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The effects of a high fibre, low fat and low sodium dietary regime on diabetic hypertensive patients of different ethnic groups

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Summary

Fifty-three diabetic patients with mild hypertension were allocated to a treatment diet with a high fibre, low fat and low sodium dietary regime or a control diet. After a 1-month treatment period, the modified-diet treated group ($n=35$) showed a highly significant reduction in mean diastolic blood pressure ($P<0.001$) accompanied by significant reduction in urinary sodium excretion ($P<0.01$). The mean values of diastolic pressure ($P<0.05$) and urinary sodium/potassium ratio ($P<0.01$) were also significantly reduced at 1 month compared to control. White ($n=16$) and West Indian ($n=10$) diabetic hypertensive patients demonstrated a similar significant hypotensive response ($P<0.05$ and <0.01 respectively) with reduction in urinary sodium excretion to the modified diet. In contrast, Asian patients demonstrated no significant changes.

Treatment of hypertension in diabetic subjects with a high fibre, low fat and low sodium dietary regimen may have a hypotensive response after a period of 1 month and there is a similar response in both black and white ethnic groups. Further observation of these patients will determine long-term response and compliance.

KEY WORDS: fibre, fat, sodium, hypertension, diabetes mellitus.

Introduction

Hypertension is common in diabetic patients (Christlieb *et al.*, 1981; Barrett-Connor *et al.*, 1981), but treatment may be unsatisfactory due to the adverse effects of antihypertensive drugs on diabetic control and lipid metabolism.

Recent studies in non-diabetic hypertensive subjects have suggested a possible alternative to drug therapy, consisting of a low dietary sodium intake, which may reduce diastolic blood pressure (Morgan *et al.*, 1978; MacGregor *et al.*, 1982a). A significant reduction in blood pressure may also occur with a low fat intake (Puska *et al.*, 1983) or with a high potassium intake (MacGregor *et al.*, 1982b). Combining these dietary measures in a high fibre, low fat and low sodium regime has also been reported to produce a significant reduction of systolic and diastolic blood pressure with reduction of antihypertensive drug therapy in non-diabetic hypertensives (Dodson *et al.*, 1981a; Beard *et al.*, 1982), and may be associated with improved glycaemic control in diabetic patients (Kiehm, Anderson and Ward, 1976; Dodson *et al.*, 1981b). This dietary regime has also been shown in both insulin and non-insulin dependent diabetics to result in alterations in serum cholesterol containing lipoproteins which may contribute to an overall reduction in cardiovascular disease (Dodson *et al.*, 1981b).

We have therefore studied the effects on blood pressure of a high fibre, low fat and low sodium dietary regime in diabetic hypertensive patients. Particular emphasis has been placed on the effects of this regime on different ethnic diabetic hypertensive groups, in view of the different reported responses of the non-diabetic hypertensive ethnic groups to antihypertensive treatment. For example, blacks, who have been shown to have lower mean plasma renin levels (Helmer and Judson, 1968), may be less sensitive to beta-blockers but more sensitive to diuretic therapy than whites. Furthermore, compliance may not be as satisfactory amongst the black compared to the white population (HDFP Co-operative Study, 1977).

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TABLE 1. Clinical details of patients studied

	Number of patients	Sex	Mean age (years)	Mean ideal body weight (lb)	Hypoglycaemic therapy (number of patients)		
					Diet alone	Tablet treated	Insulin treated
Modified diet group	35	17M 17F	53·6±8·5	133·5±18·7	21	12	1
White	16	9M 7F	59 ±7·71	132·7±18·2	10	5	1
West Indian	10	2M 8F	51·5±6·3	131·2±16·9	6	4	—
Asian	9	4M 5F	45·8±5·7	127·4±19·9	5	4	—
Control (13 West Indian, 3 white, 2 Asian)	18	10M 8F	55·3±6·7	124·8±18·2	9	6	3

Figures are mean±s.d.

Patients and methods

Fifty-three diabetic hypertensive patients, attending the out-patients at Dudley Road Hospital, were studied. The clinical details of these patients are shown in Table 1.

Criteria for entry to this study were 3 consecutive hypertensive readings (as defined by the W.H.O.: systolic ≥160 mmHg or diastolic ≥95 mmHg) in an established diabetic patient. Patients already receiving anti-hypertensive drug therapy were not excluded from the study provided World Health Organisation criteria for hypertension were met. No alteration to drug therapy was made during the trial period. Patients with evidence of diabetic or hypertensive nephropathy were excluded.

