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Rapid Communication

Effect of a Simple Meal Plan 'Eating Vegetable First Diet' on Glycemic Control for One Year in Japanese Patients with Type 2 Diabetes

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1 Introduction

It is essential to effect good metabolic control to prevent chronic complications of diabetes mellitus.[1-3] However, a significant number of patients with diabetes remain poorly controlled since very low compliance of diet.[4,5] The important choices affecting the blood glucose control of people with diabetes are made by themselves, and not by their physicians or other medical professionals. They need to make a series of choices with regards to eating and physical activity that are inevitable in regulating their blood glucose levels and preventing complications. People with diabetes are advised to adopt an appropriate diet include dietary habits and meal patterns on a lifelong basis. Frequently, efforts of patients are not in the appropriate directions or they receive confusing and contradictory advice from media or social contracts. Diabetes education, especially dietary education requires the training of medical professionals and a provision of unequivocal information based on the evidence.

Recognition of the relationship between dietary constituents and glucose tolerance has contributed to the development of nutritional prescriptions, such as the food exchange system, as strategies to restrict energy intake and provide macronutrient balance.[6] However, diabetic patients may have trouble understanding diet based on the food exchange system, and even they understand the exchange system, it is difficult to change their daily food habit according it.[3] Particularly, the elderly patients with diabetes may face difficulties in implementing the recommendations of the exchange-based meal plan. Therefore, we asked whether a simple meal plan emphasized 'eating vegetable first diet' would be as effective as a traditional exchange-based meal plan. To test this hypothesis, we conducted a randomized controlled trial in patients with type 2 diabetes, comparing changes in HbA_1c as the primary outcome and changes in weight, serum lipids, and blood pressure as secondary outcomes.

2 Methods

Research design and subjects

The study protocol was approved by the Ethics Committee of the School of Comprehensive Rehabilitation at Osaka Prefecture University with informed consent being obtained from all the subjects before enrollment in the study. Patients with type 2 diabetes were solicited for participation in the study if they had no major complications, medical illnesses, and were judged to be capable of performing basic self-management skills. A total of 101 patients were recruited at their initial visit and randomized divided into two groups to receive instruction in either a simple meal plan, which is eating vegetable first diet (VFD group) without discussion about energy intake, or a traditional exchange-based meal plan (EXB group) using the food exchange system. The dietary counseling was provided by dietitians and initial visits include an extensive evaluation and education focused on self-care management. After the

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initial visit, patients are scheduled for return visits at every 4 weeks. Patients were routinely scheduled to see dietitians with coping skills at every visit for 12 months. The dietitians were trained in all aspects of instruction, which include planning menus, making appropriate food choices. Instruction for the VFC group or the EXB group regarding diet and physical activity involved the same dietitian each time for each group. Approximately 30 min were spent on dietary counseling at the initial visit and 20 min at each subsequent session.

In the EXB group, patients were instructed in both food exchange system and portion size using educational material consisted of "Food Exchange Lists" [7] which provides a rough gauge of the amount of energy and each nutrient contained in each food, as the basis for instructions on diet. The exchange lists have been a method of meal planning for patients with diabetes. Justification for specific food inclusions and general food group of "Food Exchange Lists" is provided by a database of foods and associated energy and macronutrient values. The mean energy and macronutrient values for each of the lists closely match the mean exchange values.

The method of VFD is a nutrition advice given in the form of a simple meal plan, 'eat vegetable first and carbohydrate last'. In the VFD group, the patients were encouraged to consume every meal eating vegetable first and carbohydrate last chewing more than 20 times each bite in order to reduce the postprandial hyperglycemia. Dietary intake of subjects was assessed at baseline and after 2 months of follow-up using food record for 3 to 5 days in both groups. Current physical activity was assessed by interview and recommended the moderate exercise, such as walking 30 to 40 min a day. The primary outcome was change in glycated hemoglobin (HbAIc) and secondary outcomes included changes in body weight, lipids, and blood pressure.

Laboratory analyses

Laboratory data, body weight and body mass index (BMI; kg/m^2) were collected for all groups at baseline and every 4 weeks for all participants who completed the entire program. Fasting blood samples were collected in the morning after an overnight fast from all participants every 4 weeks. HbAIc levels were determined by a latex cohesion method (JCA-BM2250, KYOWA MEDEX, Co., Ltd., Tokyo, Japan). Total cholesterol and triglyceride levels were determined by enzyme assay. HDL cholesterol levels by a direct method (Labospect 008K, Bio Majesty JCA-BM 8060, JEOL, Ltd., Tokyo, Japan) and LDL cholesterol levels by an enzymatic method (Bio Majesty JCA-BM 8060, JEOL, Ltd., Tokyo, Japan).

