Use of Audio and Visual Aids for Educating Patients on Potassium and Phosphorus at a Middle Eastern Mediterranean Hemodialysis Unit

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Background  
It has been estimated that around half of patients on hemodialysis (HD) may not adhere to a diet restricted in potassium (K) and phosphorus (P), increasing their risk of cardiovascular events and bone manifestations. The traditional Lebanese Mediterranean food pattern entails consumption of items high in K and P. Limited data is available on the educational interventions performed for Lebanese patients on HD.

Objectives  
1. Assess the use of audio and visual aids in educating on K and P-rich sources in Lebanese Mediterranean diet and their effect on serum K and P in a sample of HD patients.  
2. Evaluate if serum phosphorus and potassium control requires repeated counseling on dietary restrictions.

Introduction  
Hyperkalemia and hyperphosphatemia in end-stage renal disease can negatively affect clinical outcomes and increase the risk of morbidity and mortality (1). Management involves frequent HD sessions, medication regimen and complex dietary restrictions (2). Around half of patients on HD may not adhere to the prescribed diet, which can lead to serious cardiovascular and bone manifestations (3). Non-adherence can be improved by changes in dietary behavior through various strategies: education given by a renal dietitian, consistent and frequent nutrition education, involvement of the multidisciplinary team, individualized education in the HD setting, and use of various audio and visual tools (2). Examples of interventions using audio-visual tools include posters, games, puzzles, videos and colored pamphlets (2,4).

The traditional Lebanese Mediterranean food pattern includes consumption of items high in P and K such as fruits, vegetables, bulgur wheat, legumes and whole fat dairy. Examples of such foods are: kibbe (bulgur and meat cooked together), tabbouli (parsley, mint, tomatoes and bulgur made into salad), majadara (lentils cooked with bulgur or rice), homos bi tahini (hummus, a Middle Eastern dip), halloum cheese (semi-hard, unripened, brined cheese), kashkawan cheese (a type of yellow cheese), or plain yoghurt. Limited data is available on the educational interventions provided for Lebanese patients on HD.

A nutrition education intervention was carried out with HD patients as part of the regular diet teaching. The aim of this quality improvement initiative was to study the effect of audio and visual teaching aids versus routine verbal explanation of a written pamphlet on ameliorating HD patient knowledge and understanding of the renal Lebanese Mediterranean diet. This understanding was expected to translate into improved serum K and P levels (2,5,6).

Materials and Methods  
The intervention was conducted in the hemodialysis unit (HDU) at the American University of Beirut Medical Center (AUBMC), a 360-bed hospital. AUBMC has been a referral center attracting patients across Lebanon and the region since 1902. It is located in the heart of the capital city of Beirut on the eastern Mediterranean coast.

The HDU is an ambulatory facility of 17 beds; serving around 80 dialysis patients distributed over 3 daily shifts. A multidisciplinary team of nephrologists, medical fellows, registered nurses, a nurse manager and a dietitian round regularly on patients. Each patient’s case is reviewed by the multidisciplinary team every 6 months and more frequently if needed. The standard nutrition management protocol entails the following: upon admission to the HDU, new patients are referred to the renal dietitian for assessment and individualized care, and laboratory studies are reviewed on a monthly basis by the nephrologist and renal dietitian. Adjustments of K baths and phosphate binders are usually done by the nephrologist, who then consults the dietitian to perform diet reinforcement for patients with significant weight loss, high serum levels of K or P, or intradialytic weight gain. In addition to monthly visits, nutrition group education sessions are provided to all HD patients, once per year over a period of 2 months. The goal of these sessions is to reinforce the individualized education received by the patients, with the aim of optimizing their nutritional status and their serum K and P levels. Four dietetic students participated in each education session alongside the renal dietitian.

