原　著

ASSESSMENT OF DIETARY BEHAVIORS IN PATIENTS WITH DIABETIC NEPHROPATHY

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Abstract: We examined 218 patients with non-insulin-dependent diabetes mellitus to determine which dietary behaviors were affected by diabetic nephropathy. Diabetic nephropathy was divided into three clinical stages : normoalbuminuria, microalbuminuria, and overt proteinuria. Information on dietary habits concerning energy intake, protein intake and salt consumption was observed among different levels of nephropathy. Inadequate behavioral lifestyle was most pronounced in patients with microalbuminuria, and whose health was disturbed by high protein intake and high salt consumption. These findings were obtained for the adults, but not for the elderly. Results in this study provide the basic data for dietary intervention for diabetic patients.
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Key words : diabetic nephropathy, dietary behavior, lifestyle

INTRODUCTION

Tertiary prevention of diabetes includes all actions taken to prevent or delay the development of diabetic complications[1]. It has been suggested that lifestyle modification may help maintain health and reduce the risk of diabetic complications[2]. These interventional strategies may be usefully applied to highrisk individuals including those adopting Westernized lifestyles[3]. However, scientific data concerning dietary behaviors in local communities are lacking. We have tried to provide some information about dietary habits of patients with diabetic nephropathy and to address the aforementioned problems.

PATIENTS and METHODS

Patients

A total of 218 patients with non-insulin-dependent diabetes mellitus who had sought medical attention by physicians in the First Department of Internal Medicine of Nara Medical University Hospital or six associated institutions were enrolled in this study. The subjects included 95 male patients and 123 female patients, aged 31 to 89 years. Patients were divided into two groups, adult (age $<$ 69 yo) and elderly (age $\geq$ 70 yo) patients. The clinical backgrounds of these subjects are given in Table 1.

Table 1. Patient characteristics

Items	Adults	Elderly	Statistical significance
Number	138	80	
Gender (M/F)	66/72	29/51	ns
Age (yr)	58.7 (8.5)	74.1 (4.1)	<0.001
Duration of diabetes (yr)	9.7 (7.1)	12.3 (9.9)	<0.05
BMI (kg/m^2)	23.1 (3.1)	23.2 (3.4)	ns
HbAlc (%)	7.28 (1.65)	7.00 (1.15)	ns
Scr (mg/dl)	0.89 (0.46)	1.12 (0.98)	<0.05
HT (−/+)	75/63	28/52	<0.01
HL (−/+)	63/75	40/40	ns
Nephropathy (NA/MA/OP)	80/38/20	46/22/12	ns
Retinopathy (NDR/NPDR/PDR)	83/34/20	47/18/13	ns
Neuropathy (Absent/PN/AN)	85/42/11	36/38/6	<0.05
Treatment (Diet/OHA/Insulin)	32/66/40	15/50/17	ns

Values are means (SD).
Abbreviations: BMI, body mass index; Scr, serum creatinine; HT, hypertension; HL, hyperlipidemia; NA, normoalbuminuria; MA, microalbuminuria; OP, overt proteinuria; NDR, no diabetic retinopathy; NPDR, non-proliferative diabetic retinopathy; PDR, proliferative diabetic retinopathy; PN, polyneuropathy; AN, autonomic neuropathy; OHA, oral hypoglycemic agent.

Clinical data

Information regarding gender, age, duration of diabetes, obesity (defined as a body mass index; BMI), glycemic control (HbA_{1C}), serum creatinine, hypertension, hyperlipidemia, diabetic nephropathy, diabetic retinopathy, diabetic neuropathy, and current treatment was obtained from medical records. Hypertension was defined according to WHO/ISH guidelines[4]. Patients undergoing treatment with antihypertensive drugs were also included in the hypertensive group. Hyperlipidemia was classified as a serum cholesterol concentration of 220 mg/dl or higher and/or a serum triglyceride concentration of 150 mg/dl or higher. Diabetic nephropathy was divided into three clinical stages: normoalbuminuria (NA; albumin excretion $< 20\ \mu g$/min), microalbuminuria (MA; 20-200 μg/min), and overt proteinuria (OP; $>200\ \mu g$/min). The grade of diabetic retinopathy was determined by ophthalmoscopy and classified as no diabetic retinopathy (NDR), non-proliferative diabetic retinopathy (NPDR), or proliferative diabetic retinopathy (PDR)[5]. Diabetic neuropathy was divided into three categories: no neuropathy, peripheral neuropathy and autonomic neuropathy.

Assessment of dietary behaviors

Energy intake (% of adequate kcal) was derived from 5-day dietary records. Protein intake was estimated using Maroni's formulas[6] to calculate the 24-hour urinary output of urea nitrogen plus non-urea nitrogen. Salt consumption was also estimated by 24-hour urine collection.

