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Full Length Research Paper

Repeated education improves diet compliance in maintenance Hemodialysis Patients

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Dietary education is important for improving the status of hemodialysis (HD) patients; however, general dietary instructions are not sufficient to reach dietary goals. To determine the effectiveness of repeated education in maintenance HD patients, we prospectively compared pre- and post-education data on the level of diet-related knowledge, role behavior, and laboratory results. Thirty HD patients were matched with a specific nurse and offered repeated individualized dietary information on sodium, potassium, phosphorus, protein, and water consumption every week for 3 months. Educational compliance was evaluated by questionnaires. The diet knowledge score increased from 4.26±0.84 to 4.72±1.43 out of 10 (p<0.001). The actual practice score, which showed the patients' knowledge application, also improved from 17.1±4.18 to 19.1±3.49 out of 25 (p<0.001). The number of sessions with greater than 5% interdialytic weight gain (IDWG) fell significantly from 22.5±0.17% to 7.46±0.09% after intensive education (P<0.001). The rate of hyperkalemia (>5.5 mEq/L) significantly decreased from 26.7±0.31% to 13.9±0.20% on a similar dosage of potassium-lowering medicine (p=0.035). There were no significant changes in the rates of hyperphosphatemia (>5.5 mg/dL) and Ca*P product (>55 mg2/dL2) although requirement for phosphate binders decreased. Repeated education is effective in terms of improving hemodialysis patients' dietary compliance and their physiological results.

Key words: Renal dialysis, education, nutrition, weight gain, hyperkalemia.

INTRODUCTION

Hemodialysis (HD) cannot completely replace the function of the kidney. HD patients must manage themselves to maintain a healthy lifestyle. Inadequate sodium and water consumption increase the interdialytic weight gain (IDWG) directly, subsequently influencing patient survival (Sarkar et al., 2006). Uncontrolled hyperphosphatemia are related to morbidity and mortality in HD patients (Noori et al., 2010a). Especially, hyperkalemia is life-threatening condition (Noori et al., 2010 b). Dietary education is important for improving the status of hemodialysis patients (Durose et al., 2004; Hollingdale et al., 2008). However, general dietary instructions are not sufficient to reach dietary goals (Pollock et al., 2008). This is due to non-adherence with dietary education in HD patients. Therefore, more structured and practical approaches are needed to reach dietary goals, instead of general dietary instruction (Kugler et al., 2011; Park et al., 2008; Mason et al. 2008).To solve non-adherence of HD patients, we applied repeated dietary education to improve diet behavior. This study compared diet-related knowledge and role behavior, the proportion of patients who exceeded the IDWG limit, and physiological parameters before andafter applying the education method to determine the effectiveness of intensive individualized educational intervention.

METHODS

Patients

Patients were eligible for the study if they were at least 18

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(**Supplement 1**)

Questionnaire on dietary knowledge

This questionnaire is to assess your baseline dietary knowledge on hemodialysis and will be utilized in developing the education program.

☞ Please, answer the followings by marking V.

Statements	Yes	No	Not Sure
1. Hemodialysis patients should increase protein intake to relieve uremic symptoms.			
2. Foods such as meat, fish, egg, tofu and milk provide high amount of protein contents.			
3. Fresh vegetables and fruits are necessary for hemodialysis patients to prevent constipation.			
4. White rice is more helpful than grain rice for potassium control.			
5. Phosphorus intake strengthens bones for hemodialysis patients.			
6. Foods such as milk, yogurt, cheese, dried fruits and nuts provide high amount of phosphorus contents.			
7. Diet such as soybean paste, soy sauce and red pepper paste are helpful in reducing salt intake..			
8. High salt intake induces volume overload, resulting in weight gain.			
9. As hemodialysis causes body fluid loss, patients should drink enough water to prevent fluid loss.			
10. Water restriction is relevant to all beverages, not to intake milk, ice or soup.			

years old, had been on HD for more than 3 months at the beginning of this study, and gave informed consent. Exclusion criteria were a history of psychological illness or a condition that interfered with the ability to understand or comply with the study requirements. The study was approved by the Institutional Review Board of Ilsan-Paik Hospital (IB-1101-007).