This intervention was part of a quality improvement initiative at the HDU in AUBMC to optimize patients’ knowledge and compliance with the K and P-restricted diet. We included only patients who received nutrition education in November 2013. Monthly laboratory results were collected for all patients for the period of November 2013 – May 2014.
FEATURE ARTICLE: USE OF AUDIO AND VISUAL AIDS

The education session started with a brief explanation of the renal diet with emphasis on the importance of adequate protein intake. Examples of foods rich in protein were showcased. Patients were reminded of the consequences of hyperphosphatemia and hyperkalemia and the importance of complying with the prescribed phosphate binders and medication regimen given by their doctors. Then, while patients were on dialysis, an interactive session included a demonstration of food portions and the display of images of modified Lebanese dishes. After the group education session, patients were visited individually to assess their appetite and the presence of any significant weight changes after which, patient-specific education was provided based on current laboratory values for K and P, intradialytic weight gain and phosphate binder use. The colored pamphlets were handed to each patient to be taken home. The video was played for 30 minutes. Finally, patients were given a True or False questionnaire available in Arabic and English to verify and evaluate their understanding of the education session which was didactic and interactive.

Baseline serum K and P levels were noted at month zero (M0) and the subsequent four months thereafter and at month six (M6). Moreover, the standard management protocol was continued during this period for patients with an elevated serum P (≥ 5mg/dl) and/or K (≥ 5mmol/L) level reminding them about foods to consume in lesser amounts or avoid completely. The patients were educated verbally as they had already received written educational material. Reinforcement did not include audio or visual tools (Figure 1).

Intervention:
Patients were given a group education session once while undergoing hemodialysis in November 2013. The educational session lasted for one hour and included the components below.

1. A video of an actual shopping trip. The video consisted of three parts; the first one was an interview between the dietitian and a character representing a patient who recently started HD. Part two was a shopping trip to educate the patient on what types of fruits and vegetables to choose at the grocery store. The last part of the video showed a one-day menu of food portions based on the renal diet restrictions.

2. The dietetic students prepared and displayed food portions of low, medium and high K, high P and high sodium food items. This allowed patients to visualize portions of allowed foods and to identify those to be avoided.

3. Colored pamphlets were developed to educate patients on K and P-restricted diets (7,8,9).

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Statistical Significance
Patients’ characteristics including age, gender, body mass index (BMI), hypertension, diabetes, use of phosphate binders, years on dialysis, duration of dialysis session and dialysis adequacy were extracted from the medical charts by a dietetic student. Since the sample size was small, data was assessed for normality using Shapiro Wilk test. As not all data distributions were normal, non-parametric tests were used. Wilcoxon Sign Rank test was utilized to assess the significance of the differences between mean serum K and P levels comparing individual months to M0. Sub-analysis was conducted on patients with elevated baseline serum K and P levels. Statistical significance was defined as p-value<0.05 in this study. IBM Statistical Package for Social Sciences version 22 was used for the analysis.
Results

Data was collected on 44 patients of whom 30 (68%) were males and 20 (47%) diabetic. The mean average age of the group was 65 years (range 14 to 95 years) with 64% of the group ≥ 65 years. Mean years on dialysis was 2.31 ± 2.74 (median = 1 year). Only 25% of the patients were on dialysis for less than one year. Mean BMI was 25.4 Kg/m² ± 4.9. Mean URR was 74.96 ± 5.96 %. Mean Kt/V was 1.57 ± 0.3. Most of the patients were on calcium based phosphate binders (45.5%) with only a few on sevelamer (2.3%) (Table 1).

Figure 2 reflects the evolution of mean serum K and P levels at all assessment points. Even though mean serum K tended to improve from M1 until M4, change was only significant at M3 and M4 compared to M0. Mean P levels did not significantly improve post the intervention (Table 2).

The percent of patients with high serum P levels was 16% at baseline, with this number dropping to 11% at M1, but gradually rising to 20% at M4 and M6. The percentage of patients with high serum K levels was 47% at baseline, with this number dropping to 33% at M4, but gradually rising to 48% at M6 (Figure 3).

A sub-analysis was done for two subgroups: those with high K levels (≥5mmol/L) and those with high P levels (≥5mg/dl) at M0. A decline in mean P levels was maximal at M3 (drop of 1.27mg/dl compared to M0, p value=0.013) after the teaching session, but became less prominent in subsequent months. Patients with high serum K (≥5mmol/L), experienced a drop of 0.75mmol/L (p value=0.015) at M1, with a continual decrease until M4 (drop of 0.86mmol/L) compared to M0, p value<0.01 (Figure 4).

