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Research Article

Evaluation of the Determinants of Microalbuminuria in Type 2 Diabetic Subjects

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Abstract

Diabetes is a metabolic disease characterized by chronic hyperglycemia resulting from a defect in insulin secretion and/or insulin action. When not well controlled, it leads to long-term microangiopathic complications, including diabetic nephropathy. Against this backdrop, we set out to evaluate microalbuminuria and the clinical and biological factors associated with it in subjects with type 2 diabetes. This is a prospective, descriptive study including type 2 diabetic patients well followed at the Mark Sankale Center of the Abass Ndao Hospital in Dakar. Biochemical parameters (microalbuminuria, lipid profile, glycated hemoglobin and fasting blood glucose) were measured using enzymatic techniques with the Cobas 6000/c501® system (Roche, Hitachi, Germany). XLSTAT software was used to evaluate the data, and a value of $p<0.05$ was considered a statistically significant difference. A total of 166 diabetic patients with a mean age of 54 ±13.9 years and a sex ratio of 0.50 were included in our study. Microalbuminuria was present in 40.36% of the study population. Among patients with unbalanced diabetes, 50.74% had positive microalbuminuria. When hypertension was associated with diabetes, microalbuminuria was positive in 61.19% of patients. In terms of dyslipidemia, hypercholesterolemia was the only abnormality significantly associated with microalbuminuria ($p<0.001$). Microalbuminuria is an essential parameter in the detection of diabetic nephropathy. In our study, its occurrence was associated with several abnormalities, including unbalanced diabetes, hypertension and hypercholesterolemia.

Keywords

Diabetes, Microalbuminuria, Lipid Profile, Hypertension

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1. Introduction

The World Health Organization (WHO) defines diabetes as a metabolic disorder of multiple etiology, characterized by chronic hyperglycemia accompanied by disturbances in carbohydrate, lipid and protein metabolism due to disorders in insulin secretion and/or action (insulin resistance) [1].

In 2014, 8.5% of the world's adult population over the age of 18 was affected by diabetes, or 415 million people (one in twelve), and if no action is taken this figure could rise to 642 million people affected by 2040. The International Diabetes Federation, which compiled these figures, estimates that 5 million people died from diabetes in 2015, equivalent to one death every six seconds [2]. According to the WHO, the aging of the population is one of the factors behind this expected epidemic [3, 4].

Hyperglycemia is responsible for microangiopathic complications, aggravated by hypertension, and contributes to overall vascular risk [3, 4]. Around 25% to 30% of type 2 diabetics develop kidney damage, in the majority of cases secondary to diabetic nephropathy [5]. Diabetic nephropathy (DN) is currently the most common cause of end-stage renal disease (ESRD) in Western countries [6]. In the United States, diabetic patients account for more than half the indications for dialysis, and more than half of these are type 2 diabetics [7].

It is in this context that we set ourselves the objective of evaluating the determinants of microalbuminuria in type 2 diabetic subjects.

2. Methodology

2.1. Study Population

This was a prospective, cross-sectional study with analytical objectives. Subjects were recruited at the Marc Sankalé Center of the Abass Ndao Hospital in Dakar, which specializes in the follow-up and management of diabetic subjects. Biological parameters were measured in the biochemistry laboratory of the Centre Hospitalier National Universitaire de Fann. We included in the study all type 2 diabetic patients regularly monitored at the said center. Pregnant women and all subjects with urinary tract infections or febrile states were excluded.

2.2. Sampling

For our entire sample, we studied microalbuminuria, defined as the excretion of 30 to 300 mg of albumin in 24-hour urine. Other parameters studied were age, sex, hypertension, lipid profile, blood glucose and HbA1c.

Blood samples were taken from fasting subjects by venipuncture at the elbow. Blood was collected on a dry tube for lipid analysis, on an EDTA tube for HbA1c determination and on a tube with sodium fluoride for fasting blood glucose determination. After collection, samples were transported to the laboratory, where they were either handled directly or stored at -20 ℃ until the day of handling.

Urine samples taken 24 hours after collection were sent to the laboratory as soon as possible. After diuresis measurement, samples were centrifuged at 3,500 rpm for 5 min before being handled directly or stored at -20 ℃ until the day of handling.

2.3. Methods

HbA1c was determined using the D-10 analyzer (Bio-Rad, France), based on high-performance liquid chromatography (HPLC). Biochemical parameters were determined with the Cobas 6000/c501® analyzer (Roche, Hitachi, Germany) using enzymatic reactions and according to the supplier's recommendations. LDL-cholesterol was calculated using Friedwald's formula (LDL-c = TC - HDL-c - TG/5) for concentrations expressed in g/L. Microalbuminuria was measured with the Cobas 6000/c501® (Roche, Hitachi, Germany) using an immunoturbidimetric method. Sheep polyclonal anti-human albumin antibodies react with albumin (antigen) in the urine sample to form immune complexes. The change in absorbance is then measured at 340 nm and is proportional to the albumin concentration in the urine sample. Microalbuminuria is said to be positive when its value is between 30 and 300 mg/24h.