Initially, 43 of all patients undergoing HD at Inje University Ilsan-Paik Hospital between January and June 2008 were enrolled. However, 5 patients were excluded due to death or transfer to other hospitals, leaving 30 (22 males, 8 females) for analysis

All patients were assigned to a specific nurse and offered repeated dietary recommendation. Educational materials were prepared by doctors, nurses, and dietician together. The educational materials consisted of six parts: salt, potassium, phosphorus, protein, calories, and water. The leaflets on each outlined the principles of dietary therapy, the daily and individualized meal requirements, recipes, and careful food selection. The assigned nurses gave the HD patients a dietary education based on these leaflets about 30 min every week for 3 months. They explained importance of dietary restriction and difference between recommended food intake and actual patients' diet. In addition, nurses provided additional education to patients with an abnormal IDWG (>5% of dry weight), hyperkalemia (>5.5 mEq/L), hyperphosphatemia (>5.5 mg/dL), or elevated calcium phosphorus product (≥55 mg^2/dL^2).

Educational compliance and clinical parameters were compared between pre-education period and post-education period. Each education was done for 3 months. Educational compliance was evaluated using a questionnaire that examined the patients' dietary knowledge and actual practice. We evaluated the IDWG, hyperkalemia, hyperphosphatemia, calcium*phosphate product. We also measured and requirement for a potassium-lowering medicine and a phosphate binder before and after education.

Questionnaire for Knowledge and Role Behavior

The dietary knowledge was evaluated using a questionnaire that consisted of 10 questions, 2 each on protein, potassium, phosphorus, sodium, and water. The correct answer was treated as 'correct', incorrect or 'do not know' answers were treated as 'incorrect'; the highest score possible was 10 points (supplement 1).

The questionnaire examining role behavior consisted of five questions, one each on water, protein, sodium, phosphorus, eating out, and potassium. Each was scored using a 5-point scale: 'not do at all' 1 point; 'do sometimes' 2 points; 'do half the time' 3 points; 'do often' 4 points; and 'should always do' 5 points. A higher average

(Supplement 2)

Questionnaire on role behavior for diet control

This questionnaire is to evaluate your role behavior for diet control and will be utilized in developing the future education programs.

☞ Please, answer the following questions by marking V in the appropriate box.

Statements	Never	Occasionally	Fifty-fifty	Very Often	Always
1. You drink calculated amount of water. (24hrurine + 500cc)					
2. You keep balanced dietary habits of proteins and calories.					
3. You restrict salty foods to control sodium intake. (salt, soybean paste, soy sauce, salted seafood or vegetables, kimchi, instant noodle, canned foods)					
4. You restrict high phosphorus foods. (mixed grain rice, beans, milk and dairy products, egg yolk, nuts, coke, cocoa, chocolates, pizza)					
5. You restrict high potassium foods. (melon, tomato, banana, orange, potato, sweet potato, chestnut, red bean, ginkgo, corn, chard, radish leaves, dried radish, crown daisy, walnut, peanut, pine nut, chocolate, cocoa)					

average score indicating greater role behavior (supplement 2).

Statistical Analysis

Data are presented as means and standard deviation (SD). The results before and after education were compared using SPSS WIN 12.0. The levels of dietary knowledge and role behavior and the proportions opatients with an abnormal IDWG, hyperkalemia, hyperphosphatemia, and elevated calcium*phosphorus (Ca*P) product were compared using paired t-tests. The numbers of patients taking a potassium-lowering and phosphate binder medications were compared using the Chi-square test.

RESULTS

Clinical Characteristics

All enrolled patients completed 9 months of education and evaluation period. Thirty patients (22 males, 8 females; mean age 63.1±13.3 years) remained for analysis.

The average duration of dialysis was 34.2±40.3 months. The most common cause of end-stage renal disease was diabetes mellitus (Table 1). There was no difference in the Kt/V before and after education (1.38±0.22 vs. 1.48±0.24).

Level of Dietary Knowledge and Role Behavior

The diet knowledge score increased from 4.26±0.15 to 4.72±0.26 out of 10 (p=0.001). The actual practice score, which showed the status of patients' application of their knowledge, also improved from 17.1±0.76 to 19.1±0.64 out of 25 (p<0.001). These results showed that the levels of dietary knowledge and role behavior improved significantly after education (Table 2).

Interdialytic Weight Gain

The IDWG of all dialysis sessions was measured for 3 months before and after education. The frequency of sessions with an abnormal IDWG, greater than 5% of their dry weight, decreased significantly from 22.5±0.17% to 7.46±0.09% after intensive education (P < 0.001) (Figure 1).

Physiological Parameters and Medication

Serum potassium, calcium, and phosphorus were measured every month for 3 months. We evaluated pro-

Table 1.Clinical characteristics of the 30 hemodialysis patients. (% of total).