Discussion

The aim of this quality initiative intervention was to increase knowledge, understanding and compliance to the renal Lebanese Mediterranean diet in the HD population. The educational session was able to decrease the number of patients with hyperkalemia during the first four months and hyperphosphatemia during the first month. Then the levels started to rise again. The maximal drop was observed in M1 (December) for P and in M4 (March) for K. One of the reasons explaining the rise in P at M2 was that December is a month of holidays in which patients are not usually very compliant with the dietary regimen. Social visits may increase on holidays leading to an increase in the number of meals and snacks without adjusting the phosphate binders. The rise in K levels after M4 may be due to Easter holidays and the start of spring where many varieties of fruits and vegetables are available in the Lebanese market. Our results compare with an educational intervention that showed that both oral and video education contributed to a decrease in serum levels, yet their results were not statistically significant (9).

Phosphorus Levels

The change in serum P levels in the high P subgroup was significant for M1, M2 and M3 compared to M0. This can be explained by the fact that the multi-component individualized and group education that was given at M0 increased the patients’ knowledge and the level of motivation resulting in a greater

### Table 1. Baseline Patient Characteristics

<table>
<thead>
<tr>
<th>Determinant</th>
<th>n=44</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age ± SD (years)</td>
<td>65.3 ± 17.96</td>
</tr>
<tr>
<td>Age ≥65 years, n (%)</td>
<td>31 (64)</td>
</tr>
<tr>
<td>Gender, n (%)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>30 (68)</td>
</tr>
<tr>
<td>Female</td>
<td>14 (32)</td>
</tr>
<tr>
<td>Mean BMI (kg/m²) ± SD</td>
<td>25.4 ± 4.9</td>
</tr>
<tr>
<td>BMI category, n (%)</td>
<td></td>
</tr>
<tr>
<td>&lt;18.5 kg/m²</td>
<td>1 (2)</td>
</tr>
<tr>
<td>18.5-22.9 kg/m²</td>
<td>12 (27)</td>
</tr>
<tr>
<td>23-25.9 kg/m²</td>
<td>12 (27)</td>
</tr>
<tr>
<td>26-31.9 kg/m²</td>
<td>11 (25)</td>
</tr>
<tr>
<td>≥32 kg/m²</td>
<td>6 (14)</td>
</tr>
<tr>
<td>Patients with diabetes, n (%)</td>
<td>20 (47)</td>
</tr>
<tr>
<td>Patients with hypertension, n (%)</td>
<td>42 (96)</td>
</tr>
<tr>
<td>Mean dialysis duration ± SD (years)</td>
<td>2.31 ± 2.74</td>
</tr>
<tr>
<td>Patients &lt; 1 year on dialysis, n (%)</td>
<td>11 (25)</td>
</tr>
<tr>
<td>Mean dialysis hours per session ± SD</td>
<td>3.5 ±4</td>
</tr>
<tr>
<td>Mean Kt/V ± SD</td>
<td>1.57 ± 0.3</td>
</tr>
<tr>
<td>Mean weekly dialysis frequency ± SD</td>
<td>2.9 ±0.3</td>
</tr>
<tr>
<td>Mean urea reduction rate ± SD</td>
<td>74.96 ± 5.96</td>
</tr>
<tr>
<td>Phosphate binders use, n (%)</td>
<td></td>
</tr>
<tr>
<td>Caltrate (calcium carbonate)</td>
<td>20 (46)</td>
</tr>
<tr>
<td>PhosLo (calcium acetate)</td>
<td>2 (4.5)</td>
</tr>
<tr>
<td>Renagel (Sevelamer)</td>
<td>1 (2.3)</td>
</tr>
<tr>
<td>Use of two or more binders</td>
<td>4 (9.1)</td>
</tr>
<tr>
<td>No binders</td>
<td>17 (39)</td>
</tr>
</tbody>
</table>

