding to 33.3%, 50% and 33.3% respectively in patients supplied with green tea.

A worse change (increase) in urea was observed only in those on green tea (27.8%). Creatinine increased in 16.7% and 38.9% in patients on diets without and with tea respectively.

Calcium improved (increased; RCV= 8.1%) in 75% and 83.3% of the patients whose diets did not include, or included tea respectively.

None of the patients showed deterioration in their phosphorous or calcium levels.

Calcium levels had significantly increased in both groups. The increase in the male patients was obvious from the first month of dietand being more profound afterreceiving diet + tea. Female patients showed significant calcium increase from the first month onward, reaching most significance on the 2nd month of diet+tea.

Changes in Phosphorus levels compared to baseline for both diets in all patients are represented in figure 7 while the changes in Phosphorus (mg/dL) levels throughout the experimental period in both genders are represented in figure 8.

Phosphorus levelshad significantly decreased in all patients with the decrease being more profound after receiving diet+ tea. This change applies to both the male and female patients.

Figure 9 represent the changes in Ca×P product levels compared to baseline for both diets in all patients and figure 10 represent the changes in Ca×P product (mg^2/dL^2) levels throughout the experimental period in both genders. The Ca×P product significantly decreased in all patients.This change applied to the group of male patients from the first month of the experiment whilethe female groupbegan to show this change on the 4th month on diet and persisted onward. Within-individual changes in BUN are summarized in table 3, within-individual changes in Creatinine are summarized in table 4, within-individual changes in Ca are summarized in table 5 , while within-individual changes in P are summarized in table 6[8 & 10].

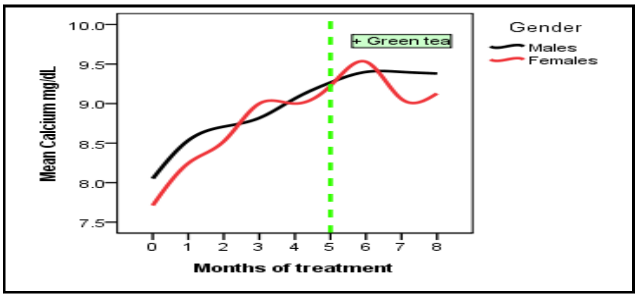

Figure 6- Changes in Calcium (mg/dL) levels throughout the experimental period in both genders Calcium levels had significantly increased in both groups. The increase in the male patients was obvious from the first month of diet and being more profound

after receiving diet + tea. Female patients showed significant calcium increase from the first month onward, reaching most significance on the 2nd month of diet + tea.

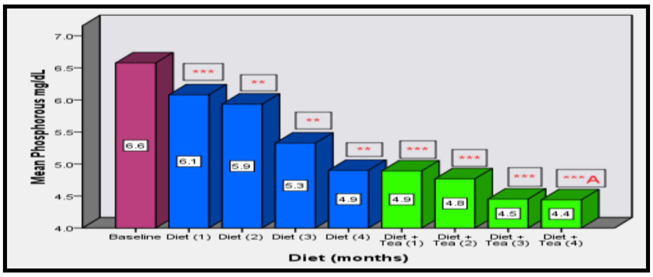

Figure 7-Changes in Phosphorus levels compared to baseline for both diets in all patients (paired t-test) A: p<0.05 vs.diet (4 months) **: p<0.01 vs. baseline ***: p<0.001 vs. baseline

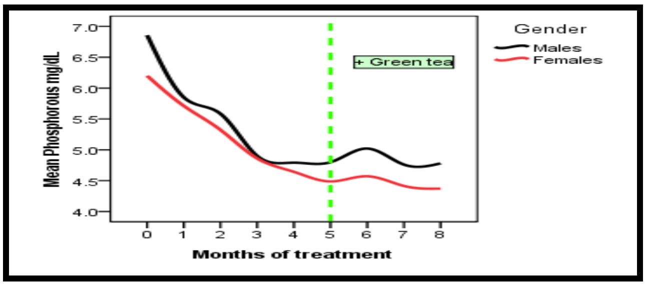

Figure 8- Changes in Phosphorus (mg/dL) levels throughout the experimental period in both genders

Phosphorus levels had significantly decreased in all patients with the decrease being more profound after receiving diet+ tea. This change applies to both the male and female patients.

