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Is Metabolic Acidosis a Considerable Problem in Peritoneal Dialysis Patients when Amino Acid-Based Peritoneal Dialysis Solution is Used?

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Abstract

Background and Aims: A tendency to metabolic acidosis exists with the use of amino acid-based peritoneal dialysis solution, especially when two exchanges are performed with the solutions. In the present study, we aimed to investigate whether metabolic acidosis is a considerable problem in patients on continuous ambulatory peritoneal dialysis (CAPD) when amino acid-based peritoneal dialysis solution is used.

Methods: The cross-sectional study included 119 PD (62 female, 57 male) patients. The first group consisted of 47 patients who had used amino acid-based PD solution once a day. The second group included 72 patients who had not used the solution.

Results: Mean age was 47 ± 13 years. Blood bicarbonate concentration and serum albumin levels were significantly lower in first group than that of the second group (25.12 ± 3.38 mmol/L vs. 26.91 ± 4.32 mmol/L, P: 0.018 and 2.82 ± 0.46 g/dL vs. 3.15 ± 0.50 g/dL, P: 0.001, respectively). On the other hand, blood urea nitrogen concentration and use of essential amino acid preparation were meaningfully higher in the first group than those of the second group (66.17 ± 13.70 mg/dL vs. 52.79 ± 16.55 mg/dL, P: 0.001 and 33 (47.8%) patients vs. 14 (28%) patients, P: 0.022, respectively). However, there was no meaningful difference between these groups for serum pH value and presence of metabolic acidosis.

Conclusions: Although mean blood bicarbonate concentration was significantly lower in amino acid-based PD solution group than that of the control group, it was in normal range in both the groups and there was no significant difference between pH value and presence of metabolic acidosis among them. Therefore, metabolic acidosis is not a considerable problem in PD patients when amino acid-based peritoneal dialysis solution is used.

Keywords: Metabolic Acidosis, Amino Acid-Based Solution, Peritoneal Dialysis

Introduction

Standard peritoneal dialysis (PD) solutions containing glucose are bio-incompatible because they have low pH and high osmolality and contain very high glucose and lactate concentrations and glucose degradation products (GDP) (1, 2). Therefore, these solutions negatively affect the peritoneal membrane. Several alternative osmotic agents have been developed to avoid the detrimental effects of the standard solutions. Formation of GDP and advanced glycation end products (AGE) can be avoided with the use of amino acid-based solutions that do not contain glucose and have a more

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physiological pH (pH 6.2). Amino acid-based solutions also provide an amino acid supplementation in PD patients, especially those with malnutrition. Thus, peritoneal protein and amino acid losses can be replaced by these solutions (3, 4). However, in several studies it has been reported that there is a tendency to metabolic acidosis with use of amino acid-based peritoneal dialysis solutions, especially when two exchanges are performed with these solutions (5). Therefore, metabolic acidosis, which stimulates protein degradation, is a matter of concern when these solutions are used and only one daily exchange of the solutions is commonly advised (4). Acidosis is caused by metabolism of amino acids such as the sulfur containing methionine and the cationic arginine and lysine, which exists in these solutions (6). If metabolic acidosis develops during use of these solutions, oral bicarbonate (HCO3) supplementation is recommended (4). In the present study, we aimed to investigate whether metabolic acidosis is a considerable problem in patients on continuous ambulatory peritoneal dialysis (CAPD) used amino acid-based peritoneal dialysis solution.