2.4. Statistical Evaluation

Our data were recorded using Excel 2016 and processed using XLSTAT 2020. The Chi2 test was used to compare frequencies, and a p-value of less than 0.05 was considered a statistically significant difference.

3. Results

Our study included 166 subjects with type 2 diabetes. The mean age of the study population was 54 years, with extremes of 16 and 87 years (Table 1). The gender distribution of the population was predominantly female, with a rate of 65.66% (the calculated sex ratio was 0.5). The average duration of diabetes in the population was estimated at 7.62 years. Sedentary lifestyle was frequent in our cohort, with a rate of 54.42%, hypertension 45.18% and obesity 16.86%. Glycemic imbalance was assessed in our study population at 47.59%.

Table 1. *Epidemiological and clinical characteristics of the study population.*

	Diabetic subjects
Included	166
Average age (years)	54 ± 13.92

	Diabetic subjects
Sex ratio	0,5
Duration of diabetes (years)	7.62 ±6.34
Fasting blood glucose (g/l)	1.69 ±0.84
HbA1c (%)	8.25 ±2.46

For our entire study population, microalbuminuria was present in 40.36% of subjects (see figure 1). In patients with arterial hypertension, the frequency of positive microalbuminuria was higher, at 61.19%, compared with only 38.81% in diabetic subjects without hypertension. Comparison of frequencies showed a statistically significant difference (p=0.001).

The frequency of occurrence of positive microalbuminuria in patients with more than 15 years' diabetes was higher, at 13.43%, than in patients with less than 15 years' diabetes, at 11.11% (p=0.65) (figure 1).

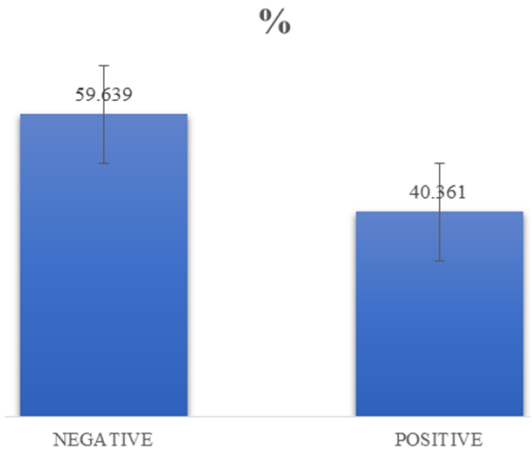

Figure 1. *Frequency of microalbuminuria in the study population.*

The frequency of occurrence of positive microalbuminuria in patients with unbalanced diabetes (HbA1c>7%), was higher at 50.74% than in subjects with balanced blood glucose (HbA1c <7%) with a rate of 49.25% (p=0.503) (Table 2).

Table 2. *Frequency of microalbuminuria according to clinical parameters.*

	Negative microalbuminuria (%)	Positive microalbuminuria (%)	P
Diabetes duration <15 years	88.88	86.56	0.65
Diabetes duration ≥15 years	11.11	13.43	
Balanced diabetes	54.54	49.25	0.503
Unbalanced diabetes	45.45	50.74	
Absence of hypertension	65.65	38.80	<0.001*
Presence of hypertension	34.34	61.19	

Table 3. *Plasma values of lipid balance parameters.*

	Average (g/L)	Standard deviation	Max (g/L)	Min (g/L)
Total cholesterol (g/l)	2.18	0.49	4.23	1.03
HDL-cholesterol (g/l)	0.68	0.21	1.23	0.25
LDL-cholesterol (g/l)	1.32	0.44	2.95	0.85
Triglycerides (g/l)	0.86	0.45	3.32	0.23

For lipid parameters, the results are shown in tables 3 and 4. Lipid parameters were more disturbed in subjects with positive microalbuminuria than in subjects with negative microalbuminuria, with the exception of triglycerides. However, no statistically significant difference was found except for hypercholesterolemia (p<0.05).

Table 4. *Evaluation of the frequency of abnormal lipid parameters according to microalbuminuria values.*

		Negative microalbuminuria (%)	Microalbuminuria Positive (%)	P
Total cholesterol	Normal	80.81	29.85	<0.001*
	High	19.19	70.14	
HDL-cholesterol	Normal	93.93	86.56	0.104
	Low <0.34 g/l	6.06	13.43	
LDL-cholesterol	Normal	80.80	74.62	0.343
	High >1.5 g/l	19.19	25.37	
Triglycerides	Normal	92.92	94.03	0.780
	High	7,07	5,97	

4. Discussion

In the long term, diabetes mellitus is associated with specific organ complications, particularly affecting the eyes and kidneys. Inadequate glycemic control may lead to an earlier onset of these microangiopathic complications. We therefore conducted a prospective, cross-sectional study to assess the determinants of microalbuminuria in type 2 diabetics.