Table 2. Energy intake, protein intake and salt consumption by patients with different levels of diabetic nephropathy

Items	Adults				Elderly			
	NA	MA	OP	All	NA	MA	OP	All
Excess caloric intake (%)	14.4 (18.7)	11.7 (18.5)	18.4 (23.5)	14.1 (19.4)	14.3 (17.8)	14.2 (20.7)	19.1 (21.6)	15.0 (19.1)
Protein intake (g/kg・BW/day)	1.12 (0.34)	1.24# (0.36)	1.03 (0.21)	1.14§§ (0.34)	1.04 (0.28)	0.98 (0.29)	1.00 (0.33)	1.02 (0.29)
Salt consumption (g/day)	9.21 (4.09)	11.05* (4.31)	9.55 (3.08)	9.82§ (4.10)	8.51 (2.89)	8.94 (3.05)	8.91 (4.63)	8.69 (3.17)

Values are means (SD).
Abbreviations: NA, normoalbuminuria; MA, microalbuminuria; OP, overt proteinuria.
* $p<0.05$ vs NA, # $p<0.05$ vs OP, § $p<0.05$ vs Elderly, §§ $p<0.01$ vs Elderly

Statistical analysis

Values are expressed as means±SD. The means of the groups were compared by analysis of variance (ANOVA) and differences between groups were tested using Fisher's exact test. Statistical significance was assumed at $p < 0.05$.

RESULTS

In the adults, no significant difference in energy intake was observed among the NA, MA and OP groups, but protein intake was significantly higher in the MA group than in the OP group. Salt consumption was also significantly higher in the MA group than in the NA group. In the elderly, no significant difference in energy intake, protein intake or salt consumption was observed among the NA, MA and OP groups. No significant difference in energy intake was observed between the adult and elderly groups. On the other hand, protein intake and salt consumption in the adult group were significantly higher than in the elderly group (Table 2).

DISCUSSION

The long-term adverse health effects of excess consumpiton of energy-dense foods have become apparent. An epidemiological study has suggested that adoption of a Westernized diet leads to glucose intolerance[3]. A decrease in daily food energy intake has been shown to produce a decrease in glycemia and plasma insulin concentration. However, definitive evidence that such dietary changes can prevent the development of diabetic nephropathy is lacking. In the present study, no significant difference in energy intake was observed among different leveles of nephropathy in both the adults and the elderly. Despite the fact that adherence to a planned diet is one of the behaviors patients must maintain for optimal management of diabetes mellitus, the successful implementation of nutritional management is achieved only in a minority of patients. In general, dietary compliance is notoriously poor. Calories, both too many and too few, are of primary importance in the elderly. The elderly have a higher percentage of body fat, a lower lean body mass, and a lower caloric requirement. Most of the elderly also lead a sedentary, more ordered life than younger adults. Thus, a reduction in caloric intake is perhaps the most important aspect of therapy in our subjects.

Protein intake, which is the strongest determinant of the progress of renal disease[7], was significantly higher in patients with microalbuminuria than in patients with overt proteinuria. This finding was obtained for adults, but not for the elderly. According to the Committee on Food and Nutrition of the American Diabetes Association[8], the recommended dietary protein allowance for nutritional management of patients with incipient renal disease is 0.8 g/kg of body weight. Moreover, dietary protein intake in patients with diabetic nephropathy with renal insufficiency should be restricted to 0.6 g/kg of body weight[7]. However, in our study, average protein intake reached 1.14 g/kg of body weight in adults and 1.02 g/kg of body weight in the elderly. Consequently, most persons in our study need to restrict their protein intake.

In this study, salt consumption was 9.8 g/day by adults and 8.7 g/day by the elderly. Salt consumption was also significantly higher in the adult patients with microalbuminuria than in normoalbuminuria. However, this finding was not obtained for the elderly. Changes in renal tubular function take place early in the course of diabetic nephropathy, and both maximal rates of glucose reabsorption and the absolute rates of sodium reabsorption are elevated[9]. Sodium may also alter albumin excretion through its effect on intrarenal hemodynamics and glomerular permeability[10]. Sodium intake should be restricted, so as not to exceed 7 g/day.

Eating patterns can be significantly influenced by many physical, mental, and emotional factors. Trying to change long-standing dietary habits by imposing new and rigid programs may not be successful. Results in this study provide the basic data for dietary intervention for diabetic patients. Consequently, reinforcement is necessary through continuous reviews of dietary managment, evaluation of adherence to the recommended diet, and provision of motivations for improving dietary behavious.

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