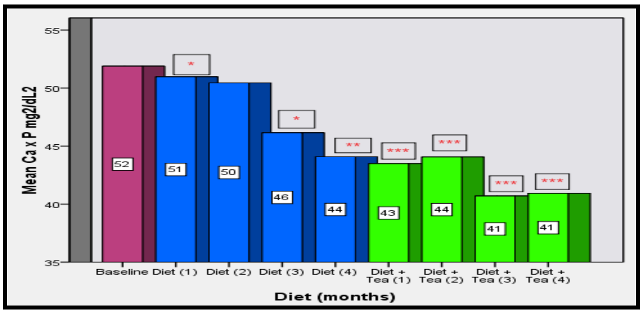

Figure 9-Changes in Ca×P product levels compared to baseline for both diets in all patients (paired t-test) *: p<0.05: p<0.01 vs. baseline ***: p<0.001 vs. baseline**

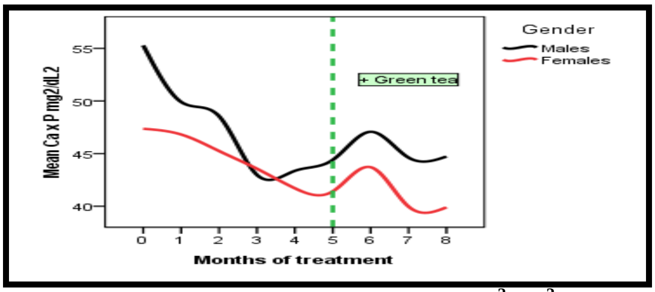

Figure 10- Changes in Ca×P product (mg^2/dL^2) levels throughout the experimental period in both genders

The Ca×P product significantly decreased in all patients. This change applied to the group of male patients from the first month of the experiment while the female group began to show this change on the 4th month on diet and persisted onward.

Urea (RCV=11.7%), creatinine (RCV=6.4%), and phosphorous (RCV=41%) levels improved (decreased) in 41.7%, 58.3% and 33.3% respectively in patients who did not take tea, corresponding to 33.3%, 50% and 33.3% respectively in patients supplied with green tea.

A worse change (increase) in urea was observed only in those on green tea (27.8%). Creatinine increased in 16.7% and 38.9% in patients on diets without and with tea respectively. Calcium improved (increased; RCV= 8.1%) in 75% and 83.3% of the patients whose diets did not include, or included tea respectively. None of the patients showed deterioration in their phosphorous or calcium levels.

DISCUSSION

"The field of nephrology is shifting from an exclusive focus on increasing survival to one that provides greater attention to quality of life (Gardham *et.al.*, 2010). The main goal of the present study was to find a suitable dietary intervention to improve hyperphosphatemia and hypocalcemia in Egyptian patients on maintenance-hemodialysis. These interventions should be simple, easily applied, related to Egyptian diets, and the patients could adhere to them. End-stage renal disease (ESRD) is one of the main health problems in Egypt. The prevalence of ESRD in Egypt is increasing, and its main cause is hypertension followed by diabetes and still unknown causes. Currently, maintenance hemodialysis (MHD) represents the main mode for treatment of chronic kidney disease stage 5 (CKD5) (Reddy *et.al.*, 2014, Ahmed *et.al.*, 2010 and Hegazy *et.al.*, 2013).

Many factors lead to serious nutritional complications for MHD patients, which eventually affect the prognosis and quality of life of patients (Chung et.al., 2012). Dietary management is an essential component to improve the quality of life of patients with CKD. Thus, the present study aimed at finding simple, cheap, easy-made Egyptian diets that could maintain optimal nutritional status, and minimize uremic symptoms, besides to establish a nutritional plan that is acceptable to each patient individually.

