Section: Biochemistry

Original Research Article

LONGITUDINAL ANALYSIS OF MICROALBUMINURIA: CORRELATING DIABETIC DURATION AND GLYCEMIC CONTROL WITH RENAL IMPAIRMENT

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Abstract

Diabetes mellitus (DM) is a metabolic disorder characterized by high blood sugar, leading to complications in multiple organs. It is a leading cause of kidney failure, amputations, and blindness in the U.S., and increases the risk of cardiovascular disease (CVD). Type 2 diabetes (T2DM) involves insulin resistance and inadequate insulin secretion, causing chronic complications like retinopathy, neuropathy, nephropathy, and cardiovascular diseases. Microalbuminuria (30-300 mg/day urinary albumin) is an important marker for cardiovascular risk. The study at RDJM Medical College, from February 2023 to April 2024, examined the relationship between microalbuminuria, diabetes duration, and glycemic control. The study included 100 diabetic patients (50 with and 50 without cardiovascular disease) and 50 healthy controls. Results showed higher blood glucose and microalbuminuria in diabetic patients, particularly those with cardiovascular disease, and a strong correlation between microalbuminuria and glycemic control. Early detection of microalbuminuria should be used in clinical practice for evaluating risk in diabetics, especially those with high cardiovascular risk. This test is affordable, easy to perform, and provides quick results. Further research should identify specific populations that would benefit most from this measurement and refine guidelines for its clinical use.

INTRODUCTION

Diabetes mellitus (DM) is a metabolic disorder marked by hyperglycemia from genetic and environmental factors. It causes reduced insulin secretion and increased glucose production, leading to complications in multiple organ systems. DM is the leading cause of end-stage renal disease, nontraumatic lower extremity amputations, and adult blindness in the U.S., and it heightens cardiovascular disease risk. Rising globally, DM will remain a major cause of morbidity and mortality.[1]

Type 2 diabetes (T2DM) involves insulin resistance and inadequate insulin secretion, leading to impaired glucose tolerance and hyperglycemia. Chronic complications include microvascular (retinopathy, neuropathy, nephropathy) and macrovascular (CAD, PAD, cerebrovascular disease) issues. Mechanisms involve advanced glycosylation end products, sorbitol pathway, protein kinase C activation, and hexosamine pathway flux. Microalbuminuria is defined as urinary albumin excretion (UAE) of 30-300 mg/day (24-hour collection), 20-200 µg/min (timed collection), or 30-300 mg/gm (UACR in spot urine). Values below these limits are normal, while higher values indicate macroalbuminuria. Within the first 5-10 years of type 1 DM, about 40% of patients develop microalbuminuria.[2]

Diabetes significantly increases the risk of cardiovascular disease (CVD), the leading cause of death in type 1 and type 2 diabetes. CVD is a major driver of healthcare costs for diabetics. Studies show a continuous positive relationship between urinary albumin excretion (UAE) and adverse clinical outcomes, including increased mortality and cardiovascular events. In high-risk patients, such as those in the HOPE study, UAE predicted mortality.3 Type 2 diabetes often occurs with metabolic syndrome, including abdominal obesity, hypertension, hyperlipidemia, and increased coagulability, all promoting CVD. Type 2 diabetes is an independent risk factor for ischemic disease, stroke, and death. Women with type 2 diabetes may have a higher risk for coronary heart disease than men. Microvascular disease also predicts coronary

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events. Numerous studies, including the Framingham study, link diabetes to coronary heart disease.[4-6]

In type 2 diabetes, microalbuminuria indicates endothelial dysfunction and higher cardiovascular mortality risk. Obesity, common in type 2 diabetes, exacerbates renal issues and atherosclerosis through hemodynamic and hormonal changes.[7-10]

Aims & Objectives:

- Investigate the correlation between microalbuminuria, duration of diabetes, and glycemic control.
- Analyze data to determine the relationship between the presence of microalbuminuria, the duration of diabetes, and levels of glycemic control.

MATERIALS AND METHODS

Study Area: The present study was conducted in the Department of Biochemistry, at RDJM Medical College, Turki, Muzaffarpur, India.

Study period: Study was conducted from February 2023 to April 2024.