Sector		n (%)	Mean ± SD
Sex	Male	22 (73.3)	
Age			63.1±13.3
Education	middle school or below	8 (26.7)	
	high school	12 (40.0)	
	college or above	10 (33.3)	
Employment status	yes	16 (53.3)	
Duration of dialysis (months)			34.2±40.3
Cause of end-stage renal disease	diabetes mellitus	19(63.3)	
	hypertension	5 (16.7)	
	chronic glomerulonephritis	2 (6.67)	
	other	4 (13.3)	
Comorbidities	coronary artery disease	12 (40.0)	
Total		30 (100.0)	

Table 2. Level of dietary knowledge and role behavior.

	Before education	After education	*p*
Level of knowledge	4.26±0.84	4.72±1.43	<0.001
Level of role behavior	17.1±4.18	19.1±3.49	< 0.001

The total score of the level of dietary knowledge is 10 and that of the role behavior is 25. All data are means ± SD.

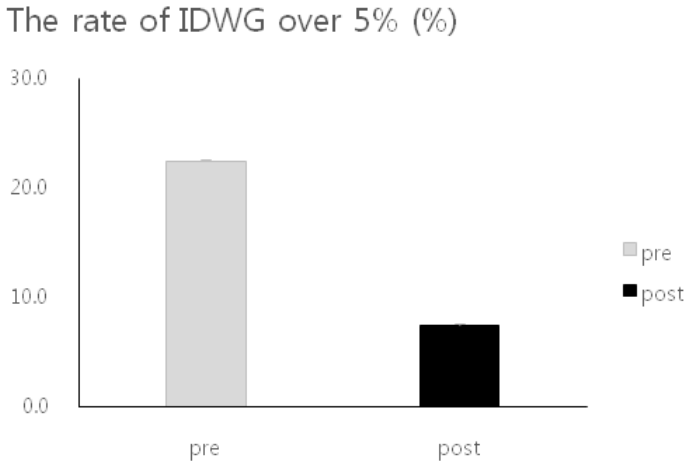

Figure 1.The rate of IDWG > 5% of dry weight before and after education. The rate of abnormal IDWG decreased significantly from 22.57% to 7.46% (*p*<0.001).

portion of hyperkalemia (>5.5mEq/L), hyperphosphatemia (>5.5 mg/dL) and the Ca*P product (>55 mg^2/dL^2). The proportion of patients with hyperkalemia (>5.5 mEq/L) significantly decreased from 26.7±0.31% to 13.9±0.23% after education on similar dosages of potassium-lowering medicine (P=0.035) (Figure 2). The proportion of patients with hyperphosphatemia (>5.5mg/dL) and the Ca*P product (>55 mg^2/dL^2) were reduced from 34.4±0.42% to 32.3±0.41% and from 18.9±0.36% to 12.2±0.25%, respectively. The changes were not statistically signif-

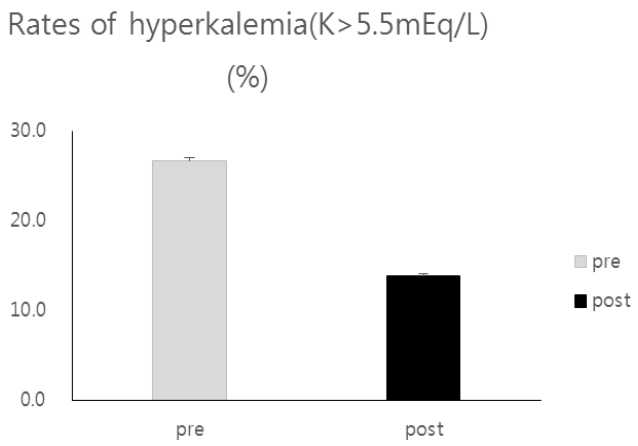

Figure 2. The change in potassium level. The rate of hyperkalemia (>5.5 mEq/L) significantly decreased after education (p=0.035).