Main findings from the present study could be summarized into the following points: 1- Decrease in phosphorus (P) levels throughout the experimental period. 2- Increase in calcium (Ca^{2+}) levels throughout the experimental period. 3- Increase in hemoglobin level. 4- On the individual level, these changes were more profound when patients were supplemented with green tea. 5- Simple Egyptian foods could improve the mineral homeostasis of patients with ESRD. 6- Nutritional counseling is vital for ESRD patients.

From the literature, it was perceived that this is the first study to describe the within-individual biologic variation of phosphorous and calcium in patients receiving maintenance hemodialysis after dietary intervention, depending mainly on Egyptian food. These data have implications for clinical decision-making and guideline targets.

Personalized nutrition necessitates adapting food to individual needs, depending on their variability in genetic differences in taste preference, food tolerance, and phytochemical absorption and metabolism**.**This conclusion was based on several recent human-nutrition studies, where human genetics and food synergism were found to play a major role in the large variability observed in different human studies. Accordingly, the description and quantification of the consequences for human physiology in response to nutrition integrates set of genetic, proteomic, metabolomic, functional and behavioral factors (Bragazzi, 2013).

CHOICE OF DIETS

Foods high in protein are a main source of dietary phosphorus (P). On the other hand, imposing dietary P restriction is often associated with a reduction in dietary protein intake. The latter can lead to malnutrition and protein energy wasting. It is thus imperative to examine sources of dietary protein that are associated with the least P burden, since higher dietary P intake or foods with higher phosphorus-to-protein ratio are associated with increased death risk in dialysis patients (Kalantar *et.al.*, 2013). In practice, the question of the effectiveness of low-protein diet in slowing the progression of CKD becomes of minor importance if most patients are not able to adhere to it. Therefore, initiatives to simplify and increase the attractiveness of low-protein diet and then evaluate its feasibility are of particular interest (Thilly *et.al.*, 2013).

Consequently, the main objective of the present study was to choose the appropriate diet for each patient, which was achieved through one-to-one counseling/month. A variety of dietary regimens was obtained from a booklet produced by the National Nutrition Institute Stuff, Food composition tables for Egypt, second edition (2006)**.** The dietary components depended on typical Egyptian foods, which were mainly plant-based diets, rich in whole-grain brown bread (Egyptian pita bread), beans (Fava beans), and sesame (as “tahini” and “helva” made from a paste of sesame seeds).

Several possible mechanisms may explain the beneficial effects of plant-based diets on kidneys: higher intake of fiber, lower intake of saturated fat, higher intake of non-heme iron and reduction in iron stores, higher intake of vegetable protein in place of animal protein, higher intake of antioxidants and plant sterols (Kahleova *et.al.*, 2011).

Additionally, chronic inflammation and oxidative stress may threaten ESRD patients with serious metabolic complications. Green tea is derived from the leaves of the *Camellia Sinensis* plant, originally cultivated in East Asia. It is made from unfermented leaves and reportedly contains the highest concentration of the powerful antioxidants ‘polyphenols’, also known as green tea catechins (Jigisha *et.al.*, 2012). Accordingly, in the present work, green tea was included as a part of the nutritional intervention trial.

In the present study, the dietary system included three daily meals in addition to snacks. According to The National Nutrition Institute Stuff, Food composition tables for Egypt, second edition (2006)**,** the constituents and amounts of the diets varied according to the patients’ body mass index (BMI), taking into consideration their preferences to specific foods. Blood samples were taken at baseline and monthly from all patients.

The main results of the present study revealed that the selected diets, with or without green tea, caused a marked reduction in blood P accompanied by a significant increase in Ca^{2+} levels ($p<0.001$). These changes were correlated with the duration of treatment ($p<0.001$), showing maximum effect when green tea was added to the dietary regimen.

Individually, none of the patients suffered from deterioration in their P and/or Ca^{2+} blood level after intervention. In order to consider that P was truly changed in ESRD patients, it must decrease (or increase) by 41% from its median (= 6 mg/dL) value (i.e. change by ± 2.46 mg/dL). As for Ca^{2+} (median = 7.9 mg/dL), the change should be 8.2% (Westgard, 2012) (± 0.65 mg/dL). Consequently, the results revealed that only 33% of the patients had a significant decrease in their P, while 75% (without tea) and 83% (with tea) of the patients had significant increase in their blood Ca^{2+} level. Comparable to the present results, two other studies have found that plant-based diets have a favorable effect on hyperphosphatemia in patients with CKD (Azadbakht, 2009 and Moe *et.al.*, 2011).They concluded that the source of protein has a significant effect on P homeostasis in these patients, and that dietary counseling must include information on not only the amount of phosphate but also the source of protein from which the phosphate derives.