The patients were all treated previously on low carbohydrate diets which had been recommended by the hospital dietitian and had stable tablet or insulin therapy for at least 1 month before the study. Ten patients in the modified-diet treated group were established on antihypertensive drug therapy which was unchanged during the trial. The response to the modified dietary regimen was evaluated initially in 18 patients. Following this, patients were then allocated in a sequential fashion by the hospital dietitian to receive either the modified or the control diet.

At the beginning of the trial period, a 24-hr collection of urine, measurement of body weight and blood pressure was made. All patients were maintained on their diets and other treatment for 4 weeks, at the end of which time the initial observations were repeated. Blood pressure was recorded in the supine position after 5 min rest with a random zero Hawksley sphygmomanometer by a separate blind observer and the mean of 2 readings recorded. Diastolic blood pressure was recorded at the 5th Korotkoff phase.

The composition of the diet given to 35 of the patients compared to a normal western diet is shown in Table 2. The modified dietary regimen, made up from readily available western foodstuffs, consisted of high dietary fibre (35–40 g/day), high unrefined carbohydrate (65% of total energy), low fat (15% of total energy), low sodium (40–50 mmol/day), and normal potassium intake (70–80 mmol/day). Modifications appropriate for the eating habits of the West Indian and Asian patients were made to the foods included in the dietary protocol. However, analysis of the modified diet was the same for all ethnic groups.

Eighteen of the patients were allocated to the control group which consisted of continuing their former dietary regimen, but they otherwise followed the same trial protocol as the dietary modified group.

Statistics were by paired and unpaired *t*-test. Statistical differences between the number of patients with normal blood pressure readings after 1 month were assessed by the chi-squared test.

Results

The changes in systolic and diastolic blood pressure, weight and 24-hr urinary sodium excretion, after a 1-month period in the modified diet treated and control group are shown in Table 3. The modified-diet treated group showed a highly significant reduction in diastolic blood pressure ($P<0·001$), accompanied by a reduction of urinary sodium output ($P<0·01$) and urinary sodium/potassium ratio ($P<0·001$). The diastolic blood pressure ($P<0·05$) and urinary sodium/potassium ratio ($P<0·01$) of the diet treated group were also significantly lower compared to control values at 1 month. However, there was no significant change in weight, urinary potassium excretion, and systolic blood pressure in both the modified diet treated and control treated groups.

TABLE 2. Composition of the modified dietary regimen compared to a modern western diet

	Trial diet	Modern western diet (U.S.A.)
Total energy (kcal)	1600–1800 (6·5–7·4 MJ)	2100–4500 (8·6–18·5 MJ)
Fat (% Total energy)	15	42
Protein (% Total energy)	20	12
Unrefined carbohydrate (% Total energy)	65	22
Refined carbohydrate (% Total energy includes alcohol intake)	0– 5	24
Sodium (mmol/day)	40–50	≃180
Potassium (mmol/day)	80–90	≃ 80
Sodium/potassium ratio	1:2	2:1

TABLE 3. Changes in blood pressure, weight and urinary sodium excretion in the diet treated and control hypertensive diabetic patients (mean ± s.d.)

	Diet treated group ($n=35$)		Control ($n=18$)	
	Time 0	1 month	Time 0	1 month
Systolic blood pressure (mmHg)	173·8 ±23·8	168·5 ±22·8	169·7 ±18·2	174·1 ±18·9
Diastolic blood pressure (mmHg)	98·4 ± 9·2	91·7 ± 8·9†	94·4 ± 7·3	96·7 ± 7·9
Weight (kg)	74·95 ± 13·7	73·7 ±11·8	73·3 ±16·6	71·7 ±15·9
Urinary sodium (24-hr output mmol)	195 ±78·1	136·7 ±70·2*	180·2 ±58·2	162·6 ±48·1
Urinary potassium (24-hr output mmol)	83·5 ±61·5	80·1 ±25·5	66·9 ±20	68·2 ±21·7
Urinary sodium/potassium ratio	2·68 ± 1·08	1·82 ± 1·09†	2·96 ± 1·39	2·84 ± 1·33
Number of patients with normal blood pressure	11 (32%)‡		2 (11%)	

*$P<0·01$; †$P<0·001$; ‡$P<0·001$ (Chi-squared statistic).