Study Population: The subjects were categorised into 2 groups:

Group I- 100 diabetic patients with age group 40-60 years were included for the study and the patients were divided into two groups.

- **Group1A:** In this group, 50 diabetic patients without any cardiovascular disease were included.
- **Group 1B:** In this group, 50 diabetic patients with cardiovascular disease were included.

Group II- 50 age and sex matched healthy subjects were included in this group.

Inclusion Criteria

Patients were included in this group if they had hypertension (BP≥140/90 mm Hg), documented coronary heart disease based on either history of myocardial infarction, Electrocardiogram evidence, echocardiography, coronary artery bypass grafting or coronary angiogram.

Exclusion Criteria

- Patients with any endocrinal disorder like thyroid hormone disorder etc.
- Patients with urinary infections.
- Gestational diabetes.

Sample collection:

For Glucose estimation- 5 ml of blood was drawn from the antecubital vein after a 12-hour fast, mixed with sodium fluoride in a plain vial, and plasma was separated to estimate fasting plasma glucose.

For Microalbuminuria - 24-hour urine collection was done in a clean, dry container using a fresh sample. To avoid bacterial contamination, samples were frozen at -20°C if tested after 24 hours. Copper and iron contamination was prevented, turbid samples were centrifuged, and conditions like hematuria that cause false positives were avoided.

Blood Glucose was estimated by Enzymatic method and Microalbuminuria by Pyrogallol red method, end point.[11,12]

RESULTS

Table 1: Mean value, standard deviation and p value of age, duration, FPG and microalbuminuria between the healthy control and diabetic patients without CV disease.

Parameters	Group	N	Mean ± SD Deviation	P value
Age	Healthy Control	50	48.48±6.876	>0.001
	Diabetic patients without CV disease	50	51.38±7.920	
Duration	Healthy Control	0a	.	.
	Diabetic patients without CV disease	50	58.28±70.181	
FPG	Healthy Control	50	80.30±7.733	<0.001
	Diabetic patients without CV disease	50	189.76±78.494	
Microalbuminuria	Healthy Control	50	13.73±5.372	<0.001
	Diabetic patients without CV disease	50	379.18±691.147	

*a denotes t cannot be computed because at least one of the groups is empty.

Table 2:Correlation between degree of microalbuminuria and cardiovascular disease.

S. No	Cardiovascular disease present	Cardiovascular disease absent	Total
Microalbuminuria<30	6	29	35
Microalbuminuria>30	44	21	65
Total	50	50	100

Chi- square: 23.253, df: 1, p<0.001 highly significant.

Table 3: Correlation between microalbuminuria and glycemic control.

S.No	FPG< 126	FPG> 126	Total
Microalbuminuria<30	55	30	85
Microalbuminuria >30	5	60	65
Total	60	90	150

Chi-square: 49.887, df: 1, p<0.001 highly significant.

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DISCUSSION

In diabetic patients without CV disease, mean FPG and microalbuminuria were higher as compared with healthy controls. Thus, there was significant difference in levels of FPG and microalbuminuria. In diabetic patients with CV disease, age, FPG and microalbuminuria were higher as compared with healthy controls. Thus, there was also significant difference($p<0.001$) in age, levels of FPG and microalbuminuria [Table 1]. Further, there was strong correlation between microalbuminuria and glycemic control ($p<0.001$ highly significant) [Table 3]. The degree of microalbuminuria, along with duration of of diabetes (microalbuminuria being highly significant with duration of diabetes, $p<0.001$) had strongly correlated with cardiovascular disease among diabetic patients. It was found in the present study that the diabetic patients having cardiovascular disease had microalbuminuria $\geq$ 30 mg/day [Table 2]. Thus, there was strong correlation between microalbuminuria and cardiovascular events in patients with diabetes mellitus.

CONCLUSION

The early determination of microalbuminuria should be implemented in clinical practice for overall risk evaluation, at least in diabetics with high cardiovascular risk. The test is inexpensive, easy to obtain in the clinical setting and the results are rapidly available. Further research should define in detail the populations that would benefit from this measurement and future guidelines should provide clear recommendations for their clinical use.

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