In recent years, the imbalance in P homeostasis in patients with ESRD has been the subject of much research (Kalantar *et.al.*, 2013, abe, 2013 and Covic, 2013). Prevention and correction of hyperphosphatemia is a major goal of CKD management, achievable through avoidance of a positive P balance. To this aim, optimal dialysis removal, careful use of phosphate binders, and dietary P control are needed to optimize the control of P balance in well-nourished patients on a standard three-times-a-week hemodialysis schedule (Hegazy *et.al.*, 2013, Kalantar *et.al.*, 2013, Abe *et.al*, 2013 and Covic, 2013). However, dialytic removal does not equal the high P intake linked to the high dietary protein requirement of dialysis patients; hence, the use of intestinal P binders is mandatory. Unfortunately, their efficacy is limited in the case of an uncontrolled dietary P load (Kalantar *et.al.*, 2013, Abe *et.al.*, 2013 and Cupisti *et.al.*, 2007).

As a result, limitation of dietary P intake is needed to reach the goal of neutral P balance, coupled to an adequate protein intake. To this aim, patients should be informed and educated to avoid foods that are naturally rich in P and processed food with phosphorus-containing preservatives (Cupisti *et.al.*, 2007 and Wright *et.al.*, 2011).

Accordingly, the Egyptian diets used in the present study could be described as renal-friendly diets. From previous studies, the grain-based diet has a lower phosphate-to-protein ratio and much of the phosphate is in the form of phytate, which is not absorbed by most mammals. Therefore, grain-based vegetarian diets may theoretically lead to decreased P absorption compared with meat- or casein-based diets (Moe *et.al.*, 2011) showed that equivalent total protein and P from grain-based vegetarian sources has a significant effect on serum P and on the homeostatic response to dietary phosphate intake.

Similarly, epidemiological studies found that diets rich in whole-grain lead to decreased risk of disease compared with refined grain based diets .Long-term cohort studies have indicated that whole-grain consumption reduces the risk of developing renal disease in type 2 diabetes (Azadbakht, 2009).

Faba beans (Viciafaba), a main constituent in the present diet systems, were reported to act as a carbohydrate absorption blockers, have lipid-lowering effects , and might be of value in treating conditions such as hypertension, heart failure, renal failure, and liver cirrhosis (Azadbakht, 2009).

Hyperphosphatemia inhibits 1α-hydroxylation of vitamin D (1, 25-D) and stimulates fibroblast growth factor-23 (FGF23), and parathyroid hormone (PTH) production and parathyroid hyperplasia. Hyperphosphatemia also reduces Ca^{2+} in the circulation; the resulting hypocalcemia further stimulates PTH synthesis and secretion. All of these factors contribute to the development of secondary hyperparathyroidism and mineral and bone disorder (MBD) (Tejwani, 2013). Late in CKD serum Ca^2 concentrations decrease, as circulating (1, 25-D) continues to decrease. The decreasing 1,25-D concentrations coupled with a decrease in serum Ca^2 concentrations suggest that CKD patients may be in net negative Ca^2 balance and that calcium supplementation may be needed to correct the Ca^2 absorption defect (Spiegel, 2012).

Studies suggest that knowledge of dietary Ca^2 intake and the use of active vitamin D need to be considered when Ca^2 is prescribed to patients with CKD. Furthermore, in adults with CKD, total elemental Ca^2 intake should be within 800-1200 mg/day to prevent Ca^2 deficiency and Ca^2 loading (Tejwani, 2013 and Spiegel, 2012).