Statistical analysis

All date are expressed as means ± SD. Data were analyzed using SPSS (version. 15.0, SPSS Inc, Chicago, IL). Student's t test was used to test differences in baseline characteristics and paired t test was performed the changes between baseline and after intervention. Chi-square analyses were used to compare categorical data. Differences were considered significant at $p < 0.05$.

3 Results

Characteristics of the patients in baseline of two study groups were shown in Table 1. There were no significant differences between the VFD and the EXB groups in gender, mean age, duration of diabetes, HbAIc levels, BMI, blood pressure, serum lipids and the percentage of each therapy in the baseline.

HbAIc declined significantly soon after intervention in both groups and over the 12-month of follow-up, dropping from 8.3 to 6.7% in the VFD group ($p < 0.001$) and 8.2 to 7.2 % in the EXB group ($p < 0.01$) (Fig. 1). The levels of HbAIc were significantly lower in the VFD group than the EXB group after 6 to 12-month of intervention ($p < 0.05$).

Table 2 showed BMI, blood pressure and serum lipids after 12 months of intervention in two groups. Systolic blood pressure, total cholesterol, and LDL cholesterol decreased significantly in both groups after 12 months. Systolic blood pressure and HbAIc levels were significantly lower in the VFD group than the EXB group after 12 months ($p < 0.05$, Fig. 1 and Table 2). Neither total BMI, HDL cholesterol, nor triglyceride differed significantly between the groups after 12 months of intervention, and values did not change significantly over time in two groups.

4 Discussion

In this study, we investigated with a randomized control trial the effect of consuming vegetable first diet in patients with type 2 diabetes. We found that instruction in dietary education based on the VFD group was more effective on

