PREVALENCE AND PREDICTORS OF MICROALBUMINURIA IN PATIENTS WITH DIABETES MELLITUS: A CROSS-SECTIONAL OBSERVATIONAL STUDY IN KUMASI, GHANA

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Objective: To evaluate the prevalence and predictors of microalbuminuria in diabetics in Kumasi, Ghana.

Design: Prospective, cross-sectional study of diabetic patients.

Subjects: Patients with diabetes, 20 to 78 years of age.

Main Outcome Measures: Microalbuminuria

Methods: All patients (109) attending an outpatient diabetic clinic at the Komfo Anokye Teaching Hospital Diabetes Centre in Kumasi, Ghana from January to July 2005 were enrolled in the study.

Results: The mean overall age of the cohort was 54.1±10.9 years, and 28% were male. The proportion of subjects who had microalbuminuria was 43.1% (n=47). The median duration of diabetes before development of microalbuminuria was 10 years. Duration of diabetes, blood urea nitrogen, serum concentration of creatinine, and triglyceride were significantly higher in patients with microalbuminuria (P<.05). Urinary potassium concentration and fractional excretion of potassium were also significantly higher in the patients with microalbuminuria.

Conclusions: The prevalence of microalbuminuria in patients with diabetes in this study was 43%. Significant predictors of microalbuminuria included duration of diabetes and serum concentration of creatinine. To reduce renal failure among these patients, strategies to mitigate its occurrence are needed. This includes strict glycemic control, control of hypertension, and the early blockade of the renin-angiotensin system. (*Ethn Dis*. 2007;17:726–730)

Key Words: Microalbuminuria, Diabetic Nephropathy, Diabetes Mellitus, End Stage Renal Disease

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INTRODUCTION

Diabetic nephropathy (DNP) develops in 30%–40%[1] of patients with type 1 diabetes mellitus and in 10%–20% of patients with type 2 diabetes mellitus.[2–4] As the prevalence of type 2 diabetes is about 9–10 times higher than that of type 1 diabetes, it is easy to understand that the vast majority of patients with end stage renal disease (ESRD) requiring renal replacement therapy are patients with type 2 diabetes. Renal damage in type 1 and type 2 diabetic patients has well-defined and clearly separable stages starting from hyper filtration, microalbuminaemia, overt proteinuria to renal failure.[5] Much less is known about the factors contributing to its development or unfavorably affecting its progression. Studying nephropathy in type 2 diabetic patients seems to be more difficult, as compared to that in type 1 diabetic patients, since:

1) the onset of diabetes is almost always unknown (may start years before the diagnosis[6];
2) The age of elderly type 2 diabetic patients can affect the kidney function (for patients >40 years of age, glomerular filtration rate (GRF) decreases 8–10 mL/min every 10 years[7];
3) Elderly patients frequently suffer from other diseases (essential hypertension, arteriosclerosis, etc.), which can also damage the parenchyma and thus the function of the kidneys;
4) The high mortality rate of patients with type 2 diabetes, especially of those with complications, inhibits the complete development of the natural history of DNP, thus making long-term follow-up examinations difficult.

The higher incidence of kidney failure due to type 2 diabetes and the increased cardiovascular morbidity and mortality of these patients emphasizes the need for acquiring more information concerning microalbuminuria as an early marker of diabetic nephropathy. The purpose of our study was to establish the prevalence of microalbuminuria and to evaluate risk factors for the development of microalbuminuria in patients with diabetes mellitus.

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MATERIALS AND METHODS

Diabetes mellitus was diagnosed on the basis of oral glucose tolerance testing, HbA1C and need for antidiabetic therapy (diet, drugs and insulin). We followed 109 diabetic patients (31 males, 78 females), with an average age of 54.1±10.9 years, at our outpatient diabetes clinic of the Department of

The purpose of our study was to establish the prevalence of microalbuminuria and to evaluate risk factors for the development of microalbuminuria in patients with diabetes mellitus.

Table 1. A comparison of characteristics of patients with normoalbuminuria vs microalbuminuria

	Microalbuminuria 30–300 (mg/day)	Normoalbuminuria 0–29 (mg/day)	*P*
n (%)	47(43.1%)	62(56.9%)	
Male/female	15/32	16/46	
Age	55.2± 11.0	53.2±10.8	.17
Duration of DM years	11.9± 7.4*	9.8±5.0	.04
Treatment			
*OHA only	31	42	
Insulin and OHA	10	10	
Insulin only	6	10	
Hypertension	18	25	.83
FBS	10.4±5.0	11.2±5.3	.21
HbA1C	8.6±2.2	8.7±2.7	.44
BMI	26.3± 4.4	26.3±4.4	.48
Systolic BP	131.3±20.9	130.0±18.90	.37
Diastolic BP	71.5±8.6	69.7±8.1	.13
Serum chemistry			
Creatinine	105.3±39.8	91.4±48.60	.05
BUN	4.7±2.2	3.8±1.5	.01
Urea/creatinine	11.5±3.3	11.5±4.7	.49
Albumin	40.9±7.7	40.8±6.30	.82
Potassium	4.2±.6	4.2±.6	.36
Sodium	144.1±5.4	144.6±7.1	.34
Total chol	189.6±61.9	192.8±56.3	.61
Trigliceride	146.5±77.0	125.3±56.8	.05
HDL	45.9±17.1	48.1±14.2	.23
LDL	114.6±51.7	118.8±54.3	.34
Urine			
Sodium	106.5±43.5	103.5±47.5	.36
Potassium	56.5±35.7	41.2±22.2	.0061
FeNa	1.6±.3	1.5±.2	.310
FeK	25.0±2.8	18.3±2.5	.038
Creatinine	69.2±31.3	68.1±39.7	.43