The response according to ethnic group to the modified dietary regime is shown in Table 4. Both white and West Indian groups demonstrated a significant fall in diastolic blood pressure, which was accompanied by a significant fall of urinary sodium excretion, but only the whites showed a significant fall in sodium/potassium ratio. However, in the West Indian group, both the initial mean urinary sodium output and urinary sodium/potassium ratio were lower than both whites and Asians, although this did not reach statistical significance.

The Asian group demonstrated no significant changes in blood pressure although there was a greater fall in urinary sodium output and diastolic blood pressure when compared to control. In the Asian patients, 56% ($n=5$) showed either an increase or no change in urinary sodium output, in contrast to the West Indian group at 33% ($n=3$) and the whites at 31% ($n=5$).

Most patients complained that the modified dietary regimen was bland but the protocol has now been extended to a 3-month period so that assessment of compliance and the effects of this dietary regimen on diabetic control can also be made.

Discussion

The important finding of this study is a significant fall in diastolic blood pressure on the modified dietary regimen which was also observed in both the West Indian and white diabetic hypertensive patient groups when compared to control. These findings are in agreement with similar studies in the non-diabetic essential hypertensive patients (Dodson *et al.*, 1981a; Beard *et al.*, 1982; MacGregor *et al.*, 1982a). In particular, Beard *et al.* reported a reduction in anti-hypertensive drug therapy on a similar dietary regimen. In our study, a significant number of patients had normal blood pressure after 1-months treatment on the modified diet, therefore reducing the number of patients who would have otherwise received anti-hypertensive drug therapy.

The fall in diastolic blood pressure was associated with significant changes in urinary sodium output. Previous studies have shown a relationship between sodium intake and blood pressure and it seems likely that the fall in blood pressure in our group may relate to the low sodium aspect of the diet. However, the other aspects may also be responsible for the hypotensive effect. These may include the low fat aspect of

TABLE 4. Changes in blood pressure, weight and urinary sodium excretion in the diet-treated group according to ethnic group (mean ± s.d.)

	White ($n=16$)		West Indians ($n=9$)		Asians ($n=9$)	
	0	1 month	0	1 month	0	1 month
Systolic blood pressure (mmHg)	175·6 ± 13·5	172·8 ± 17·8	179·7 ± 37·7	164 ± 24·1	164·1 ± 23·6	165·8 ± 29·9
Diastolic blood pressure (mmHg)	97·6 ± 9·0	92·6 ± 9·9*	100·3 ± 9·7	90·5 ± 8·3†	97·8 ± 9·5	92·4 ± 8·96
Urinary sodium (24-hr output, mmol)	214·9 ± 93·2	139 ± 77·5†	152·6 ± 70·8	115·8 ± 67·7	184 ± 55·7	144 ± 55·4
Urinary sodium/potassium ratio	2·8 ± 1·2	1·6 ± 0·9‡	2·19 ± 0·98	1·61 ± 0·58	2·96 ± 1·0	2·45 ± 1·6
Patients with normal blood pressure	5 (31%)*		5 (56%)‡		3 (33%)	

*$P<0·05$; †$P<0·01$; ‡$P<0·001$.

The number of patients with normal blood pressure after 1 month in the control group was 11% (see Table 3).

the dietary regimen which has been reported by Puska *et al.* (1983) to be hypotensive, and the high fibre intake, as Rouse *et al.* (1983) has demonstrated the hypotensive effect of a vegetarian diet. It has also been previously reported that black hypertensive patients appear to have a poorer response to anti-hypertensive medication than whites and it has been suggested that this may be due to poor compliance or low socio-economic status (HDFP Co-operative Study, 1977). However, it is clear from this study that a similar significant hypotensive response associated with a fall in urinary sodium output was observed in both white and West Indian ethnic groups, suggesting similar compliance. Luft *et al.* (1977) has shown that normotensive blacks following a sodium load excrete significatly less sodium and potassium than did matched whites. It is therefore of note that the initial urinary sodium output of the black group was lower than both whites and Asians, although this did not reach statistical significance.

The Asian group demonstrated no significant results in the study although a fall in diastolic blood pressure and urinary sodium output was observed. The reason for this is not clear although we suspect that it was a combination of poor compliance and understanding of the dietary protocol.

We conclude that a high fibre, low fat and low sodium dietary regimen may have a hypotensive response after a period of 1 month, and that there is a similar response in both black and white diabetic hypertensive patients. Further observations on these patients will determine the response, compliance, and whether this dietary regimen will obviate or reduce the need for anti-hypertensive drug therapy in the long-term.

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