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Parathyroid Hormone and Calcitonin in Diabetes Mellitus

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ABSTRACT

Forty patients with diabetes mellitus and a reference group of forty-five healthy controls have been studied. Significantly increased serum concentrations of parathyroid hormone and calcitonin were found in the diabetics as well as increased levels of alkaline phosphatase activity and phosphate independent of the duration of the diabetic state. No difference was found in serum calcium levels when compared with the healthy controls.

Since these results cannot be explained by diabetes nephropathy an altered balance between parathyroid hormone and calcitonin in diabetes mellitus is postulated.

INTRODUCTION

Studies published during the last decades (for references see 3, 6) indicate the existence of an altered calcium metabolism in diabetes mellitus. Because of the absence of reports on parathyroid hormone and calcitonin levels in diabetes the study presented here was performed.

MATERIAL AND METHODS

Forty patients with diabetes mellitus, well controlled according to conventional criteria, were seen regularly at the out-patient department. Twelve were men with a mean age of 41 years (range 18-62), 28 women with a mean age of 39 years (range 19-68), most of them treated with insulin. Known duration of diabetes was for the men 4-43 years, for the women ½-38 years. Ten of the patients had signs of diabetic nephropathy, i e proteinuria and serum creatinine above 100 µmol/l.

The controls were healthy blood donors or hospital staff, 12 men and 33 women with a mean age of 40 years (range 21-56) for the men and 33 (range 19-60) for the women.

Blood samples were drawn in the morning with the patients fasting and with standardized sampling technique.

Serum parathyroid hormone was analysed radioimmunologically with an antiserum with dominating C-terminal specificity (Wellcome AS 211/32) using the technique described in ref. (7, 8). The intra-assay coefficient of variation calculated from 47 double analyses was 16.4 % with a mean value of 231 pmol/l.

Serum calcitonin was determined radioimmunologically (8) with antigen-ligand from human MCT (medullary carcinoma of the thyroid). The coefficient of variation based on 39 double tests was 14.9 % with a mean value of 226 pmol/l.

Serum creatinine was determined kinetically with Jaffé's picrate method according to Bartel & Böhmer (1) with an intra-assay variation of 1.9 % (mean value 258 µmol/l) and between day variation of 2.5 % (mean value 143 µmol/l).

Serum calcium was determined as total calcium according to Küffer et al. (2). The intra-assay variation was 2.5 % (mean value 2.34 mmol/l), between day variation 4.1 % (mean value 2.48 mmol/l).

Serum phosphorus was determined according to Richterich (4). Intra-assay variation 1.3 % (mean value 1.13 mmol/l), between day variation 5.6 % (mean value 1.47 mmol/l).

Serum alkaline phosphatase was determined according to the Scandinavian enzyme committee (5). Intra-assay variation 1.2 % (mean value 4.52 µkat/l), between day variation 2.2 % (mean value 5.59 µkat/l).

Common statistical methods were used for calculations of standard deviation (SD), mean value (M) and standard error of the mean (SEM). Significance of differences between the sample groups was tested with the student t-test.

RESULTS

The results of the determinations of serum parathyroid hormone, serum calcitonin, serum alkaline phosphatase, serum calcium, serum phosphorus and serum creatinine are shown in table 1.

The mean value for serum parathyroid hormone was 255 pmol/l, significantly higher ($p < 0.005$) than in the control group with 206 pmol/l. The subgroup with no sign of nephropathy had a mean value of 245 pmol/l, also significantly higher ($p < 0.005$) than in the control group. See Fig. 1.

Table 1.

		Nephropathy included			Nephropathy excluded		
		n of cases	Mean value	SEM	n of cases	Mean value	SEM
S-Parat-hormone pmol/l	Diabetes	40	254.5	12.5***	30	244.7	14.8***
	Controls	45	206.4	5.2	45		
S-Calcitonin pmol/l	Diabetes	40	254.8	9.9***	30	246.0	9.6***
	Controls	45	66.0	3.1	45		
S-Alkaline phosphatase ukat/l	Diabetes	40	3.19	0.18***	30	3.14	0.22***
	Controls	45	2.40	0.12	45		
S-Calcium mmol/l	Diabetes	40	2.31	0.02	30	2.31	0.02
	Controls	45	2.34	0.02	45		
S-Phosphorus mmol/l	Diabetes	40	1.11	0.04**	30	1.09	0.05
	Controls	45	1.00	0.03	45		
S-Creatinine µmol/l	Diabetes	40	92.1	7.7*	30	70.3	2.3
	Controls	45	77.6	1.4	45		

In the table the patients have been included respectively excluded in the "nephropathy" group according to the rules described in the text. A p-value < 0.025 was considered significant.