OHA=oral hypoglycemic agents, FeK=fractional excretion of potassium, FeNa=fractional excretion of sodium, * mean±standard deviation.

Medicine at Komfo Anokye Teaching Hospital between January and June 2006. From patient case histories, we recorded the following factors: duration of diabetes, hypertension (patients were regarded as having hypertension if either their systolic blood pressure was ≥140 mm Hg, diastolic blood pressure was ≥90 mmHg or both, or patient had received antihypertensive treatment), the type of antidiabetic therapy (diet, tablets or insulin), as well as the administration of angiotensin-converting enzyme inhibitors (ACEI).

Patient levels of fasting blood glucose, HbA1C, serum levels of triglycerides, total cholesterol, HDL-cholesterol, and creatinine were estimated from laboratory reports. GRF was determined by using the Cockcroft-Gault formula.[8] Urinary albumin excretion (UAE) was determined and normoalbuminuria (NA) was recorded, in cases where UAE was less <30 mg/day. Likewise, microalbuminuria (MA) was recorded if the UAE was 30–300 mg/day. Body mass index (BMI) was calculated according to the formula, kg/m^2.

Statistical analysis

Stata data analysis and statistical software (v7) was used (College Station, Texas, USA). Results are expressed as means ± SD. Unpaired Students *t* tests were used for comparisons between the groups. A *P* value <.05 was considered to be significant. We also plotted an actuarial Kaplan Meier analysis of the proportion of patients without microalbuminuria.

RESULTS

Of the 109 patients, the average duration of diabetes was 10.7 ± 6.2 years and 73 (67.0%) were on oral hypoglycaemics; 20 patients (18.3%) were also on insulin and oral hypoglycaemic drug and 16 patients (14.7%) were on insulin only. Forty-three (39.4%) of the patients were hypertensive. The average serum creatinine was 97.4±45.3 μmol/L and blood urea nitrogen of 4.2±1.9 mmol/L.

Table 1 shows a comparison of characteristics between patients with normoalbumnuria vs microalbuminuria. Duration of diabetes, serum concentration of creatinine, blood urea nitrogen, triglyceride were significantly higher in the patients with microalbu-

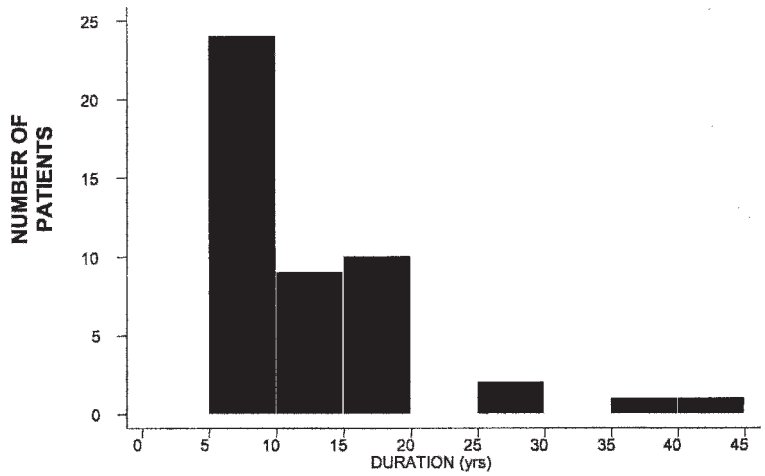

Fig 1. Duration of diabetes mellitus for the 47 diabetic patients with microalbuminuria

minuria ($P<.05$). Urinary potassium concentration and fractional excretion of potassium were also significantly higher in the patients with microalbuminuria.

Figure 1 shows the duration of diabetes mellitus for the 47 patients with microalbuminuria; Figure 2 shows the duration of diabetes and percentage of the patients without microalbuminuria for all patients (109) using actuarial Kaplan Meier analysis. The median duration of diabetes mellitus at which patients develop microalbumnuria is 10 years.

DISCUSSION

Diabetes is already a major health concern in all countries and type 2 diabetes is undergoing a major escalation, not only in developed countries, but also in countries, including those in sub-Saharan Africa, newly exposed to the Westernized lifestyle.[8] Diabetes is now one of the leading causes of end-stage kidney disease in Western countries.