The net changes in urea and creatinine levels at the end of treatment by both diets revealed no significant changes. Meanwhile, intra-individual variation analysis revealed that 41.7% of patients on diet alone had lower urea after treatment, and none of them showed deterioration. On the other hand, adding green tea to the diet revealed that 33.3% of the patients had better urea level while 27.8% of them showed deterioration in their blood urea. Creatinine improved in 58.3% and 50%, and increased in 16.7% and 38.9% of patients on diets without or with green tea respectively.

There are debatable results on the effects of plant-based diets on the progression of renal disease (Cupisti *et.al.,* 2007). Similar to the present results, some studies suggested that a plant-based diet does not have a significant effect on renal functions (Chen *et.al.,* 2006 and Lin *et.al.,* 2010). Others found that it improved renal function especially in diabetic patients, depending on the diet constituents. The effect of green tea on renal markers was extensively studied on experimental animals, but not in humans, showing that it improves the renal function (Yokozawa, 2012). However, it is difficult to relate these animal studies with humans, since the cause of renal failure is completely different, besidesthe metabolic processes differ significantly between both species**.**

CONCLUSION

Advising the patients on maintenance-hemodialysis to adhere to simple Egyptian plant-based diets supplemented with green tea could alleviate their hyperphosphatemia and hypocalcemia. Further studies with larger number of patients and longer periods of follow-up are recommended. In view of the main findings, the present study prompts several further observations worth discussing. Possibly, because of the flexible policy, the allowance of free-choice meals, and absence of monotony made it easier for the patients to adhere to the dietary changes required. Nutritional counseling is vital for ESRD patients. The strong individuality observed supports the preferential use of within-subjects biological variations and the reference change values (RCVs) rather than population-based reference intervals.

REFERENCES

- Zahran A: Epidemiology of hemodialysis patients in Menofiagovernorate, delta region, Egypt. Menoufiya Medical Journal, 2011; 211(24):211– 220.
- Kendrick J and Chonchol MB. Nontraditional Risk Factors for Cardiovascular Disease in Patients with Chronic Kidney Disease. *Nature Clinical Practice Nephrology*2008; 4(12):672-681.
- Reddy YN, Sundaram V, Abraham G and Nagarajan.P optimal management of hyperphosphatemia in end-stage renal disease: an Indian perspective .International Journal of Nephrology and Renovasculardisease 2014; Volume: 7 Pages 391—399.
- Biosca C, Ricós C, Jiménez CV, Lauzurica R, Galimany R. Model for establishing biological variation in non, healthy situations: renal posttransplantationdata.ClinChem 1997; 43(11):2206, 8.
- Hui L, Ge W, Zhiyue L, YananG . Association Analysis of Biological Variations in Different Routinely Measured Biochemical Parameters in Healthy Subjects. Lab Medicine 2009; 40:474, 477.
- Smellie WS. What is a significant difference between sequential laboratory results? J Clin. Pathol 2008; 61: 419, 425.
- Ricos C, Perich C, Minchinela J, Álvarez V, Simón M, Biosca C,Doménech M, Fernández P, Jiménez CV, Garcia, Lario JV, Cava F .Application of biological variation, a review. Biochemia Medica 2009; 19: 250-259.
- Westgard QC. Biologic Variation Database, the 2012 update.
- www.westgard.com/biodatabase--update.htm.
- Hölzel WG. Intra, individual variation of some analytes in serum of patients with insulin, dependent diabetes mellitus. Clin Chem 1987;33(1):57, 61.
- Gardham C, Stevens PE, Delaney MP, LeRoux M, Coleman A, LambEJ. Variability of parathyroid hormone and other markers of bone mineralmetabolism in patients receiving hemodialysis. Clin J Am SocNephrol 2010 Jul; 5(7):1261-7.