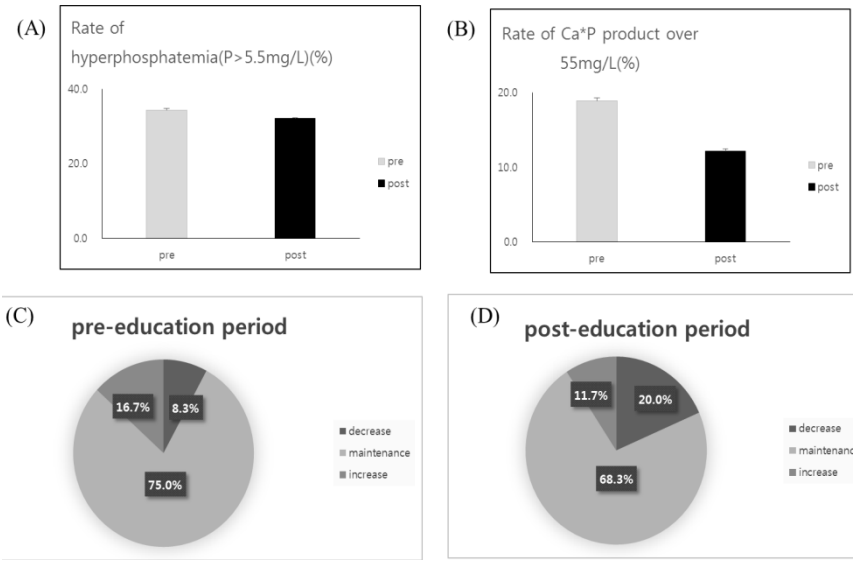

Figure 3.Changes in phosphorus, Ca*P product, and phosphate binder. The rates of hyperphosphatemia (A) and Ca*P product (B) did not change. (C, D) The requirement for a phosphate binder tended to decrease after education.

cant, because dose adjustment was targeted for the optimal serum level: There was reduction in proportion of patients who increased dose of the phosphate binder (from 16.6% to 11.7%).

On the contrary, there was increase in proportion of patients in dose reduction (from 8.33% to 20.0%) (Figure 3).

DISCUSSION

This study indicates that repeated dietary education is an effective way to improve the dietary compliance of HD patients. Repeated dietary education significantly enhanced HD patients' dietary knowledge and role behavior. And it also reduced rate of abnormal IDWG and hyperkalemia.

The levels of dietary knowledge and role behavior in HD patients were improved significantly after intensive education. These results have important implications for HD patients and for physicians, nurses, and nutritionists. The encouragement of the dialysis staff could increase patients' adherence to their diets (Yokoyama et al., 2009; Cupisti et al., 2012). Recently, Sullivan reported that education did not increase diet food knowledge; however, although the level of knowledge was unchanged, patients were more interested in reading ingredient lists and nutrition fact labels, decreasing serum phosphate level (Sullivan et al., 2009). This study indicated that it was worth feeling an importance of diet in HD patients.

Excessive IDWG is a significant independent predictor of cardiovascular morbidity and mortality in HD patients (Lee et al., 2014, Liang et al., 2013; Kimmel et al., 2000). This is associated with an increase in the predialysis blood pressure and the resulting changes in hemodialysis (Inrig et al., 2007). Higher sodium consumption induces higher water consumption, resulting in excessive IDWG (Sarkar et al., 2006). The subgroup analysis of HEMO study showed higher dietary sodium intake was associated with a higher ultra-filtration requirement and mortality (McCausland et al., 2012). Therefore, it is important to restrict water and salt intake to prevent an abnormal IDWG. Our results also showed that intensive education decreased the rate of an abnormal IDWG.

The physiological parameters were improved after the intensive education. Our results showed that the rates of hyperkalemia significantly decreased after education. The prevention of life-threatening hyperkalemia is one of the main goals of hemodialysis. Compliance with dietary potassium restriction is higher than other dietary compliance (Park et al., 2008). Therefore, repeated education can be effective way to prevent hyperkalemia.

The rate of hyperphosphatemia, and Ca*P product also tended to decrease after intervention. Considered that requirement of phosphate binder reduced, these parameters' reduction would have significant clinical meaning. Other studies have shown that education is effective at reducing hyperphosphatemia (Sullivan et al., 2009; Sherman et al., 2009). The control of hyperphosphatemia can ameliorate the Ca*P product, subsequently preventing cardiovascular morbidity and mortality in HD patients (Wald et al., 2008; Tentori et al., 2008). One limitation of this study was that the knowledge and role behavior questionnaires have not been validated, as no standard tool for their evaluation is available. In addition, the study enrolled a small number of patients at a single center.

In conclusion, this study suggests that repeated, personalized dietary education is an effective way in improving patients' dietary compliance and in preventing abnormal IDWG and physiological parameters. Future work is needed to enhance dietary compliance for HD patients.

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