### Table 2. Changes in Mean Serum Potassium and Phosphorus Levels Compared to M0

<table>
<thead>
<tr>
<th>Assessment Point</th>
<th>Serum Potassium (mmol/L) ± SD</th>
<th>P value</th>
<th>Serum Phosphorus (mg/dL) ± SD</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>M0</td>
<td>5.12 ± 0.90</td>
<td>1.00</td>
<td>4.41 ± 1.96</td>
<td>1.00</td>
</tr>
<tr>
<td>M1</td>
<td>4.80 ± 0.71</td>
<td>0.10</td>
<td>4.22 ± 1.34</td>
<td>0.62</td>
</tr>
<tr>
<td>M2</td>
<td>4.89 ± 0.64</td>
<td>0.46</td>
<td>4.24 ± 1.11</td>
<td>0.86</td>
</tr>
<tr>
<td>M3</td>
<td>4.74 ± 0.68</td>
<td>0.01</td>
<td>4.24 ± 1.13</td>
<td>0.90</td>
</tr>
<tr>
<td>M4</td>
<td>4.71 ± 0.77</td>
<td>&lt;0.01</td>
<td>4.24 ± 1.34</td>
<td>0.68</td>
</tr>
<tr>
<td>M6</td>
<td>4.97 ± 0.85</td>
<td>0.18</td>
<td>4.32 ± 1.54</td>
<td>0.84</td>
</tr>
</tbody>
</table>
Hyperkalemia was defined as a serum potassium level ≥5mmol/L and hyperphosphatemia as serum phosphorus level ≥5mg/dL.

Individual potassium and phosphorus levels were compared to baseline (M0) levels. Stars indicate significant p values compared to baseline levels.
compliance with the renal diet, as evidenced by improved lab results. Several studies indicate the need to repeat education on a regular basis (2). As for the factors affecting compliance, women might face more difficulty with diet compliance due to their responsibility in purchasing and preparing food that could be affected by fatigue and physical health (10). Older patients tend to be more compliant than younger patients possibly since their food is prepared by their caretakers and because low appetite and comorbidities are more prevalent as they grow older (10,11). In addition, educated patients are more likely to know how to read food labels and how to substitute food exchanges in their diet list (10). In our study, males constituted 68% of the sample and 63% of the patients were greater than 65 years which might have contributed to the positive effects. Yet, information on education level was not collected.

Beto et al. (2016) in his literature review emphasized that nutrition advice in chronic kidney disease (CKD) patients is most effective when it is individualized and matched to the needs and interests of each patient. One-on-one communication, and individualization of nutrition care highly contributes to an increased adherence to the diet (10). Another approach for enhancing patients’ motivation for change, is motivational interviewing (MI), a treatment that is increasingly being used in health care settings to counsel patients with chronic diseases (12). Russell et al. (2011), showed in his pilot study the promising effect of MI in improving adherence to treatment, diet and fluid restriction in HD patients (13). In our study, dietitians communicated and listened to patients’ dietary problems which could have increased their motivation but did not follow the MI technique.

Although the percentage of patients with high serum P at M0 decreased at M1, it increased gradually at M4 and M6. The increase in serum P level may have been influenced by the fact that patients were only given oral reinforcement in follow up visits, as compared to M0 when they were given oral, visual and audio-based education. In fact, Albert et al. argued that patient education through oral teaching alone is somehow short and does not provide full knowledge whereas education using visual and audio tools makes the teaching content more meaningful (14). A similar study by Karevetian and Ghaddar (2013) was conducted in one HDU in Lebanon (15). The purpose of this 8-week cluster-based randomized control trial was to assess the effect of Self-Management Dietary Counseling (SMDC), a tool used to enhance active involvement by providing a series of educational sessions on adherence to a P-restricted diet. Participants were divided into 3 groups: The full intervention group received two education sessions per week, using SMDC and educational games, while the partial intervention group received only educational games and the control group received no intervention. Serum P only improved in the SMDC group (15). These results were more significant than ours: decreasing 1.16mg/dl (p value<0.05) versus a decrease of 0.17mg/dl in P level, non-statistically significant changes observed in our study. This is likely due to the frequency of the active intervention received by the SMDC group.