Methods and Materials

The cross-sectional study was performed in CAPD Unit in Erciyes University Medical School between June 2008 and August 2008. The study included patients undergoing CAPD due to end-stage renal disease. The patients, who had history of peritonitis within the previous two months, dialysate leak, and dialysis catheter dysfunction and received HCO3 supplementation and were inserted PD catheter within one month, were excluded. One hundred forty-two patients, who had clinical and biochemical examinations were enrolled in the study. Twelve patients received HCO3 supplementation. Eight patients had history of peritonitis and two had dialysate leak within the previous two months, respectively. One patient was inserted PD catheter two weeks ago. Finally, the study included 119 patients undergoing CAPD due to end-stage renal disease. The first group consisted of 47 patients, who had used aminoacid based PD solution once a day. The solution had dwelled for a period of 6 hours within peritoneal cavity of the patients who were infused with the solution after feed. The other solutions of the first group consisted of standard PD solutions. In the second group, there were 72 patients, who had used standard PD solutions but not this solution. We recorded demographic and clinical data including age, gender, duration of CAPD, duration of use of amino acid based PD solution (in the first group), use of essential amino acid preparations, systolic and diastolic blood pressures, and body weight and height; biochemical parameters including hemoglobin, white blood cell (WBC) count, blood urea nitrogen (BUN), levels serum creatinine and glucose, serum lipid profile, serum calcium, phosphorus, potassium and albumin concentrations, levels of intact parathormon (iPTH) and serum alkaline phosphatase (ALP); parameters of venous blood gas analysis including serum pH, presence of metabolic acidosis, that was defined as serum pH value was lower than 7.35, and serum HCO3 concentration at the last follow-up.

The transport property of peritoneal membrane was determined by the standard peritoneal equilibration test (PET) (7). The findings of PET nearest to the patient's examination were evaluated for the analysis. Patients were categorized as one of the following four peritoneal transport types: high (above +1 SD from the mean), high average (between the mean and +1 SD), low average (between the mean and –1 SD), or low (below –1 SD from the mean). Weekly Kt/V urea was calculated as the index of adequacy of peritoneal dialysis.

Statistics

SPSS 11.0 software (SPSSFW; SPSS Inc., Chicago, IL, USA) was used for the statistical analysis. Kolmogorov-Smirnov test was used for normality

analysis of quantitative variables. Continuous variables with normal distribution were presented as mean ± standard deviation. Statistical analysis for the parametric variables was performed by the Student's t-test. Median value was used where normal distribution is absent. The Mann-Whitney U test was used to compare nonparametric variables. The qualitative data were defined as percentages. The Chi-square test and Fisher exact test were used to compare qualitative data. The correlation analysis was evaluated by the Pearson's correlation test for parametric variables and by the Spearman's correlation test for nonparametric variables. A P value < 0.05 was considered statistically significant.

Results

Mean age of 119 patients was 47 ± 13 years; 62 (52.1%) of 119 patients were female. Demographic, clinical, and laboratory parameters and index of PD adequacy in patients who used amino acid based PD solution and in those who did not use the solution are summarized in Table 1. Blood HCO_3 concentration, serum albumin level, serum potassium concentration, and triglyceride level were significantly lower in the first group than those of the second group. BUN concentration, serum ALP level, and use of essential amino acid preparation were meaningfully higher in the first group than those of the second group. However, there was no significant difference between two groups in terms of age, gender, body mass index (BMI), systolic and diastolic blood pressures, duration of PD, presence of metabolic acidosis; WBC count, serum hemoglobin and creatinine levels, serum glucose concentration, serum lipid profile (except triglyceride), iPTH level, concentrations of serum calcium and phosphorus, calcium x phosphorus product (Ca x P), pH; 4-hour D/P creatinine ratio, peritoneal transport group categorized according to 4-hour D/P creatinine, weekly Kt/V urea.

Table 1: Comparison of demographic, clinical, and laboratory parameters and index of PD adequacy between group 1 and group 2