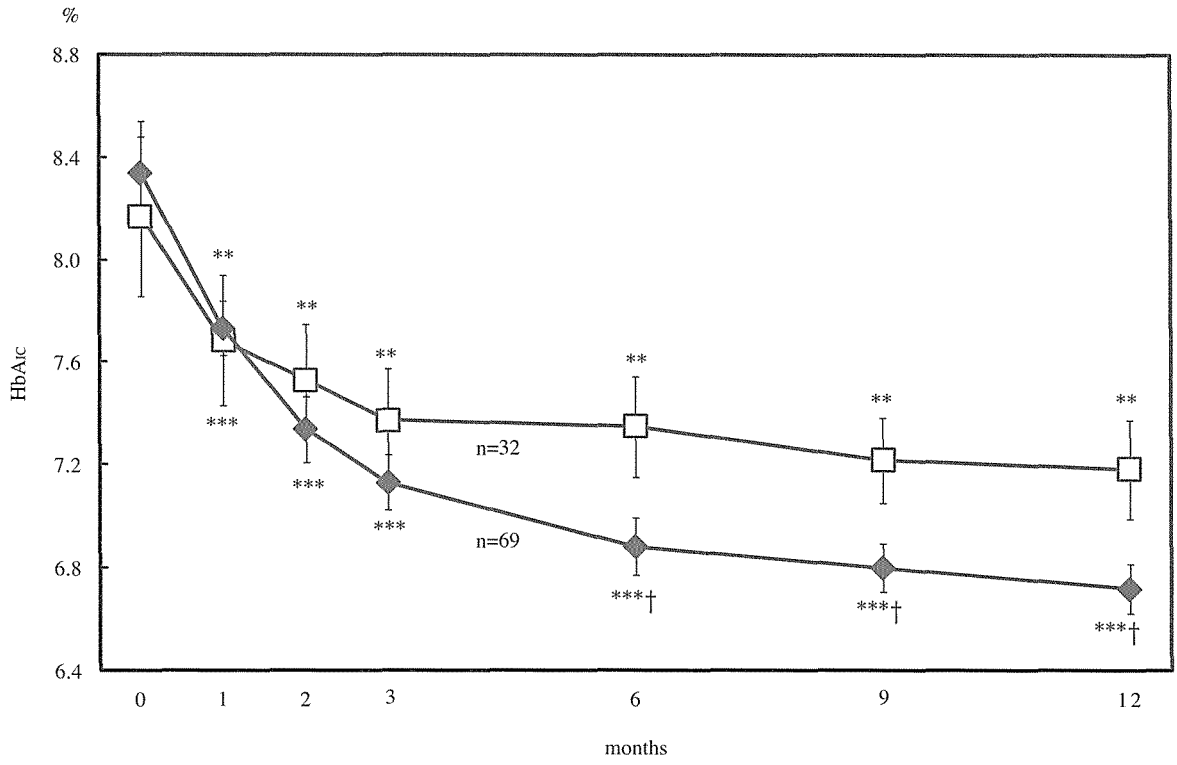

Fig. 1 Changes in HbAIC levels in patients on the VFD group (closed diamond-shape) or the EXB groups (opened square) for 12 months. Data are means ± SE. Significant difference from the baseline, ** $p < 0.01$, *** $p < 0.001$. The VFD group versus the EXB group, $^{\dagger}p < 0.05$.

Table 1 Characteristics of the subjects at baseline in two study groups

	VFD (n=69)	EXB (n=32)	P
Gender (males / females)	31/38	17/15	0.443
Age (yrs)	63.4 ± 11.7	65.1 ± 12.4	0.503
BMI (kg/m^2)	23.7 ± 4.0	22.7 ± 4.4	0.371
Duration of diabetes (yrs)	7.5 ± 8.4	7.0 ± 8.3	0.777
Systolic blood pressure (mmHg)	132 ± 15	136 ± 25	0.391
Diastolic blood pressure (mmHg)	75 ± 11	77 ± 13	0.651
HbAIC (%)	8.3 ± 1.7	8.2 ± 1.8	0.642
Total cholesterol (mg/dl)	213 ± 34	220 ± 32	0.377
HDL cholesterol (mg/dl)	56 ± 17	56 ± 13	0.932
LDL cholesterol (mg/dl)	129 ± 30	138 ± 28	0.166
Triglyceride (mg/dl)	141 ± 87	144 ± 83	0.866
Diabetes treatment			
Diet only	21	9	0.813
Oral hypoglycemic agents	39	19	0.787
Oral hypoglycemic agents + insulin	9	4	0.940

Data are means ± SD or n.

Table 2 Laboratory data after 12 months of follow-up in subjects in two study groups

	VFD (n=69)	EXB (n=32)
BMI (kg/m^2)	23.3 ± 4.8	23.7 ± 4.4
SBP (mmHg)	123 ± 11***†	129 ± 16*
DBP (mmHg)	70 ± 8***	72 ± 10*
Total cholesterol (mg/dl)	197 ± 31***	202 ± 33*
HDL cholesterol (mg/dl)	58 ± 16	54 ± 14
LDL cholesterol (mg/dl)	117 ± 28***	120 ± 28**
Triglyceride (mg/dl)	123 ± 63	149 ± 83

Data are means ± SD or n.
Baseline vs after 12 months of follow-up, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$
VFD group vs EXB group, $^{\dagger}p < 0.05$.

glycemic control, blood pressure and lipids levels than the EXB group. The reason of the effects of consuming 'vegetable first diet' on the reduction of glycated hemoglobin and LDL cholesterol in subjects can be explained partly the contents of dietary fiber in the vegetable consuming before the carbohydrate.[8] Additionally, these results demonstrated that dietary carbohydrates after eating vegetable were slowly digested and required less insulin for their disposal may benefit subjects with diabetes, since they often delay the secretion of insulin.[9]

The aim of this study was to re-organized nutritional strategies in helping diabetes to adhere to the dietary regimes. Patients with diabetes encounter several psychological and lifestyle difficulties in modifying their lives to accommodate diabetic management.[10] They exhibit restrictive behaviors with regards to food intake and are convinced that rigid dietary control is the only way for good glycemic control. The VFD approach can be seen as support for the idea that emphasizing food choices, what to eat first, how to eat and not just energy intake can be an important element in improving glycemic control. With regards to the nutritional approaches, this research evidence has shown that nutrition advice given in the form of a simple meal plan, 'eat vegetable first and carbohydrate last'. It is easier to understand and easier to teach than the other approaches and importantly it is easier to make behavior changes for patients with diabetes since the dietary changes need to be consistent and applied to lifelong period. The VFD approach may be preferable for use in people with diabetes, especially for elderly patients.

It would be useful if further long-range studies could be performed, including quality of life outcomes with validated instruments to determine the acceptability of incorporating a 'vegetable first diet' in a patient's lifestyle as well as measurements of long-term glycemic control. The vegetable first, carbohydrates last meal may have a beneficial role in prevention of chronic complications for patients with diabetes.

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