Microalbuminuria, usually defined as a urinary albumin excretion rate of 30–300 mg per 24 hours, is known to be an independent predictor of an increased risk for cardiovascular and renal disease in diabetic subjects.[6] Research evidence links microalbuminuria with increased cardiovascular risk in non-diabetic populations as well.[9,10] Studies conducted in Europe in the 1980s revealed that small amounts of albumin in the urine, microalbuminuria, not usually detected by conventional methods were predictive of the later development of proteinuria in type 1[11–13] and type 2[14] diabetic patients. Therefore, the early identification of patients at greatest risk, and the subsequent initiation of renal and cardiovascular protective treatments, is of the utmost importance.

In our study, we found that 43.1% of the diabetic patients had microalbuminuria, an early marker of the onset of diabetic nephropathy

Wu et al, in their study of Asian type 2 diabetic patients, found the prevalence of microalbuminuria to be 39.8% and a prevalence rate of 18.8% for macroalbuminuria.[15] In our study, we found that 43.1% of the diabetic patients had microalbuminuria, an early marker of the onset of diabetic nephropathy, which could be treated to prevent early renal disease[16] before the predicted progression to proteinuria and chronic kidney disease. In hypertensive diabetics, the effective control of blood pressure and reduction of microalbu-

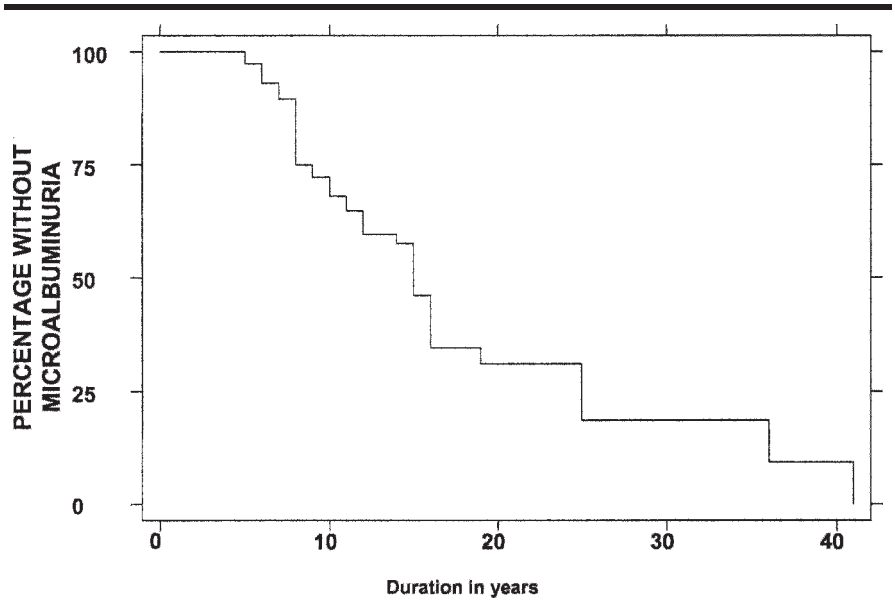

Fig 2. Duration of diabetes mellitus for all 109 patients and percentage without microalbuminuria

minuria translates into a reduction of not only ESRD but also of coronary artery disease and stroke.[17] Angiotensin converting enzyme (ACE) inhibitors have been found to be effective for diabetic nephropathy.[18]

The elevated urinary potassium excretion might indicate an activated renin-angiotension-aldosterone system in patients with microalbuminuria, leading to a clear empirical reason why ACE inhibitors must be recommended for Ghanaian diabetics. Serum concentrations of creatinine and blood urea nitrogen were significantly higher in the patients with microalbuminuria, a finding similar to that found by Molnar.[19]

Serum triglyceride was found to be significantly higher in our patients with microalbuminuria. There was no significant difference in the other lipid fraction, serum high density lipoprotein-cholesterol (HDL-C) and low density lipoprotein-cholesterol (LDL-C) and also glycaemic control. Tentolouris et al and Molnar M et al also found a high triglyceridemia in patients with type 2 diabetes and microalbuminuria[19,20] and no significant difference in glycemic control, serum cholesterol and HDL-C.[20]

The median duration of diabetes mellitus at which patients developed microalbuminuria in our study was 15 years. In the UK Prospective Diabetes Study (UKPDS), the incidence of microalbuminuria was 2.0% per year, with a prevalence rate of 25% after 10 years of being diagnosed.[21] In other findings, proteinuria occurred in 15%–40% of patients with type 1 diabetes, with a peak incidence around 15–20 years of diabetes diagnosis.[22,23,24] In patients with type 2 diabetes, the prevalence was variable, ranging from 5% to 20%.[25,21]

The high prevalence of microalbuminuria observed in our patients (43%) is alarming. This prevalence is an indication of an impending pandemic of cardiovascular and renal diseases in diabetic patients at the diabetic centre in Kumasi, Ghana, and has the potential for grave economic consequences.

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AUTHOR CONTRIBUTIONS

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Data analysis and interpretation: Eghan, Adjei-Poku
Manuscript draft: Eghan
Statistical expertise: Eghan
Acquisition of funding: Eghan, Frempong, Adjei-Poku
Administrative, technical, or material assistance: Eghan, Frempong, Adjei-Poku
Supervision: Eghan, Frempong