parameters	Group 1 (n: 47)*	Group 2 (n: 72)*	P value
Age	48.91 ± 11.57	47.38 ± 14.32	0.538
Male/Female§	19/28	38/34	0.129
pH	7.38 ± 0.05	7.39 ± 0.06	0.424
Presence of acidosis§	7 (14.9%)	10 (13.9%)	0.540
Use of essential amino acid preparation§	33 (47.8%)	14 (28%)	0.022
HCO_3 concentration (mmol/L)	25.12 ± 3.38	26.91 ± 4.32	0.018
Blood urea nitrogen (mg/dL)	66.17 ± 13.70	52.79 ± 16.55	0.001
Serum albumin level (g/dL)	2.82 ± 0.46	3.15 ± 0.50	0.001
Alkaline phosphatase (IU/L)&	126 (41-699)	95 (37-1377)	0.007
Triglyceride level (mg/dL) &	139 (45-551)	166 (42-799)	0.025
Serum phosphorus level (mg/dL)	4.51 ± 1.43	4.70 ± 1.33	0.459
Serum potassium level (mmol/L)	3.94 ± 0.64	4.25 ± 0.67	0.014
Hemoglobin (g/dL)	10.58 ± 1.90	10.85 ± 1.36	0.407
Intact parathormon level (pg/mL) &	459 (3-1767)	355 (4-2120)	0.265
4-h D/P creatinine ratio	0.72 ± 0.11	0.68 ± 0.10	0.066
Weekly Kt/V urea	2.34 ± 0.46	2.52 ± 0.79	0.597

*Group1 and Group 2 consisted of patients used amino acid based PD solution and those not used amino acid based PD solution, respectively.

PD, Peritoneal Dialysis; **D**, Dialysate; **P**, Plasma

Statistical analysis was performed by the Student's t-test , Chi-square test and Fisher exact test (§), and the Mann-Whitney U test (&).

Blood HCO_3 concentration correlated with only serum pH value (r: 0.539, p: 0.001). It did not correlate with other parameters including age, BMI, systolic and diastolic blood pressures, duration of PD, duration of use of amino acid based PD solution, BUN, levels of serum creatinine and glucose, serum albumin concentration, hemoglobin, WBC count, serum lipid profile, ALP, serum potassium and phosphorus concentrations, CaxP, iPTH, 4-hour D/P creatinine ratio, and weekly Kt/Vurea.

Discussion

Our study showed that although blood HCO_3 concentration was statistically significant lower in patients had used amino acid-based PD solution compared to those that had not used the solution, it was within normal range in both groups and there was no significant difference between the groups for mean serum pH value and presence of metabolic acidosis. Therefore, if it is used only one daily exchange, use of amino acid-based PD solutions do not affect body acid load. It should be also emphasized that none of the patients included the present study received HCO_3 supplementation.

Use of amino acid-based PD solutions results in increased generation of urea because the absorption and metabolism of amino acids present in the solution (4). Similarly, in the present study, we observed that BUN concentration was significantly higher in patients who had used this solution. However, minimum target weekly Kt/V urea of 1.7 was reached in all the patients except two patients whose weekly Kt/V urea values were 1.66 and 1.68 (8). But two patients, one in each group, had not clinical PD inadequacy findings as rest of the patients.

Malnutrition is a common problem in dialysis patients and is related to an increased mortality risk. Several factors, including dialysate protein and amino acid losses, insufficient protein and energy intake, acidosis, inflammation, poor appetite are involved in the development of malnutrition in PD patients. Amino-acid based solutions can induce an anabolic response in PD patients with malnutrition (9). Interestingly, serum albumin level was significantly lower in amino-acid based PD solution group compared to the control group. This situation results from possibility of our choice. We generally recommend amino acid based PD solution to the malnourished patients with hypoalbuminemia. Similarly, use of essential amino acid preparation was meaningfully higher in patients who had used amino acid-based PD solution compared to the control group.

Serum potassium concentration and triglyceride level were significantly lower in patients who had used the solutions compared to those who didn't. The possible cause of significant difference between two groups in terms of potassium and triglyceride is that malnourished patients had inadequate oral intake. There was no significant difference between two groups for the other lipid parameters. Similarly Kanbay et al observed that the use of amino acid-based PD solutions or icodextrin-based PD solutions does not affect serum lipid parameters in PD patients (10).

In conclusion, metabolic acidosis is not a considerable problem in PD patients who used amino acid-based peritoneal dialysis solution.

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Conflict of interest

It is stated that there was no conflict of interest.

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