Our study included 166 subjects, 65.66% of whom were women. This female predominance has been found in other studies [8, 9], including that of Yamewogo in Senegal, which found a female rate of 74.5% [10]. This female predominance could be explained by demographics, where women outnumber men, and also by a lifestyle marked mainly by a sedentary lifestyle and weight gain considered locally as a criterion of beauty. The average age of our study population was 54. This result is similar to that of numerous studies, including that carried out by Adji et al. in Morocco, with an average age of 55 ±9.5 years [11]. Our result is also similar to that of Nassib et al [12], who found a mean age of 54, and to that of a descriptive study of microangiopathies in type 2 diabetics by Marmouch et al, who found a mean age of 61 [13]. The prevalence of diabetes increases sharply with age, and elderly diabetics represent a large and growing proportion of the population. Recent data show that one in two diabetic patients is over 65, and 25% over 75 [14]. This predominance of subjects over 50 could be justified by the silent nature of the evolution of type 2 diabetes, but also by the frequency of diabetes, which increases markedly with age [15]. Subjects over 50 are more likely to develop diabetes than younger subjects.

In our study population, microalbuminuria was present in 67 subjects, a rate of 40.36%. This result is close to those found by Monabeka et al [16] in Congo (37.9%) and by Yameogo et al [10] in Senegal (36.8%). The determinants of microalbuminuria studied are, on the one hand, age and duration of diabetes, which are non-modifiable factors, but, on the other hand, we have modifiable factors, namely hypertension, glycemic control and lipid balance parameters. Assessment of hypertension in subjects with microalbuminuria revealed a frequency of 61.19%, with a statistically significant difference compared with subjects without microalbuminuria (p=0.001). Several studies carried out in Africa, particularly in Senegal, have also demonstrated the link between hypertension and the occurrence of microalbuminuria [10, 16, 17]. According to the results of the study by Ranjit Unnikrishnan et al. [18], hypertension is a significant risk factor associated with microalbuminuria. Indeed, hypertension is known to be a major cardiovascular risk factor in diabetics [19]. In this association, it is also difficult to differentiate the specific role of diabetes and hypertension in the renal impairment of the elderly diabetic subject, given their high frequency with age and the high sensitivity of the kidney to hypertension in this population [20].

In our study, assessment of glycemic imbalance in subjects with microalbuminuria showed a frequency of 50.74% (p=0.503). In the series by Tanaka et al [21], glycemic imbalance was strongly responsible for the development of both microalbuminuria and hypertension. The impact of glycemic control on the development and progression of nephropathy has been demonstrated by several authors [10, 22, 18, 23]. Better glycemic control can slow the progression to chronic renal failure and ensure better survival on dialysis. Similarly, the results of Ching-Heng-Lin et al. provide further confirmation of this link [24].

Lipid disturbances also play a role in the onset of microvascular complications of diabetes. In our study, the incidence of hypercholesterolemia (70.14%) was significantly higher in subjects with microalbuminuria (p=0.001). HDL cholesterol and triglycerides are most often implicated in the occurrence of microalbuminuria. In our study, we were unable to demonstrate this. In fact, when we analyzed our results, we found that only total hypercholesterolemia was a risk factor for microalbuminuria.

5. Conclusion

In our study, microalbuminuria was associated with several clinical and biological factors, including unbalanced diabetes, hypertension and hypercholesterolemia. The other factors studied were more preponderant in subjects with positive microalbuminuria, but no statistically significant difference was found. This study deserves to be consolidated with a larger cohort, incorporating many more clinical as well as biological parameters.

Abbreviations

DN	Diabetic Nephropathy
ESRD	End-stage Renal Disease
HPLC	High-performance Liquid Chromatography
WHO	World Health Organization

Ethical Approval

This study was approved by the Research Ethics Committee of Cheikh Anta Diop University (UCAD) in accordance with the rules laid down by Senegal's National Health Research Ethics Committee under number: 0227/2017/CER/UCAD.

Author Contributions

Djite Moustapha: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Resources, Writing – original draft

Kandji Pape Matar: Conceptualization, Formal Analysis, Investigation, Methodology, Writing – original draft

Barry Nene Kesso Oumou: Funding acquisition, Resources, Supervision

Thioune Ndeye Marième: Writing – review & editing

Diouf Niokhor Ndane: Supervision, Writing – review & editing

Conflicts of Interest

The authors declare no conflicts of interest.

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Research Fields

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