Although dietary compliance highly affects the patient’s serum P levels, other factors might contribute to hyperphosphatemia such as medication nonadherence that ranges between 19 and 99%, and nonadherence to the hemodialysis sessions, which has been reported to range between 0 and 35% (16). Moreover, the psychological status of the patients receiving hemodialysis is an important factor that might alter their compliance to both the dietary and medical treatments. Kimmel et al. (1993) suggested that depressive symptoms result in a decreased oral intake and an increase in the pro-inflammatory cytokines therefore worsening the patients’ medical condition (1,17). In our dialysis unit compliance to treatments is relatively high but medication adherence and psychological assessment were not evaluated in this study.

**Potassium Levels**

Limited data is available on the effect of education interventions on adherence to a K-restricted diet in the Middle Eastern Mediterranean region. Our study revealed that audio visual tools can have a positive effect on patient understanding of K-rich food sources such as legumes, potatoes and some dairy products that are commonly eaten in our Mediterranean culture. This was reflected by the significant drop in the K levels especially in the subgroup with elevated K level at M0.

The Mediterranean diet is not one specific diet followed by all countries around the Mediterranean Sea. It is influenced by the eating habits traditionally followed by each country. Several researchers have studied the Lebanese Mediterranean diet as compared to other Mediterranean countries and deduced the following: (18,19,20)

- The bulk of the diet comes from plant sources, including whole grains, bulgur, potatoes, fruits, vegetables, legumes (beans and lentils) and nuts.
- Popular dishes and salads are prepared with tomato sauces and K-rich vegetables and legumes such as mouloukhiah (leaves of Corchorus olitorius commonly known as Jew’s mallowcooked with chicken or meat and served with rice), tabbouli (salad of very finely chopped vegetables, lots of fresh parsley and bulgur wheat) and fattouch (lettuce, tomatoes, mint, purslane made into salad served with toasted bread).
- Fruits and vegetables are eaten in large quantities; they are usually dried or fresh, unprocessed, grown locally, and consumed in season.
- Dairy products are consumed in large amounts daily, mainly as white cheese in brine, labneh (strained yogurt) and yogurt.
- Popular sweets like Baklava (puff pastry baked with ghee, nuts and sugar), maamoul (baked cookies made with semolina, ghee, nuts, dates, and sugar) and drinks (jellab, kamareddine and licorice drink) are rich in either K and/or P.

HD patients would find it difficult to comply with the dietary K restriction that excludes numerous local dishes.

**Limitations**

Our study had four main limitations. First, the results did not adjust for confounding factors such as time of year, socioeconomic status, use of phosphate binders, adequacy of dialysis, quality of life and degree of malnutrition. This was due
to the lack of an electronic health records system in the facility and limited research resources. Second, the study did not assess for secondary outcomes such as changes in parathyroid hormone levels, re-hospitalization and mortality rates. Moreover, the education session was performed only once rather than repeatedly on a monthly basis due to the dietitian’s time restrictions and limited number of educators. Repeated educational sessions might have enhanced patients’ compliance which would have been reflected in their blood studies. Inclusion of spouses could have improved diet compliance since the majority of subjects were men. Lastly, there was no control group and our sample size was small, affecting the statistical power of the study.

Conclusion

Patients on dialysis face a difficult time trying to comply with their complicated therapeutic regimen which involves taking multiple medications, the dialysis procedure itself, and the dietary and fluid restrictions. In particular, the Lebanese hemodialysis patients face several dietary challenges because of the nature of the Mediterranean diet rich in K and P.

Using targeted audio and visual teaching aids for patients has shown to be effective in reducing serum K and P levels in a sample of patients undergoing hemodialysis. Our sample has shown to be receptive to such an educational intervention. However, adequate control seems to be lost over time, highlighting the potential need to deploy the same intervention with different approach on a more frequent basis. Further randomized prospective controlled trials are needed to fully elucidate the effect of such an intervention in patients undergoing hemodialysis.

References