Significance of difference: *** $p < 0.005$

** $0.01 < p < 0.005$

* $0.025 < p < 0.0125$

No asterix, no significance

n = Number of cases

M = Mean value

SEM = Standard error of the mean

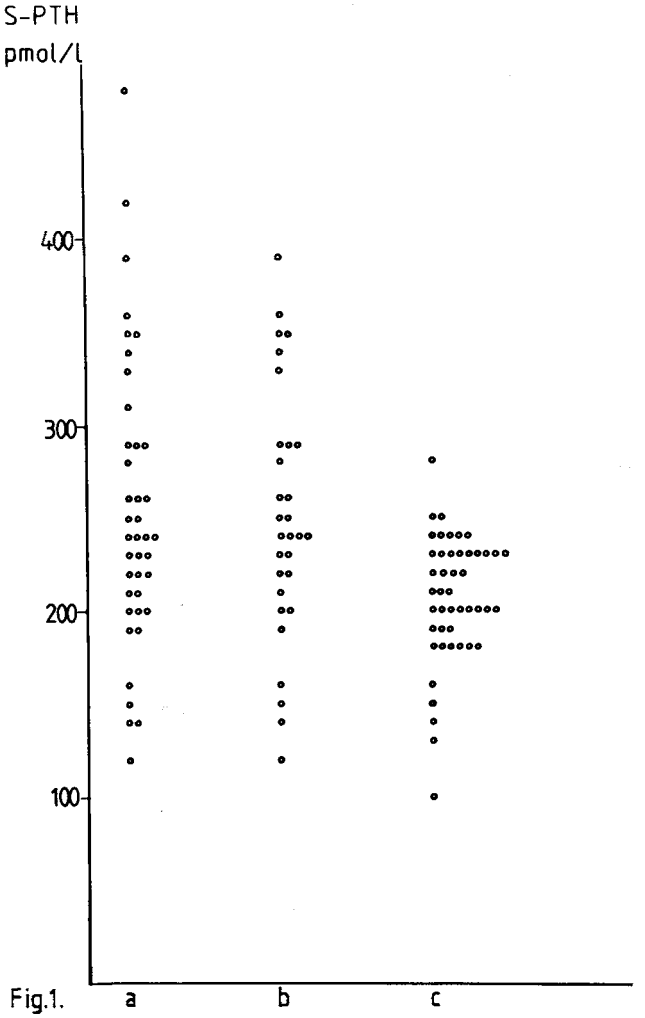

Fig.1.

Fig. 1.

Serum parathyroid hormone in

a) 40 patients with diabetes

b) 30 diabetes patients without nephropathy and

c) healthy controls.

Serum calcitonin in the diabetes group was 255 pmol/l), which is significantly ($p < 0.005$) higher than in the control group (66 pmol/l). In the subgroup with no signs of nephropathy the same high significance of difference was found. See Fig. 2.

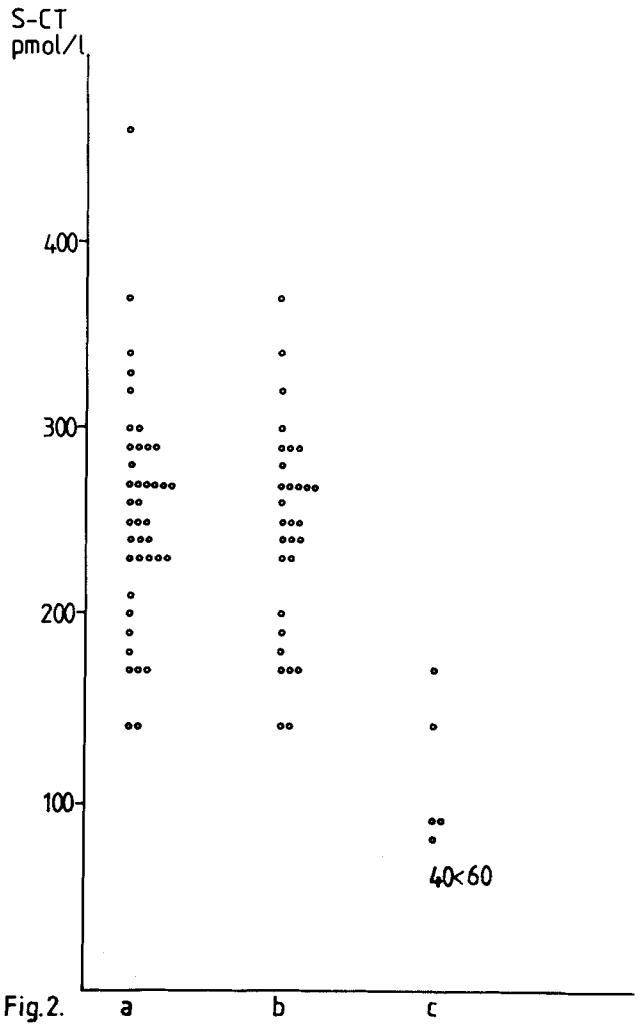

Fig. 2.

Serum calcitonin in

a) 40 patients with diabetes

b) 30 diabetes patients without nephropathy and

c) healthy controls, 40 of which had levels less than 60 pmol/l (40 < 60).

Fig.2.

Both serum alkaline phosphatase activity and serum phosphorus were significantly higher in the diabetes group than in the control group. No significant difference in serum calcium levels was found between the diabetic group and the control group or between the non-nephropathic group and the controls.

The levels of calcitonin and parathyroid hormone were independent of the duration of the diabetic disease.

DISCUSSION

There is a wellknown connection between parathyroid function, calcitonin, calcium and phosphorus balance, i e there seems to be a coordination between parathyroid hormone and calcitonin in order to stabilize the ionized calcium level in plasma. Because of this balancing function a normal calcium level can be found even if, at the same time, there is hyperactivity both of the parathyroid glands and of the calcitonin-producing C-cells (9).

In this study increased levels of parathormone and calcitonin have been demonstrated in patients with diabetes. The result indicates an increased activity of parathyroid and calcitonin producing cells in order to keep the ionized calcium level constant. This cannot be explained be renal dysfunction.

Thus, in order to visualize calcium homeostatis it is necessary to determine both parathyroid hormone level and calcitonin and not to rely on a normal calcium level alone.

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