surement of microalbuminuria in diabetic patients. *Diabetes Care* 16:616–20, 1993

Hyperinsulinemia in type II diabetic patients with microalbuminuria

Microalbuminuria predicts reduced survival in type II diabetes and is associated with both cardiovascular disease and cardiovascular death (1,2). So far, no risk markers have been clearly identified as a potential explanation for the increased cardiovascular morbidity and mortality among type II diabetic patients with microalbuminuria (3). In the general population, hyperinsulinemia has emerged as an independent predictor of coronary heart disease (4). Because many variables (such as body weight, age, duration of disease, sex) may be important confounders of any putative relation between hyperinsulinemia and microalbuminuria, we have compared fasting and postglucagon C-peptide levels of 43 type II diabetic patients with microalbuminuria (albumin excretion rate >20 μg/min, range 25–278 μg/min) to those of 43 normoalbuminuric (albumin excretion rate <20 μg/min) type II diabetic patients attending our outpatient clinic individually matched for age (54 ± 1.4 vs. 54 ± 1.4 yr; mean ± SD), sex (30 M/13 F in each group), BMI (30 ± 1.3 vs. 30.1 ± 1.3 kg/m^2), known duration of diabetes (7.82 ± 0.92 vs. 7.79 ± 0.90 yr), and treatment (10 patients were treated by dietary advice, 29 were taking oral antidiabetic therapy, and 4 were on injected insulin in each group). Serum creatinine concentration was in the normal range (<120 μM) in all patients. No significant differences were found between the two groups in total serum cholesterol, sBP, dBP, prevalence of smoking, FBG, and GHb. Only basal and postglucagon C-peptide and triglyceride plasma levels were significantly higher in patients with microalbuminuria (Table 1).

Table 1—*Clinical and selected biochemical data in microalbuminuric and normoalbuminuric type II diabetic patients*

	Type II diabetic patients	
	Microalbuminuric	Normoalbuminuric
n	43	43
sBP (mmHg)	150 ± 3	148 ± 3
dBP (mmHg)	87 ± 3	87 ± 2
Total cholesterol (mM)	5.88 ± 0.28	5.92 ± 0.24
Triglycerides (mM)	3.04 ± 0.42*	1.98 ± 0.53
Blood glucose (mM)	12.2 ± 0.7	12.1 ± 0.7
GHb (%)	8.8 ± 0.4	8.8 ± 0.3
Basal C-peptide (ng/ml)	2.9 ± 2.2*	2.0 ± 1.3
C-peptide after glucagon (ng/ml)	4.5 ± 3.1†	3.3 ± 1.8
Prevalence of smoking (%)	25	26

Data are means ± SD.
*$P < 0.005$.
†$P < 0.01$.

Microalbuminuria was also associated with a significantly increased prevalence of coronary heart disease (37.2 vs. 18.6%; $P < 0.05$). We conclude that conventional risk factors cannot explain the increased cardiovascular morbidity of microalbuminuric patients. The higher C-peptide concentrations, along with elevated plasma triglyceride plasma levels in patients with microalbuminuria, would suggest peripheral hyperinsulinemia, possibly because of a greater insulin resistance. In view of these data, the possibility must be considered that hyperinsulinemia and/or insulin resistance would be the underlying factor for the association between microalbuminuria and cardiovascular disease.

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TYPE II DIABETES, NON-INSULIN-DEPENDENT DIABETES MELLITUS; BMI, BODY MASS INDEX; sBP, SYSTOLIC BLOOD PRESSURE; dBP, DIASTOLIC BLOOD PRESSURE; FBG, FASTING BLOOD GLUCOSE.

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