- Cohen LM, Moss AH, Weisbord SD, GermainMJ . Renal palliativecare. J Palliat Med 2006; 9(4):977–92.
- Ahmed AM, Allam MF, Habil ES, Metwally AM, Ibrahiem.NA, RadwanM, El-Gaafary MM, Afifi A, Gadallah MA. Development of practice guidelines for hemodialysis in Egypt. Indian J Nephrol 2010; 20(4):193-202.
- Hegazy IS, El Raghy HA, Abdel-Aziz SB, ElhabashiEM . Study of the effect of dietary counselling on the improvement of end-stage renaldisease patients. East Mediterr Health J 2013; 19(1):45-51.
- Chung S, Koh ES, Shin SJ, Park CW . Malnutrition in patientswith chronic kidney disease. Open Journal of Internal Medicine 2012; 2, 89-99.
- Bragazzi NL.Situating Nutri-Ethics at the Junction of nutrigenomicsand Nutriproteomics in Postgenomics. Medicine.Curr PharmacogenomicsPerson Med 2013 ; 11(2):162-166.
- Kalantar-Zadeh K, Kuhlmann MK, Stenvinkel P, Terwee P, Teta D, Wang AY, Wanner C . Prevention and treatment of protein energywasting in chronic kidney disease patients: a consensus statement by the International Society of Renal Nutrition and Metabolism 2013; Kidney Int. doi:10.1038/ki.2013.147.
- Thilly N. Low-protein diet in chronic kidney disease: fromquestions of effectiveness to those of feasibility. Nephrol DialTransplant 2013; 28 (9):2203-5.
- Kahleova H, Matoulek M, Malinska H, Oliyarnik O, KazdovaL, Neskudla T, Skoch A, Hajek M, Hill M, Kahle M, Pelikanova T Vegetarian diet improves insulin resistance and oxidative stress markers more than conventional diet in subjects with Type 2 diabetes. Diabet Med 2011; 28(5):549-59.
- Jigisha A, Rai N, Kumar N and Gautam P. Green tea: a magical herb with miraculous outcomes. International research journal ofpharmacy 2012; 3 (5).
- Azadbakht L, Esmaillzadeh A. Soy-protein consumption and kidney-related biomarkers among type 2 diabetics: A cross over, randomized clinical trial. J Ren Nutr 2009; 19: 479–486.
- Moe SM, Zidehsarai MP, Chambers MA, Jackman LA, Radcliffe JS, Trevino LL, Donahue SE, Asplin JR.Vegetarian compared with meat dietary protein source and phosphorus homeostasis in chronic kidney disease.Clin J Am Soc. Nephrol 2011; 6(2):257-64.
- Abe M, Okada K, Soma.M Mineral metabolic abnormalities and mortality in dialysis patients. Nutrients 2013; 22; 5(3):1002-1023.
- Covic A, Rastogi A.Hyperphosphatemia in patients with ESRD: assessing the current evidence linking outcomes with treatment adherence.BMC Nephrol 2013; 14:153.
- Cupisti A, Aparicio M, Barsotti G Potential benefits of renal diets on cardiovascular risk factors in chronic kidney disease patients. Ren Fail 2007; 29(5):529-34.
- Wright Nunes JA, Wallston KA, Eden SK, Shintani AK, Ikizler TA, Cavanaugh KL. Associations among perceived and objective disease knowledge and satisfaction with physician communication in patients with chronic kidney disease.Kidney Int 2011; 80(12):1344-51.
- Tejwani V, Qian Q. Calcium regulation and bone mineral metabolism in elderly patients with chronic kidney disease.Nutrients 2013; 5(6):1913-36.
- Spiegel DM, Brady K. Calcium balance in normal individuals and in patients with chronic kidney disease on low- and high-calcium diets.Kidney Int 2012; 81(11):1116-22.
- Chen KJ, Shaw NS, Pan WH, Lo FL, Lin PF Effect of a vegetarian diet on the vitamin B status and homocysteine levels in elderly Taiwanese. NutrSci J 2006; 31:117–26.
- Lin CK, Lin DJ, Yen CH, Chen SC, Chen CC, Wang TY, Chou MC, Chang HR, Lee MC.Comparison of renal function and other health outcomes in vegetarians versus omnivores in Taiwan.J Health PopulNutr 2010; 28(5):470-5.
- Yokozawa T, Noh JS, Park CH. Green Tea Polyphenols for the Protection against Renal Damage Caused by Oxidative Stress. Evid Based Complement Alternat Med 2012; 2012:845917.